Water Supply Reserve Account – Grant and Loan Program
Water Activity Summary Sheet
September 21-22, 2016
Agenda Item 19(g)

Co-Applicants & Fiscal Agent:	Lower Arkansas Valley Water Conservancy District & Fort Lyons Rule 10 Association.
Fiscal Agent:	Lower Arkansas Valley Water Conservancy District
Water Activity Name:	Phase 2 of Tailwater Return Flow Study of Fort Lyon Canal
Water Activity Purpose:	Agricultural
County:	Bent
Drainage Basin:	Arkansas
Water Source:	Arkansas River
Amount Requested/Source of Funds:	$26,000 Arkansas Basin Account* $148,796 Statewide Account* $174,796 Total Grant Request * The Roundtable Chair Recommendation Letter indicating $36,000 request from the Arkansas Basin Account; and $138,796 request from the Statewide Account are incorrect, while the values in the Application are correct and are reflected above.
Matching Funds:	Basin Account Match ($26,000) = 15% of total grant request; Applicant Match ($75,000) = 43% of Total Grant Request (meets 5% min); Basin & Applicant Match ($101,000) = 57.8% of Total Grant Request (meets 25% min). (refer to *Funding Summary/Matching Funds* section)

Staff Recommendation:

Staff recommends approval of up to $26,000 from the Arkansas Basin Account; and $148,796 from the Statewide Account to help fund the project titled: Phase 2 of Tailwater Return Flow Study of Fort Lyon Canal.

Water Activity Summary: If approved, WSRF grant funds will constitute additional funding to continue a study currently underway pursuant to a Water Supply Reserve Account grant originally titled: *FIRI Analysis and Tailwater Return Flow Study on Fort Lyon Canal Project*. The overarching goal of the Project is to conduct an investigation and collect data to determine whether adjustment to the assumed tailwater factor and irrigation efficiency factor for flood irrigation in the H-I Model and Irrigation System Analysis Model (ISAM) is warranted to more accurately reflect actual conditions, as both of these inputs are considered overly conservative.

The first phase of the Project determined that given the extensive size of the Fort Lyon Canal and the amount of data needed to support potential adjustments to the H–I Model and the ISAM, the Project should be pursued in a phased approach. Phase One of the Project is yielding promising results – showing that the tailwater assumption contained in the H-I Model and ISAM does appear to be overly conservative. However, additional study and data are required before the results are sufficiently persuasive to support a potential State of Colorado request to Kansas for a modification of the irrigation efficiency factor and tailwater factor assumptions in the H-I Model and ISAM. Therefore, Lower Ark seeks funding for a second phase of the Project that will (1) allow for continued site monitoring and data collection on actual amounts of tailwater occurring from flood irrigated farms and (2) to begin on-farm measurement and data collection to analyze irrigation efficiency.

Discussion: This project furthers multiple goals and objectives of the Arkansas Basin Implementation Plan. With respect to the Colorado Water Plan, this project supports Objective A Supply-Demand Gap: "Protect and Develop Compact Entitlements and Manage Risks," Objective D. Agriculture: "Support Agricultural Conservation and Efficiency," (Section 10.3).

Of particular note are the benefits which may derive from this project's alignment with Objective H. Education, Outreach and Innovation: Inform Coloradans about water issues to encourage engagement and innovation in determining Colorado's water future." By assessing return flow patterns in the field, as agriculture becomes more efficient, this project may benefit Colorado's future water use with respect to both agricultural efficiency and water quality.

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

Threshold and Evaluation Criteria:
The application meets all four Threshold Criteria.

Tier 1-3 Evaluation Criteria:
This activity has undergone review and evaluation and staff has determined that it satisfies the Evaluation Criteria. Please refer to WSRA Application for applicant's detailed response.

Funding Summary/Matching Funds:

Funding Source	Cash	In-kind	Total
Lower Arkansas Valley Water Conservancy District	$75,000	$0	$75,000
WSRA Arkansas Basin Account	$26,000	n/a	$26,000
WSRA Statewide Account	$148,796	n/a	$148,796
Total Project Costs	**$249,796**	**$0**	**$249,796**

CWCB's Project Manager: Craig Godbout

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 revised WSRA Criteria and

Guidelines, 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.

Arkansas Basin Roundtable

July 13, 2016

Via Electronic Mail: craig.godbou@tate.co.us

Mr. Craig Godbout
Colorado Water Conservation Board
1313 Sherman Street, Room 721
Denver, CO 80203

Re: Water Supply Reserve Account Grant Application: Phase Two of Tailwater Return Flow Study on Fort Lyon Canal

Dear Craig:

At its July 13, 2016 meeting, the Arkansas Roundtable approved Phase 2 of the Fort Lyon Tailwater Return Flow Study for $36,000 ($26,000) in Basin Funds, $138,796 ($148,796) in Statewide Funds with $75,000 in cash matching funds. There were no dissenting opinions expressed in the consensus decision.

This project furthers multiple goals and objectives of the Arkansas Basin Implementation Plan. With respect to the Colorado Water Plan, this project supports Objective A Supply-Demand Gap:"Protect and Develop Compact Entitlements and Manage Risks," Objective D. Agriculture: *"Support Agricultural Conservation and Efficiency,"* (Section 10.3).

Of particular note are the benefits which may derive from this project's alignment with Objective H. Education, Outreach and Innovation: *Inform Coloradans about water issues to encourage engagement and innovation in determining Colorado 's water future."* By assessing return flow patterns in the field, as agriculture becomes more efficient, this project may benefit Colorado's future water use with respect to both agricultural efficiency and water quality.

Should you have any questions or concerns, please feel free to contact me either by telephone, 719-742-6164, or by email, sandy@white-jankowski.com.

With warm regards

Michael D. (Sandy) White
Chair

Copy via email:
Applicant
ABRT Executive Committee

COLORADO WATER CONSERVATION BOARD

WATER SUPPLY RESERVE ACCOUNT APPLICATION FORM

Today's Date: July 14, 2016

Phase Two of Tailwater Return Flow Study on Fort Lyon Canal

Name of Water Activity/Project

Lower Arkansas Valley Water Conservancy District and Fort Lyon Rule 10 Association

Name of Applicant

Arkansas Basin Roundtable (pending)

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

Amount from Statewide Account: 148,796

Amount from Basin Account(s): 26,000

Total WSRA Funds Requested: 174,796

FEIN: 481298144

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:

Craig Godbout - WSRA Application
Colorado Water Conservation Board
1580 Logan Street, Suite 200
Denver, CO 80203
Craig.godbout@state.co.us

If you have questions or need additional assistance, please contact Craig Godbout at: 303-866-3441 x3210 or craig.godbout@state.co.us.

Water Supply Reserve Account – Application Form
Revised October 2013

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

1. Applicant Name(s): Lower Arkansas Valley Water Conservancy District & Fort Lyon Rule 10 Association

Mailing address: 801 Swink Ave.
Rocky Ford, CO 81067

FEIN #: 481298144

Primary Contact: Jay Winner Position/Title: General Manager

Email: jwinner@centurytel.net

Phone Numbers: Cell: 719-469-8935 Office: 719-254-5115

Alternate Contact: Leah K. Martinsson Position/Title: Special Counsel

Email: lkm@bhgrlaw.com

Phone Numbers: Cell: 720-940-4021 Office: 303-402-1600

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.

[x] 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 Lower Arkansas Valley Water Conservancy District ("Lower Ark District") is a water conservancy district established in 2002 pursuant to Colorado law, C.R.S.§ 37-45-101 et seq. The Lower Ark District's mission is to acquire, retain and conserve water resources within the Lower Arkansas River; to encourage the use of such water for the socio-economic benefit of the District citizens; and to participate in water-related projects that will embody thoughtful conservation, responsible growth, and beneficial water usage within the Lower Arkansas Valley. As such, this includes promoting and protecting agriculture in the Lower Arkansas Basin. A critical aspect in preserving agriculture is to ensure agriculture's current and future economic viability. This can be achieved through increased irrigation efficiency and the associated maximum utilization of available water supplies. Currently, the vast majority of irrigation occurring in the Arkansas River Basin continues to employ surface (flood) irrigation. After participating in the development of the Irrigation Improvements Rules (discussed below), the Lower Ark District stepped forward to prepare and administer the only Rule 10 Compact compliance plans on behalf of irrigation system improvement owners.

The Fort Lyon Rule 10 Association is a recently-created, not-for-profit corporation with the goal of administering and operating a Compact compliance plan for Fort Lyon shareholders with irrigation system improvements. The Fort Lyon Rule 10 Association similarly seeks to encourage the continued installation of irrigation system improvements while assisting farmers with Compact compliance issues associated with such improvements.

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

The Lower Ark District formed a Water Activity Enterprise in 2003 to manage the District's water assets and provide services to the District on a reimbursable basis. The Lower Arkansas Valley Water Enterprise Fund would be the contracting entity for this project. This approach has successfully completed on five prior CWCB grants (two concerning the Super Ditch, including three WSRA grants, and two concerning the State Engineer's Irrigation Improvements Rules).

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 Lower Ark District's 1.5 mill property tax levy is exempt from TABOR pursuant to the election that formed the district in 2002.

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)
x	Agricultural
	Municipal/Industrial
	Needs Assessment
	Education
	Other Explain:

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

In addition to agricultural purposes, Phase Two of the Tailwater Return Flow Study on the Fort Lyon Canal ("Tailwater Study") will also address ongoing Arkansas River Compact compliance issues and has the potential to benefit M& I and other in-basin water users through increased transferrable yields from Fort Lyon Shares.

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)
Approx. 1000 AFY	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)
	Other -- Explain:

****NOTE: This approximated 1000 acre-feet is an estimate of the potential reduction in Rule 10 Compact Compliance obligations for sprinkler irrigated acres under the Ft. Lyon Canal based on an increase in the maximum farm efficiency by 5%. Additional supplies would be similarly saved in future years as more sprinklers are installed.*

4. To help us map WSRA projects please include a map (Exhibit B) and provide the general coordinates below: *The coordinates for the Fort Lyon Diversion Dam are:*

Latitude: 38°07′03″N Longitude: -103°48′33″W

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.

In 2014, Applicants obtained a WSRA grant to conduct Phase One of the Tailwater Study. In its second and final year, Phase One is yielding promising results that support continuation of the Tailwater Study into this proposed Phase Two. The Tailwater Study is enabling a better understanding of how tailwater return flows actually accrue to the Arkansas River as compared to the tailwater assumption contained in the H-I Model and the Irrigation System Analysis Model (ISAM). ISAM was developed to provide a standard methodology for performing evaluations as to whether irrigation system improvements result in a reduction or change in the timing or location of historical seepage losses or return flows in violation of Article IV-D of the Arkansas River Compact and to implement the "Compact Rules Governing Improvements to Surface Water Irrigation Systems in the Arkansas River Basin in Colorado" (the "Irrigation Improvements Rules"). The H- Model and the ISAM assume approximately 10% of the supply to the farm headgate is returned to the river as tailwater. This was based on studies that gathered data on a field-by-field basis on numerous ditches, which is believed to be overly-conservative on water-short ditch systems such as the Fort Lyon Canal. These studies had a very broad focus with various objectives and were not tailored to measure tail water return flows. Moreover, it did not consider whether tailwater run-off from one field may actually be utilized on another field within the same farm. Similarly and related, the assumed irrigation efficiency factor in the H-I Model and ISAM is viewed as overly conservative, as the water not returning to the river as tailwater is likely consumed by crops and would thus result in an actual higher irrigation efficiency on the Fort Lyon Canal.

A priority of all parties in developing the Irrigation Improvements Rules and the ISAM was to ensure that these rules would not create a disincentive to install irrigation system improvements. However, overly-conservative assumptions in the ISAM can have this effect and can also result in over-delivery of Colorado's water resources to Kansas. As recognized in crafting Phase One of the Tailwater Study, completion of work needed to support an adjustment to the assumed tailwater factor and irrigation efficiency factor in the HI –Model and the ISAM will require a number of phases building on the results from the previous phases. In this Phase Two, high-quality data on actual tailwater will continue to be collected, additional fields will be studied to verify results from Phase One, and the initial investigation into irrigation efficiency (which is the dominant factor in determining the tailwater factor) on a small number of farms will be conducted. If results continue to show that the tailwater factor and irrigation

efficiency factor are overly-conservative, a third and final phase of the Tailwater Study that would generate data sufficient to support a requested modification to the H-I Model and the ISAM will be developed.

Specifically, Applicants will continue to measure and monitor tailwater on the farms included in Phase One of the Tailwater study using the equipment installed in Phase One. The data will then be analyzed to determine actual tailwater return flows. In addition, fields in a second region of the Fort Lyon Canal will be measured and monitored to verify the applicability of the results on a canal-wide basis. In addition, a small number of farms will be measured and data collected to determine actual irrigation efficiency. These results will be compared with results derived from satellite imagery to determine whether use of satellite imagery will produce high-quality data on irrigation efficiencies on a canal-wide basis.

By reducing the deliveries required by Fort Lyon improvements in Compact compliance plans, demands on water supplies to meet delivery obligations will similarly be lessened, and additional water sources will remain available for maximum utilization and beneficial use within Colorado. A lower assumed tailwater factor and higher assumed maximum irrigation efficiency will also have the benefit of increasing the anticipated transferable yield associated with Fort Lyon shares in the context of other water transfers, such as rotational leasing-fallowing projects. The study will also yield high quality data for inclusion in the anticipated Arkansas River Decision Support System and other water management tools to assist in Basin-wide water resource management decisions.

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]

[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.

The Tailwater Study and its continuation into Phase Two would positively enhance the current system of allocating water within Colorado through ensuring maximum utilization of available water supplies, encouraging water savings through improved irrigation efficiency, and reducing potential over-deliveries of Colorado's water resources to Kansas under the Irrigation Improvements Rules. The study would enhance and improve evaluations of current water use practices and would inform water resource management decisions. The grant would not be implemented in a 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 decree, or any other similar document related to the allocation or use of water.

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.

The Arkansas Basin Roundtable evaluated and recommended for approval this grant application on July 13, 2016, including the allocation of $26,000 in Basin Roundtable WSRA funds. This information will also be included in the letter from the roundtable.

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.

The Tailwater Study is designed to conserve existing water resources and reduce pressure on existing water supplies, both of which would assist in meeting both the M&I and agricultural water gaps identified in the Arkansas River Basin Consumptive Needs Assessment: 2030 (June 2008). The potential water savings that may result from a more accurate tailwater factor and irrigation efficiency factor on the Fort Lyon Canal could reduce the amount of water supplies needed to meet Compact compliance requirements under the Irrigation Improvements Rules, leaving that water available to meet other needs, including M&I needs. Also, by decreasing the costs associated with Compact compliance for

[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.

irrigation system improvements, continuation and ultimate completion of all phases of the Tailwater Study could promote further installation of irrigation system improvements and the resultant benefits of increased water efficiency, increased productivity, and improved water quality. Additional transferable yield will similarly be available from temporary (i.e., rotational leasing and fallowing programs) and/or permanent changes to Fort Lyon shares. These outcomes will mean that less pressure is placed on existing water supplies and existing water supplies may be extended further. This will assist in filling the identified Arkansas Basin's 28,000 acre-foot M&I gap.

This information will also be addressed in the letter from the Arkansas Basin Roundtable chair.

d) Matching Requirement: For requests from the **Statewide Fund**, the applicants will be required to demonstrate a **25 percent** (or greater) match of the total grant request from the other sources, including by not limited to Basin Funds. A minimum match of 5% of the total grant amount shall be from Basin funds. A minimum match of 5% of the total grant amount must come from the applicant or 3rd party sources. 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 contract or purchase order between the applicant and the State of Colorado is executed. 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)

14.5%** ($36,000) matching funds from the Arkansas Basin Roundtable **(requested)
***30%** ($75,000) matching funds from the Lower Ark District*

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.**

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).

Continuation of the Tailwater Study through Phase Two will address multiple needs and issues and address the needs and issues of multiple interests within the Arkansas River Basin. A key goal of the study is to encourage further water savings through continued installation of more efficient irrigation system improvements. Increases in irrigation efficiency provide benefits to Colorado water users. With agricultural water use accounting for over 80% of water use in the State, increases in irrigation efficiency are a crucial way to address water scarcity problems. Moreover, improved irrigation efficiency can lead to improved water quality by reducing irrigation runoff and seepage, may result in improved crop yields, and can reduce the need for hired labor, thereby supporting the agricultural economy. These benefits accrue not just to the State's agricultural communities, but can be felt Basin-wide.

By reducing the amount of water needed to meet Compact compliance obligations (which will encourage further investments in water-saving irrigation improvements) and increasing the transferrable yield of Fort Lyon Canal shares, completion of the Tailwater Study could also result in both direct water savings and a reduction in demands placed upon all basin water supplies. And in so doing, it has the potential to contribute to a reduction in the agricultural and M&I water gaps and serve multiple interests. Irrigation improvement owners on the Fort Lyon and municipal users interested in participating in leasing-fallowing with shareholders in the Fort Lyon Canal Company could all directly benefit. Moreover, all water users that compete for the limited water supplies available in the Arkansas River basin would benefit from a reduction in the pressure placed on limited supplies to meet Compact compliance obligations.

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 Lower Ark District and the Fort Lyon Rule 10 Association will continue to work in close collaboration to undertake Phase Two of the Tailwater Study, similar to the successful coordination demonstrated in Phase One. The study will continue to involve cooperation and collaboration with the Fort Lyon Canal Company and the Division 2 Engineer's Office of the Division of Water Resources. Applicants will continue working closely with the Division 2 Engineer's Office in the study's final design, implementation, and in the potential integration of the results into the H-I Model and ISAM.

Because the Tailwater Study has the potential to free-up existing water supplies, increase water supplies through irrigation efficiency, and increase the transferable yield of Fort Lyon shares in temporary and permanent transfers, the study could ultimately benefit all water users in the Arkansas River Basin. It therefore has the potential to promote cooperation amongst historically competing water interests. Moreover, the data that will be obtained from the study will contribute to a better understanding of Arkansas River Basin's water resources, which can lead to improved decision-making and reduced

conflicts among historically competing users. Finally, by reducing one of the barriers associated with sprinkler installation (the amount and concomitant cost of calculated return flow maintenance under ISAM), the Tailwater Study could lead to increases in the installation of irrigation improvements which has the benefit of improving water quality and the environment.

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.

The Tailwater Study is designed to actively and measurably lead to the development of conserved water to meet both the M&I gap and the agricultural gap, as identified in the Arkansas River Basin Consumptive Needs Assessment: 2030 (June 2008). It also keeps with the vision of that Needs Assessment by sustaining agriculture through encouraging increasing water efficiency and agricultural productivity. The potential water savings that may result from completion of the Tailwater Study will assist in reducing the agricultural and M&I water gaps by reducing the amount of water supplies needed to meet Compact compliance requirements under the Irrigation Improvements Rules, leaving that water available to meet other needs, including M&I needs.

The Tailwater Study also meets the needs of irrigators and agricultural communities, and rural economies by reducing the costs associated with improvements to irrigation. By promoting water conservation through irrigation improvements, potentially reducing Compact compliance requirements, and increasing the transferable yield associated with Fort Lyon shares, the study meets the broad-based water management goal of maximum utilization of water while ensuring compliance with Arkansas River Compact.

The benefits from a potentially reduced assumed tailwater factor and associated increased irrigation efficiency factor on the Fort Lyon Canal will continue to grow and multiply over time. As more sprinklers are installed, the amount of water saved through a reduction in the tailwater assumption and associated increase in the irrigation efficiency will continue to increase. And by reducing the costs associated with installation of sprinklers, the study will encourage continued sprinkler installation and the associated water conservation savings. As the largest canal in Colorado, water savings on the Fort Lyon Canal will be significant.

<u>Tier 2: Facilitating Water Activity Implementation</u>

d. Funding from this Account will reduce the uncertainty that the water activity will be implemented.

Funding from the WSRA will reduce the uncertainty that the Tailwater Study will be completed and ensure that efforts undertaken and resources invested in Phase One can be positively and meaningfully used. The Lower Ark District and Division 2 Engineer's Office have discussed the Tailwater Study and its potential benefits since the original development of the ISAM. Without funding from the WSRA, Phase Two of the Tailwater Study will not be undertaken and the work completed and investment made

in Phase One will not be built upon to support the ultimate goals and objectives of the Tailwater Study. Alternate means of funding have been explored but none appear to be available.

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

The Lower Ark District has demonstrated a significant commitment to the Tailwater Study through matching funds of $75,000, which represents 30% of the Phase Two costs. Moreover, the Lower Ark District has consistently demonstrated its commitment to implementation of the Irrigation Improvements Rules through its in-kind efforts in operating and administering the only Compact compliance plans since the adoption of the rules. The District has worked closely with the Division 2 Engineer's Office and the CWCB to improve and refine the Compact compliance process and the ISAM.

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

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

The results of the Tailwater Study will help sustain agriculture by ensuring that Fort Lyon farmers continue to have incentives to invest in their operations and install irrigation system improvements and ensure their shares' transferrable yield is appropriately determined. Such investments are needed to ensure the future health and vitality of agricultural communities. Moreover, these irrigation system investments could improve water quality and benefit both the environment and recreation on the Lower Arkansas River.

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.

The Tailwater Study will address problems related to compact-entitled water and compact compliance and will also promote maximum utilization of state waters. One of the study's broad aims is to ensure that the accuracy of "return flow maintenance water" calculations pursuant to the Irrigation Improvements Rules such that a violation of the Arkansas River Compact is avoided. The Tailwater Study will provide the data needed to refine ISAM in a way that is anticipated to reduce the burdens of Compact compliance on farmers. By reducing Compact compliance obligations (which, in turn, preserves existing water supplies and could lead to future water savings), the results of the study will promote maximum utilization of state waters to a high degree.

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

While the Tailwater Study does not directly assist in the recovery of threatened or endangered wildlife, it will provide important information that can be integrated into water management decisions. With

better information, decisions regarding water resource management can more carefully balance the needs of consumptive water users with those of threatened and endangered species and the environment. Moreover, if the Tailwater Study has the intended effect of continuing to encourage irrigation efficiency improvements, the associated water quality benefits would accrue to the Lower Arkansas River ecosystem. Such ecosystem improvements could contribute to the overall recovery of threatened and endangered wildlife species.

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

The Tailwater Study provides a high level of benefit in relationship to the amount of funds requested. Though not easily quantified because the amount of water saved will ultimately depend on the results of the study, the rate of sprinkler growth, and future uses of Fort Lyon shares to meet basin demands through projects such as leasing fallowing, the data and analysis generated from the Tailwater Study will provide a high level of benefit.

The anticipated reduction in the assumed tailwater factor and associated increase in the irrigation efficiency factor on the Fort Lyon is likely to lead to encourage increasing water efficiency and agricultural productively through installation of sprinkler systems on irrigated lands and reductions in return flow obligations under the Arkansas River Compact. This would result in less pressure on other Arkansas basin water supplies. It could similarly increase the potential transferable yield of Fort Lyon shares in, for example, a rotational municipal leasing - land fallowing program, which will benefit farmers and municipalities alike.

Just in the period between 2012 and 2016, the Fort Lyon Canal has seen nearly a doubling of sprinklers operating under it and included in a Compact compliance plan. If the rate of sprinkler installation continues during the term of the Tailwater Study, up to approximately 250 sprinklers on the Fort Lyon could be covered by Compact compliance plans. Extrapolating from the current "return flow maintenance requirements," this could mean more than a doubling in the amount of water needed for operation of those plans which could be in the thousands of acre-feet of water annually. This is a significant amount of water and reflects a high degree of benefit from the funds requested for the Tailwater Study.

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

The Tailwater Study, and specifically this Phase Two, both compliments and assists in the implementation of other CWCB programs. Most immediately, this data and analysis may be incorporated into the ISAM and will further the CWCB goals of promoting more efficient use of water while ensuring Compact compliance, C.R.S. § 37-60-106(1)(i) and (r). Consistent with these goals, the CWCB has previously provided financial assistance to the Lower Ark District to formulate and implement cost-effective means to comply with the Irrigation Improvements Rules to avoid potential Compact violations. See e.g. S.B. 09-125. Moreover, it will build upon the significant investment made by the CWCB in Phase One of the Tailwater Study. It also will have the likely benefit of encouraging

participation in alternative transfer method through increasing the transferable yield of Fort Lyon Shares, another key objective of the CWCB and the Governor.

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.

The Tailwater Study will facilitate more complete use of the water available to shareholders of the Ft. Lyon Canal. The study will accordingly lead to better utilization of available water supplies within the Arkansas River basin. The results of the Tailwater Study are expected to positively affect all Fort Lyon Canal water rights by allowing the maximum utilization of those rights. Additionally, the results of the Tailwater Study are anticipated to have reduced pressure on water supplies currently being used to meet what are believed to be excessive return flow maintenance requirements. The Arkansas River as a whole may be positively affected by the results of the study.

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

Phase Two builds upon and continues work completed as a part of Phase One of the Tailwater Study, which was funded from the WSRA in 2014. The Tailwater Study builds upon work previously conducted by Colorado State University in the Lower Arkansas River Basin regarding irrigation practices, water consumption, and return flows pursuant to a number of CWCB and other grants. As discussed above, it specifically seeks to refine the generalized 10% tailwater factor that came out of that work.

The Tailwater Study also relates to prior work done by the Division 2 Engineer's Office in developing and refining ISAM, including the pond seepage study. Finally, it is anticipated that data and analysis from this study would be utilized in the anticipated Arkansas Decision Support System currently in development by the CWCB.

It is not currently anticipated that Phase Two of the Tailwater Study would require any permits or approvals. Participation in the study would be voluntary and installation of equipment is anticipated to be on-farm only. However, if it is determined that any permits or approvals are required, Applicants will commit to obtaining such approvals.

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.

See Exhibit A. *Additionally, maps depicting the irrigated acres under the Fort Lyon Canal and those parcels covered by a Lower Ark District-operated Rule 10 Compact compliance plan are attached hereto.*

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 10 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: R. Jay Winner
Lower Arkansas Valley Water Conservancy District, by R. Jay Winner (General Manager)

Project Title: Phase Two Tailwater Return Flow Study on the Ft. Lyon Canal

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

Craig Godbout – WSRA Application
Colorado Water Conservation Board
1580 Logan Street, Suite 200
Denver, CO 80203
303-866-3441, ext. 3210 (office)
303-547-8061 (cell)
craig.godbout@state.co.us

Statement of Work

WATER ACTIVITY NAME – Phase Two Tailwater Return Flow Study on Fort Lyon Canal

GRANT RECIPIENT – Lower Arkansas Valley Water Conservancy District

FUNDING SOURCE – Water Supply Reserve Account (Statewide and Arkansas Basin)

INTRODUCTION

The Lower Arkansas Valley Water Conservancy District (Lower Ark) seeks additional funding to continue a study currently underway pursuant to a Water Supply Reserve Account grant originally titled for the *FIRI Analysis and Tailwater Return Flow Study on Fort Lyon Canal Project* (Project). The overarching goal of the Project is to conduct an investigation and collect data to determine whether adjustment to the assumed tailwater factor and irrigation efficiency factor for flood irrigation in the H-I Model and Irrigation System Analysis Model (ISAM) is warranted to more accurately reflect actual conditions, as both of these inputs are considered overly conservative. This Statement of Work is in support of a grant application to fund Phase Two of the Project. In the Statement of Work for Phase One of the Project, it was explained that given the extensive physical size of the Fort Lyon Canal and the amount of data needed to support potential adjustments to the H–I Model and the ISAM, the Project would be pursued in a phased approach and outlined task items for the first phase. Phase One of the Project is yielding promising results – showing that the tailwater assumption contained in the H-I Model and ISAM does appear to be overly conservative. However, additional study and data will be required before the results of the Project are sufficiently persuasive to support a potential State of Colorado request to Kansas for a modification of the irrigation efficiency factor and tailwater factor assumptions in the H-I Model and ISAM. Therefore, Lower Ark seeks funding for a second phase of the Project that will (1) allow for continued site monitoring and data collection on actual amounts of tailwater occurring from flood irrigated farms and (2) to begin on-farm measurement and data collection to analyze irrigation efficiency.

BACKGROUND

The Lower Arkansas Valley Water Conservancy District is committed to preserving agriculture in the Lower Arkansas River Basin. In the face of competing demands on limited water resources, encouraging improvements in irrigation efficiency and agricultural productivity is critical in preserving the agricultural economy and supporting rural communities. However, this must be achieved in a manner that ensures compliance with the Arkansas River Compact. Since adoption of the "Compact Rules Governing Improvements to Surface Water Irrigation Systems in the Arkansas River Basin in Colorado" (the "Irrigation Improvements Rules") in 2011, Lower Ark has stepped forward to prepare and administer the only Rule 10 Compact compliance plans on behalf of irrigation system improvement owners.

After operating a single Rule 10 Plan for the first two years, Lower Ark recognized the unique needs of the Fort Lyon Canal Company Rule 10 Plan members and determined that these needs would be better addressed under a separate Rule 10 Plan. The Fort Lyon Canal, at over 113 miles

long and irrigating approximately 94,000 acres, is the largest irrigation canal in Colorado. The Fort Lyon Canal is typically a water-short system, and Fort Lyon shareholders also make up approximately 2/3rds of the irrigated acreage covered by Compact compliance plans. In the fall of 2013, a Fort Lyon Rule 10 Association was formed and was recently incorporated in order to establish a cooperative, self-sustaining entity for Fort Lyon Canal shareholders who face compact compliance obligations under the Irrigation Improvements Rules.

The ISAM was developed to provide a standard means for evaluating whether a specific irrigation system improvement results in a reduction or change in the amount, timing, or location of historical seepage losses or return flows in violation of Article IV-D of the Arkansas River Compact and to implement the Irrigation Improvements Rules. The ISAM allows for a comparison of computed seepage losses and return flows between the pre-improvement and post-improvement conditions. In making this comparison, for flood irrigation (pre-improvement conditions) the ISAM assumes a standard 9.65% of farm headgate deliveries are returned to the river as tailwater and a 65% maximum irrigation efficiency factor. The tailwater assumption and irrigation efficiency factor are believed to be overly-conservative, particularly on the water-short Fort Lyon Canal where most of the tailwater from one field is likely beneficially used by crops on other fields and does not reach the stream system. If the irrigation efficiency factor and tailwater assumption in the ISAM are, in fact, overly-conservative (i.e., there is less than 9.65% of tailwater return flows from flood-irrigated farms and the percentage of crop consumption (irrigation efficiency) is greater), then return flow maintenance deliveries are being made pursuant to Compact compliance plans in excess of actual changes to return flows associated with the installation and use of irrigation system improvements under the Irrigation Improvements Rules.

Given the extensive physical size of the Fort Lyon Canal, the Project is being pursued in a phased approach. Phase One of the Project has provided high quality data on actual amounts of tailwater return flows occurring from flood-irrigated farms on a subset of the Fort Lyon Canal and supports broader on-site field irrigation evaluations on both tailwater and irrigation efficiency. The first phase involved the installation of measurement equipment and collection of data on a limited number of farms on a single section of the Fort Lyon Canal to evaluate whether the initial results support pursuing a more broad-based, geographically extensive study on a canal-wide basis. Phase One also determined that use of the Farm Irrigation Rating Index (FIRI) method to analyze irrigation efficiency was not appropriate because it would not provide adequate site-specific and data-supported results to establish a representative irrigation efficiency for the Fort Lyon Canal.

Phase Two will build on Phase One results, with the ultimate aim of adjusting the assumed tailwater factor and irrigation efficiency factor in the H-I Model and the ISAM to more accurately reflect actual conditions. By reducing the return flow maintenance deliveries required by Compact compliance plans operating under the Irrigation Improvements Rules, pressure on limited water supplies to meet these delivery obligations will similarly be lessened and additional water sources will remain available for beneficial use to meet other demands within the Arkansas River Basin. Additionally, the transferrable yield associated with Fort Lyon shares in both temporary and permanent changes could be increased as a result of reductions in assumed tailwater return flows and increases in irrigation efficiency. The Project's data could also be incorporated into the anticipated Arkansas Decision Support System and similar water

management tools providing high-quality information to assist in Basin-wide water management decisions. Each of these potential Project outcomes could directly lead to reductions in the agricultural and M&I gap identified in the Arkansas Basin Consumptive Needs Assessment: 2030 (2008).

OBJECTIVES

The objectives are as follows:

Objective 1 – Generate High-Quality Data on Tailwater and Irrigation Efficiency. Applicant will continue measurement and monitoring on farms identified and equipped during Phase One within the McClave Drain segment of the Fort Lyon Canal and will conduct measuring and monitoring for one or two irrigation seasons on an upstream segment of the Canal. Data gathered from upstream segments will be analyzed to verify if results from the McClave Drain segment of the Canal are sufficiently representative of the Canal as a whole. Applicant will conduct on-site data collection and field measurement on factors affecting irrigation efficiency and compare these results with estimates of irrigation efficiency gained through review of satellite imagery. Ultimately, the Project's data could be incorporated into the anticipated Arkansas Decision Support System and similar water management tools providing high-quality information to assist in Basin-wide water management decisions.

Objective 2 – Evaluate Results to Determine Potential for Phase Three to Support Possible Integration of Results into the H-I Model and the ISAM: After completion of Phase Two of the Project, Applicant will evaluate, in coordination with interested parties and the Division 2 Engineer's Office, whether the results justify and support a broader study to perform more extensive field-specific evaluations on a canal-wide basis. The methodologies and approaches used in conducting this Phase Two of the Project will be designed to provide a basis for any potential adjustment to the H-I Model's and ISAM's tailwater and farm efficiency assumption.

Objective 3 – Support a Potential Increase in Transferrable Yield of Fort Lyon Shares: By potentially correcting for overly-conservative assumptions of tailwater and irrigation efficiency on the Fort Lyon Canal, the transferrable yield of Fort Lyon Shares in other temporary and permanent transfers, such as for use in Rule 14 Plans or for alternative agricultural transfers to meet Arkansas Basin demands will increase. This will benefit not only Fort Lyon shareholders, but potentially the Arkansas Basin as a whole by making additional supplies available to meet identified water supply gaps.

TASK ONE

Continue Tailwater Site Monitoring and Data Collection on Participating Fields. Phase One of the Project provided funding adequate to purchase and install measurement equipment and to conduct two years of site monitoring and data collection for fields located on a single area of the Fort Lyon Canal (the McClave Drain). However, in order to provide defensible data to ultimately support a potential revision to the H-I Model and ISAM, more than two years of data (under varying hydrological conditions) is necessary. Phase Two will include site monitoring and data collection for an additional two to three years (depending on available funding and actual labor costs) using the measurement equipment already purchased and installed on participating fields during Phase One.

Method/Procedure: When possible, measurement devices will be checked prior to an irrigation run to ensure all equipment remains in good working condition. With the long length of the Fort Lyon Canal and the large number of head gates it serves in relation to its relatively small capacity, it is operated in numerous sections. Therefore, only irrigators in the currently-active section are allowed to receive water at one time. This period of time when water can be received is called a "run". Typically, irrigators are given approximately 12 hours of notice prior to receiving water and each run is normally 48 hours in length. This method of operation will facilitate monitoring and data collection activities. Following completion of a run, study personnel will return to each measurement device and download all flow data. Data will be given a preliminary review to ensure it is reasonable and representative of the flows and volumes expected for that field.

Deliverable: Task Deliverables will be data log sheets for each of the farms included in the study and any summaries of such data.

TASK TWO

Upstream Tailwater Site Monitoring and Data Collection. As previously explained, tailwater monitoring and data collection in Phase One was confined to the McClave Drain, which is located below John Martin Reservoir and where the majority of acreage remains under flood irrigation. In order to verify the results obtained from the participating fields on the McClave Drain, investigation of another section of the Fort Lyon Canal located above John Martin Reservoir and where the share per acre ratio is higher than in the McClave Drain will be conducted to determine whether results on McClave Drain are representative of the Fort Lyon Canal as a whole. Equipment will be purchased and installed on selected fields in an appropriate upstream section of the Fort Lyon Canal. Selected fields will be monitored and data will be collected for two irrigation seasons. These results will then be compared to results from participating fields on the McClave Drain.

Method/Procedure: Farm selection and equipment installation will generally be consistent with methodology and selection used in Phase One of the Project. Farms with the necessary characteristics will be identified through review of maps, aerial photographs, soil maps, and meetings with persons knowledgeable about farms located on the Fort Lyon Canal. Owners of suitable farms for inclusion in the study will be contacted to determine whether they are willing to participate in the study. Meeting(s) with Division 2 personnel will take place to discuss potential farms for inclusion and obtain input as to preferred farm locations. As needed, meetings may also take place with the Fort Lyon Canal Company board and superintendent to explain the purpose and operations plan of the study and address any questions or concerns they may have.

Applicant will work with the owners of the participating farms to determine proper locations for flow measurement/recording equipment installation to ensure collection of accurate and reliable data. The study area will be assessed to determine the appropriate type of measurement equipment, but in general, Parshall, trapezoidal and cutthroat flumes, as well as sharp-crested weirs will be used, all equipped with automatic data loggers to measure tailwater amounts. Permanent measurement structures owned by study participants will also be used when feasible. Once selected, equipment will be installed using standard installation procedures and Applicant will provide an opportunity to Division 2 personnel to inspect the equipment.

Data collection will also occur in the same manner as was used in Phase One of the Project on the McClave Drain (and will continue under Task One). Measurement devices will be checked prior to an irrigation run to ensure all equipment remains in good working condition. Following completion of a run, study personnel will return to each measurement device and download all flow data. Data will be given a preliminary review to ensure it is reasonable and representative of the flows and volumes expected for that field.

Deliverable: Task deliverables will include: (1) maps and legal descriptions of the selected farms, the locations and types of equipment to be installed on each farm, and description as to the basis for inclusion in the study; (2) documentation of the equipment purchased and a brief narrative and/or photographs showing the sites where the measuring and monitoring equipment was installed; and (3) data log sheets for each of the farms included in the study and any summaries of such data.

TASK THREE

Irrigation Efficiency Site Monitoring and Data Collection. The Statement of Work for Phase One contemplated conducting a Farm Irrigation Rating Index (FIRI) Analysis on irrigation efficiency to determine whether this approach would provide useful information to assist in better understanding actual canal-wide irrigation efficiency, as opposed to the irrigation efficiency factor contained in the H-I Model and ISAM. As will be detailed in the final report for Phase One (and as discussed with staff at DWR and the CWCB), it was determined in the course of investigations under Phase One that the FIRI Analysis methodology would not provide information that would be useful in evaluating the appropriateness of the irrigation efficiency factor on a canal-wide basis. Because Phase One has determined that limitations inherent in the FIRI Analysis methodology will not yield useful data on irrigation efficiency, Phase Two will identify and conduct actual field measurements of factors that affect irrigation efficiency on a small sample (estimated to be between one and three) of the participating fields for which Phase One tailwater data has been obtained. Equipment will be installed, as needed, on these participating farms and measurements will be taken for one or two irrigation seasons. The results obtained on irrigation efficiency will be compared with estimates of irrigation efficiency derived from evapotranspiration estimates measured with multispectral satellite imagery. This comparative analysis will assist in determining whether a more extensive study of irrigation efficiency using satellite imagery on a canal-wide basis in a future phase of the Project is supported, since use of satellite imagery could significantly streamline evaluation of canal-wide irrigation efficiency.

Method/Procedure: Farms with the necessary characteristics will be identified through review of maps, aerial photographs, soil maps, and meetings with persons knowledgeable about farms located on the Fort Lyon Canal. Owners of suitable farms for inclusion in the study will be contacted to determine whether they are willing to participate in the study. Meeting(s) with Division 2 Engineering personnel will take place to discuss potential farms for inclusion and obtain input as to preferred farm locations. As needed, meetings may take place with the Fort Lyon Canal Company board and superintendent to explain the purpose and operations plan of the study and address any questions or concerns they may have. Appropriate equipment will be purchased for use in quantification of irrigation efficiency water balance components. This may include soil moisture monitoring equipment, precipitation gages, evapotranspiration measurement devices, and additional flumes.

Deliverable: Task deliverables will include: (1) maps and legal descriptions of the selected farms, the locations and types of equipment to be installed on each farm, and description as to the basis for inclusion in the study; (2) documentation of equipment purchased and a brief narrative and/or photographs showing the sites where the measuring and monitoring equipment was installed; (3) data log sheets for each of the farms included in the study and any summaries of such data; and (4) summary sheets on irrigation efficiency derived from satellite imagery.

TASK FOUR

Data Processing, Analysis and Evaluation for Phase Three. Results from both Phases One and Two will be compiled and evaluated. If deemed adequately supportive of a potential modification to the H-I Model and ISAM by the District and subsequently Colorado DWR staff, results may presented to the State of Kansas during a meeting between the District and appropriate representatives from Colorado and Kansas. This meeting would likely include a discussion on additional technical study that may be appropriate to support a formal modification to the irrigation efficiency factor and tailwater factor assumptions in the H-I Model and ISAM. It is currently anticipated that recommendations on additional technical study would guide the formulation of a third phase of the Project that could culminate in a formal request by Colorado for a modification of the H-I Model and ISAM.

Method/Procedure: Tailwater measurements will be analyzed as a total volume and as a percentage of total supply delivered to all farms in the study area. Precipitation data and conveyance losses will be included where necessary to derive tailwater fraction results for each study area. This analysis will be performed for each farm on an irrigation run basis and a yearly basis. Measurable irrigation efficiency water balance components including soil moisture content, irrigation application and tailwater amounts, precipitation, evapotranspiration, and irrigation distribution uniformity will be analyzed on a run basis and yearly basis. Evapotranspiration estimates measured with multispectral satellite imagery will be coordinated with the DWR State Engineer's Office for comparison with on-farm irrigation efficiency measurements.

Deliverable: Task deliverables will be the final report (below) which: (1) describes the methods and procedures used during the study; (2) summarizes the study results and conclusions; and (3) outlines recommendations for a potential Phase Three of the study.

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 results of the project and documents how the project was completed. This report may contain maps, photographs, summaries of meetings and engineering reports/designs.

BUDGET

Labor Costs

	Project Manager/ Staff Engineer	Field Technician	Legal	Total
Billing Rate	$75	$25	$240	
Task 1 – Continue McClave Drain Monitoring and Data Collection	400	1,000	-	$55,000
Task 2 – Upstream Region Tailwater Study				
a. Farm Identification	50	-	-	$3,750
b. Purchase and Installation of Equipment	200	-	-	$15,000
a. Site Monitoring and Data Collection	250	800	-	$38,750
Task 3 – Irrigation Efficiency Monitoring and Data Collection	50	250	-	$10,000
Task 4 – Data Processing, Analysis and Evaluation for Phase Three	300	100	65	$40,600
Total Cost	$93,750	$53,750	$15,600	$163,100

Equipment and Direct Costs

	Mileage ($.55/mi)	Materials	Total
Task 1 – Continue McClave Drain Monitoring and Data Collection	2,000	$3,000	$4,120
Task 2 – Upstream Region Tailwater Study			
a. Farm Identification	500	$0	$280
b. Purchase and Installation of Equipment	500	$ 70,500	$70,780
a. Site Monitoring and Data Collection	3,000	$0	$1,680
Task 3 – Irrigation Efficiency Monitoring and Data Collection	500	$9,500	$9,780
Task 4 – Data Processing, Analysis and Evaluation for Phase Three	100		$56
Total Cost	$3,630	$83,000	$86,696

Total Budget

	Equipment/ Direct Costs	Labor	Total
Task 1 – Continue McClave Drain Monitoring and Data Collection	$4,120	$55,000	$59,120
Task 2 – Upstream Region Tailwater Study			
a. Farm Identification	$280	$3,750	$4,030
b. Purchase and Installation of Equipment	$70,780	$15,000	$85,780
a. Site Monitoring and Data Collection	$1,680	$38,750	$40,430
Task 3 – Irrigation Efficiency Monitoring and Data Collection	$9,780	$10,000	$19,780
Task 4 – Data Processing, Analysis and Evaluation for Phase Three	$56	$40,600	$40,656
Total Cost	$86,696	$163,100	**$249,796**

Phase Two Tailwater Return Flow Study on the Fort Lyon Canal

Total Budget:

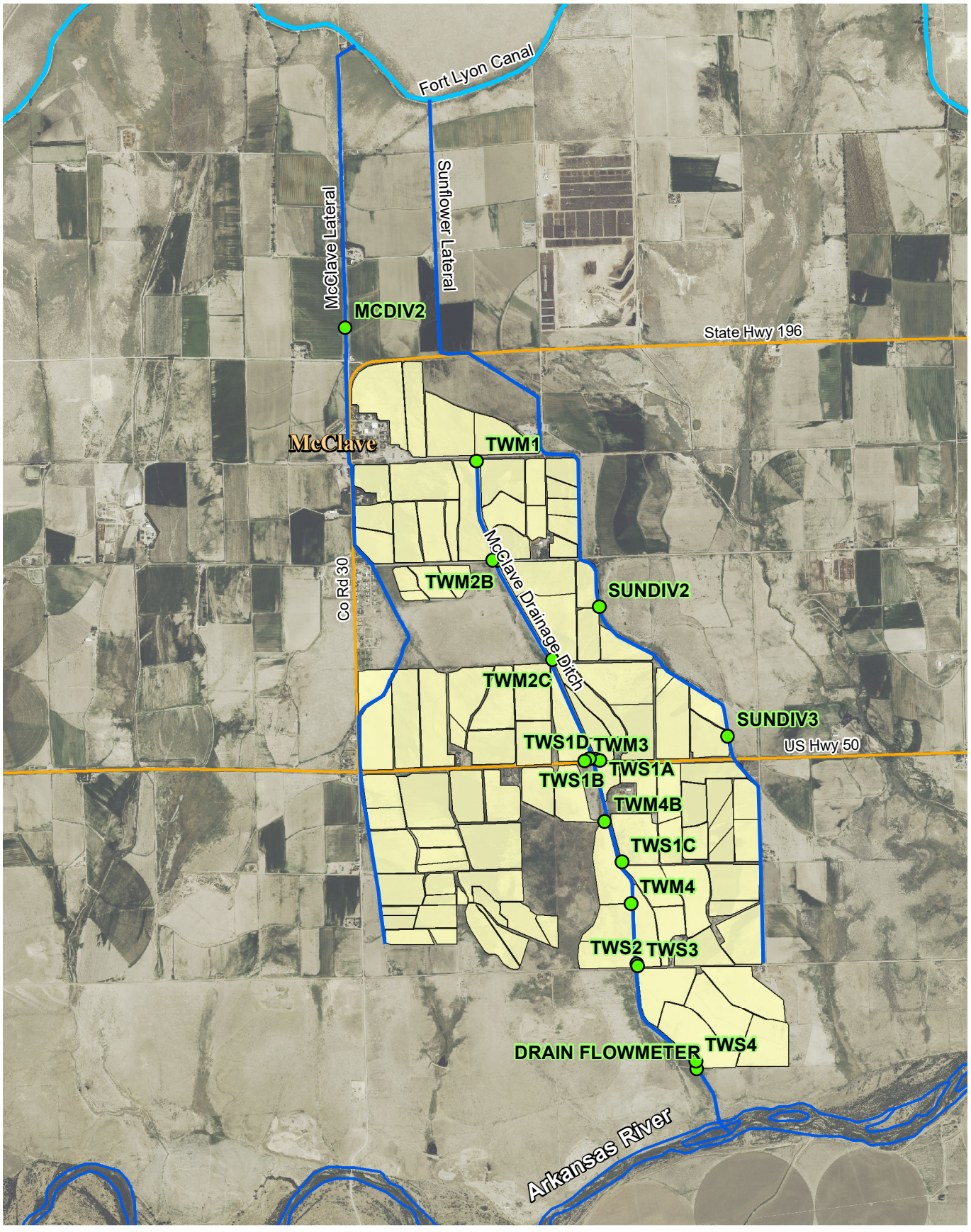
	WSRA	LAVWCD	Total
Task 1 – Continue McClave Drain Monitoring and Data Collection	$41,370	$17,750	$59,120
Task 2 – Upstream Region Tailwater Study			
a. Farm Identification	$2,820	$1,210	$4,030
b. Purchase and Installation of Equipment	$60,025	$25,755	$85,780
a. Site Monitoring and Data Collection	$28,291	$12,139	$40,430
Task 3 – Irrigation Efficiency Monitoring and Data Collection	$13,841	$5,939	$19,780
Task 4 – Data Processing, Analysis and Evaluation for Phase Three	$28,449	$12,207	$40,656
Total Cost	$174,796	$75,000	$249,796

SCHEDULE

A proposed project schedule including key milestones for each task and the completion dates or time period from the Notice to Proceed (NTP) is as follows (note that this is an estimated schedule and may be adjusted depending on month of NTP, since certain tasks may only occur during the irrigation season):

Task	**Month**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Task 1 – McClave Drain Monitoring and Data Collection												
Task 2 – Upstream Region Tailwater Study												
Task 3 – Irrigation Efficiency Monitoring and Data Collection												
Task 4 – Data Processing, Analysis, and Evaluation for Phase Three												

Task	**Month**															
	13	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**
Task 1																
Task 2																
Task 3																
Task 4																



Fort Lyon Tailwater Study

0 0.5 1 2 Miles

Legend

- Measurement Locations
- TW Study Acreage

N W E S