# STATE OF COLORADO

**Colorado Water Conservation Board**
**Department of Natural Resources**
1313 Sherman Street, Room 721
Denver, Colorado 80203
Phone: (303) 866-3441
Fax: (303) 866-4474
www.cwcb.state.co.us

John Hickenlooper
Governor

Mike King
DNR Executive Director

Jennifer L. Gimbel
CWCB Director

June 1, 2011

Lower Arkansas Valley Water Conservancy District
Attn: Peter Nichols, Trout, Raley, Montano, Witwer & Freeman, P.C.
801 Swink Avenue
Rocky Ford, CO 81067

**RE: Alternative Agricultural Water Transfer Methods - Potential Impacts to Long-Term Farm Financial Planning from Temporary Water Transfers**

Dear Peter:

This letter is to inform you that the purchase order to assist in the Potential Impacts to Long-Term Farm Financial Planning from Temporary Water Transfers was signed on May 11, 2011.

With the executed contract, you are now able to proceed with the project and begin invoicing the State of Colorado for costs incurred through December 31, 2011. Upon receipt of your invoice(s), the State of Colorado will provide payment no later than 45 days. I wish you much success in your project.

Sincerely,

/s/

**Todd Doherty**
**Colorado Water Conservation Board**
**Water Supply Planning Section**
1580 Logan Street, Suite 200
Denver, CO 80203
Phone: 303-866-3441 x3210
Mobile: 720-214-3262
Todd.doherty@state.co.us
www.cwcb.state.co.us and www.ibcc.state.co.us

WATER CONSERVATION BOARD
1313 SHERMAN STREET, ROOM 721
DENVER, CO 80203

**Buyer:** ALLAN SMITH
**Phone Number:** 303-866-3292
**Agency Contact:** DORI VIGIL
**Phone Number:** 303 866 3441

**DATE:** 06-01-11

**IMPORTANT**
The PO# and Line # must appear on all invoices, packing slips, cartons and correspondence

ACC: 05-31-11

# PURCHASE ORDER
## STATE OF COLORADO

**P.O. #** OE PDA 11000000123 **Page#** 01

**State Award #**

**BID #**

**FEIN** 481298144 **Phone:** 719-254-5155
**Vendor Contact:**
**Purchase Requisition #:**

**VENDOR**
LOWER ARKANSAS VALLEY WATR CNSRVNCY
801 SWINK AVENUE
ROCKY FORD CO 81067

**Invoice in Triplicate**
**To:** DIVISION OF WATER CONSERVATION
1313 SHERMAN STREET, ROOM 721
DENVER, CO 80203

**Payment will be made by this agency**

**Ship To:** DIVISION OF WATER CONSERVATION
1313 SHERMAN STREET, ROOM 721
DENVER, CO 80203

**Delivery/Installation Date:** 12-31-11
**F.O.B.** DESTINATION STATE PAYS NO FREIGHT

**INSTRUCTIONS TO VENDOR:**

1. If for any reason, delivery of this order is delayed beyond the delivery/installation date shown, please notify the agency contact named at the top left. (Right of cancellation is reserved in instances in which timely delivery is not made.)
2. All chemicals, equipment and materials must conform to the standards required by OSHA.
3. NOTE: Additional terms and conditions on reverse side.

**SPECIAL INSTRUCTIONS:**

| LINE ITEM | COMMODITY/ITEM CODE | UNIT OF MEASUREMENT | QUANTITY | UNIT COST | TOTAL ITEM COST |
|---|---|---|---|---|---|
| 001 | 91843000000 | | | | $31,633.00 |

ALT AGRICULTUREAL WATER TRANSFER METHOD - DEVELOP PLANNING MODEL/ANALYSIS TO CONSIDER IRRIGATION WTR TRANSFER.CMS#32322

DOCUMENT TOTAL = $31,633.00

THIS PO IS ISSUED IN ACCORDANCE WITH STATE AND FEDERAL REGULATIONS
This PO is effective on the date signed by the authorized individual.
EPSPO PAA

FOR THE STATE OF COLORADO

Authorized Signature

6/1/11
Date

DP-01 (R-02/06)

# Statement of Work
## [AMENDED FEBRUARY 15, 2011, BASED ON CWCB STAFF RECOMMENDATIONS]

**WATER ACTIVITY NAME - Potential Impacts to Long-Term Farm Financial Planning from Temporary Water Transfers**

**GRANT RECIPIENT – Lower Arkansas Valley Water Conservancy District**

**INTRODUCTION AND BACKGROUND**

Provide a brief description of the project. (Please limit to no more than 200 words; this will be used to inform reviewers and the public about your proposal)

Recent efforts by Colorado State University, University of Nebraska, the USDA Agricultural Research Service (ARS), the private firm Regenesis, and others have focused on farm economics in a static environment, meaning results are for a single time period only, with future conditions extrapolated from the snapshot result. Collectively, these efforts have developed valuable decision-making tools for irrigators considering selling or leasing some portion of their operation's water supply. However, these tools may only account for a portion of the farm economics picture as viewed by irrigators. Two important, related aspects not yet fully considered include:

1. In the case of water leases, how the transfer terms impact the long-term financial picture of the remaining farm operation over a number of wet and dry hydrologic cycles. In effect, what is the impact on the operation's cash flow over time?

2. The ever-present uncertainties of agricultural production, such as uncertain prices, yields, and input costs. In light of these, analyses have tended to use either expected values or have used low and high ranges to place bounds on their possible outcomes. From a planning perspective, these are reasonable responses to reign-in the analysis. However, from an operator perspective, there are potential opportunity costs that need to be highlighted in order to assess the full upside and downside of a potential transfer.

**OBJECTIVES**

List the objectives of the project

This effort's objective is to develop a whole-farm financial planning analysis that considers irrigation water transfers over an extended period of time and also the inherent uncertainties underlying irrigators' decisions to lease, sell, or keep all or a portion of their water supply. To accomplish this objective, ***a farm financial planning model will be developed, building directly upon the static model developed for the CWCB by a collaboration that included the Colorado Corn Growers, Ducks Unlimited, Brown and Caldwell, and Harvey Economics. The proposed analysis will use the existing model to establish initial conditions with respect to cropping patterns, including anticipated annual farm revenues, production costs, yields, irrigation water availability, and irrigation water application rates. The proposed analysis will add a time dimension to the existing model, modifying it from a static single period model to an analysis of a multi-year planning horizon, considering risk and uncertainty.***

### Cash Flow Model

A cash flow model will be the basis for the analysis, with each line item in the analysis drawing from a component of the model. This analysis would consist of four components to account for (1) nature of the contract, water demand, and lease revenues; (2) sources of funds; (3) uses of funds; and (4) carryover balances. The model will cover the time period 2010-2050, which is estimated to be the approximate life of a water lease contract and is sufficiently long as to experience a wide range of hydrologic conditions.

A number of case studies from the Lower Arkansas Valley are recommended for initially testing the model and for subsequent analysis, with each case study representing a different type of operation. Types of operations might include:

- Medium to large-sized irrigated cash grain and/or alfalfa operation, representative of a well-established owner-operator with minimal debt load.

- Smaller, heavily-leveraged cash grain/alfalfa operation, representative of a younger operator with a mix of owned and rented cropland.

- Medium-sized grain and forage operation supporting a cattle feeding operation, with relatively high debt load.

Crop rotations typical of these types of operations in the Lower Arkansas Valley would be developed for baseline revenue and cost projections.

### Water Component

The Water component defines the proposed lease type, its terms, the frequency of water deliveries taking place, and other information needed to determine lease proceeds in a given year of the analysis. For example, the lease could require fallowing a proportion of their irrigated acreage at a given frequency, say 1 in every 4 years. The lease terms may require some compensation to the operator every year, with additional compensation in years when water is delivered. The price received for water, either on a per acre basis or per acre-foot basis, would be initially specified but price escalators would be used to adjust prices over time.

Based on the terms of the proposed hypothetical lease contract, Leonard Rice Engineering (LRE) will use historic data to develop one or more hydrologic sequences to determine which years during the period 2010-50 the lease might be exercised and how much water the farm would be giving up in those years and how much remaining supplies are available for irrigation. The output from the water component would be a schedule of lease revenues and acres to be fallowed for each year of each hydrologic sequence developed.

### Sources of Funds

Annual sources of funds include lease proceeds, revenues from crop production and/or livestock

production, and interest income. Carryover cash balances from the previous year are also a source of funds.

Annual lease proceeds are estimated in the Water component. Revenues from crop production for each year of the analysis would be estimated based on irrigated acreage (also estimated in the Water component) and expected crop yields and prices. For the baseline analysis expected crop yields and prices would be developed from historical data indexed to the current period. Uncertainty associated with these variables is addressed later in this proposal. Similarly, baseline fed cattle prices can be indexed from historical data.

### Uses of Funds

Uses of funds consist of crop and livestock production expenses, land costs, taxes, hired labor, and depending on the organizational structure of the operation, either the operator's wages or a family living allowance.

Crop expenses will be categorized as seed, fertilizer, chemicals, fuel, repairs, hired labor, custom work, and interest expenses. Existing enterprise crop budgets available through CSU and other sources will be used to develop baseline estimates of total crop expenses for the entire operation. Further, based on assumptions regarding the debt structure of the case study, the operation's fixed cost outlays will be estimated.

Livestock expenses will include feeder cattle purchase, feed, supplements, veterinary supplies, hired labor, and interest expenses. Similarly, payments towards fixed costs will depend on the operator's assumed existing debt.

### Contribution to Reserves

For a given year the difference in sources of funds and uses of funds is the contribution to cash reserves. In this cash flow analysis, the annual contribution to reserves can be equivalently considered the operation's annual profit. The reserves themselves could be considered savings or accumulated wealth.

### Results of the Baseline Analysis

The results of the analysis are the comparative cash flow impacts of water transfer options for various types of operations with differing financial situations. These options would include rotational fallow leases, outright sales, and no-action. Important financial components would be the annual contribution to annual reserves, its variability over time, and the ability to maintain a positive balance in cash reserves over the entire period of analysis.

In addition, and possibly as important, will be the model's ability to work backwards in the analysis to see what conditions must be met for the various transfer options to work for the various types of farm operations under a range of financial conditions. The model's spreadsheet-based framework will allow for a wide range of "what if" scenarios.

### Dealing with the Uncertainty of Future Commodity Prices, Yields, and Costs

Overall, farm commodity prices have increased significantly during the latter half of this decade, about 50 to 75 percent higher than their relatively stationary levels during the 1980's to the early 2000s. For instance, Corn Belt corn prices have appeared to reach a new plateau of about $3.50 per bushel, up from the $2.00 per bushel range experienced during the previous 20 years. However, there is greater variability around this new level than around the old price levels, driven by increased market speculation and greater exposure to international weather events and politics. To an Arkansas Valley irrigator, this means that higher crop prices may be expected in the future, but it is a big risk getting there. However, it introduces a seed of doubt about whether selling or leasing water is always the most profitable decision over time and forces one to re-examine the risk and returns of continuing irrigating.

Adding to this uncertainty in the opposite direction are widespread rumors that new drought-resistant crop hybrids will soon be available that have the ability to achieve high yields under substantial water stress, making deficit irrigation cost effective. On the cost-side, it is well-known that fuel and fertilizer costs have varied tremendously over the last 3 years.

### Methods of Dealing with Uncertainty and Recommendation

Overall, it is clear that farmers deal in a highly uncertain environment that weighs heavily upon them. Accounting for this uncertainty in the context of deciding whether to sell water, lease water, or continue irrigating is essential. Previous analyses have dealt with uncertainties in various ways, including:

- Considering worst case and best case scenarios to bracket possible outcomes.
- Through sensitivity analysis, identifying key variables and their impact on the outcomes.
- Similar to how water planners deal with average and firm-yield concepts, use of a probabilistic approach that identifies strategies that meet certain criteria, say for example, 90 percent of the time.

Of these approaches, the latter is most appealing because it uses all of the information available about the future uncertainties in the most efficient manner. In addition, it likely matches-up with the decision process used by irrigators, although they would probably not express the process in such academic terms. The use of a probabilistic approach is recommended here to develop a range of possible future cash flow scenarios for the decision of whether to sell, lease, or continue irrigating.

In addition, it is recommended that Monte Carlo simulation be the method used to generate ranges of possible cash flow paths over time, based on the underlying uncertainty of each critical variable and the correlation between these critical variables. The critical variables are anticipated to be crop yields, crop prices, and input costs, which translate to line items under the Sources of Funds and Uses of Funds cash flow model components. Other than the Monte Carlo simulation, there are few other tools available to synthesize these future cash flow paths. In addition, the Monte Carlo analysis has a long history in the commodity trading business as a risk management tool and has also been used to examine risk-reducing strategies by Colorado farm operators.[1]

[1] King, Robert P. and George Oamek. "Risk Management by Colorado Dryland Wheat Farmers and the

The underlying uncertainty of critical variables would be described by a statistical probability distribution. The characteristics of this distribution would be based on historic variability, with added emphasis of its variability over the last 10 years.

### Results of the Uncertainty Analysis

The output of the Monte Carlo-based uncertainty analysis would be cash flow paths over time corresponding to each decision made – whether to sell, lease, or continue farming, that have statistical distributions associated with each. These statistical distributions can be used to develop traditional confidence intervals around these paths, or they can be used to support statements such as the following:

- "If I lease water with 25% of my operation in one of every 4 four years, there is a 90 percent probability that my accumulated savings will exceed my annual operating costs after 10 years and I can meet all debt obligations in all years. If I don't lease water, there is only a 50% probability that I'll accumulate this level of reserves in 10 years and I can only meet debt service obligations 60% percent of the time."

The above statement is intentionally biased towards the leasing option in order to illustrate the ability of the probabilistic-based analysis to use all available information. It is also propped on the assumptions that would have to be made about the uncertain variables, but it realistically recognizes that nothing in the future is certain and placing "odds" on outcomes is the best an analyst can do.

## TASKS

Provide a detailed description of each task using the following format

### Task 1. Cash Flow Model

Description of Task

Develop the Cash Flow Model.

Method/Procedure

Develop the spreadsheet-based cash flow model described above assuming expected values for critical income variables. In addition, develop the model for a single case study, the medium to large-sized cash grain operation, assuming an established farm operator with a relatively small debt load. Seek Quality Control review of the model and revise it as considered necessary.

Deliverables

- Spreadsheet model with documentation provided in an appendix to the Final Report.
- Sections in Final Report discussing the cash flow model and its components.

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Elimination of the Disaster Assistance Program." American Journal of Agricultural Economics, Vol. 65, No. 2 (May, 1983), pp. 247-255.

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### Task 2. Case Studies

Description of Task

Develop the remaining case studies.

Method/Procedure

Based on the experience gained from the initial case study and the Quality Control review, develop the remaining case studies.

Deliverables

- Spreadsheet models of case studies.
- Sections in Final Report discussing case studies and insights gained from them.

### Task 3. Uncertainty Analysis

Description of Task

Develop the uncertainty analysis with respect to most critical variables.

Method/Procedure

Develop the Monte Carlo simulation component of the cash flow model. Base the underlying statistical characteristics of the uncertain variables (prices, yields, and costs) on historical trends and variability. Develop this component in a modular framework, allowing it to be switched on and off at the user's discretion.

It is anticipated that Microsoft Excel add-ins "Crystal Ball" or "Risk" will be used to implement the Monte Carlo approach.

Deliverables

- Spreadsheet model of first case study, with embedded assumptions about variables' uncertainties. This model would be observable in Excel, but only executable with the Excel add-in.
- Section in Final Report discussing risk and uncertainties and assumptions used to make the model operational

### Task 4. Irrigator Workshop

Description of Task

Conduct an irrigator workshop.

Method/Procedure

Conduct a small, informal workshop with a number of Lower Arkansas Basin irrigators to "reality check" the model and its assumptions. Focus initially on the cash flow component, making sure some level of buy-in is achieved prior to discussing the uncertainty component. This meeting could be prior to a larger LAVWCD Board meeting or a Super Ditch Board meeting to minimize inconvenience to the

participants.

Deliverables

- The workshop is the deliverable
- Summary notes and Action Items from the Workshop will be summarized in the Final Report.

**Task 5. Draft and Final Reports.**

Description of Task

Develop the Draft Final Report and the Final Report.

Method/Procedure

Develop a Draft final report for electronic distribution to the CWCB and LAVWCD. After a 2-week comment period, develop the Final Report. The Final Report will be electronically distributed as a pdf file, with two bound copies for the CWCB. Although it is not anticipated that software will be developed as part of this effort, the spreadsheet model would be available for distribution post-development. Using the full model, including the uncertainty component, would require specialized Monte Carlo software. However, since this component would be modular, the baseline model remains usable with Excel.

Deliverable

Draft Final Report and Final Report, including a downloadable Excel Spreadsheet Model that irrigators can use to evaluate their own operations.

**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.

Development of the final deliverables, the Draft Final Report and the Final Report is included as Task 5 above. The project will be less than 6 months in duration and, as a result, not require a 6-month progress report.

**KEY PERSONNEL**

Honey Creek Resources will be primarily responsible for the work under the supervision of the Applicant. George Oamek, an agricultural economist, has been involved in the development of the

Super Ditch since the inception, and this work will build on work he did for the initial feasibility study that led farmers to incorporate the Super Ditch. George will be the principal researcher.

Leonard Rice Engineers (LRE) will assist in the preparation of the assumptions, model and workshop. Key LRE personnel are Heath Kuntz and Gregg Ten Eyck, who are responsible for key modeling tasks regarding in the first grant to the Super Ditch. They have also helped the Applicant prepare its Rule 10 Plans for the new Arkansas River Basin Compact Compliance Rules for irrigation improvements. LRE has done the most extensive and recent modeling in the Lower Arkansas River Basin, and have been working closely with the State and Division Engineers on modeling to ensure consistency, credibility, usability, and transferability of the model for this and other uses.

## BUDGET

The total estimated cost for the Farm Financial Model is $31,633, derived in the following tables.

**Alternative Agricultural Water Transfer Methods –**
**Amended Statement of Work (February 15, 2011)**
**Grant Recipient: LAVWCD**

## Total Cost

| Task | | Labor | Other Direct Costs | Matching Funds | Total Project costs |
|---|---|---|---|---|---|
| 1 | Develop baseline cash flow model | $ 8,100 | $ 50 | $ - | $ 8,150 |
| 2 | Develop case studies | $ 7,000 | $ 61 | $ - | $ 7,061 |
| 3 | Develop uncertainty component | $ 3,940 | $ - | $ - | $ 3,940 |
| 4 | Irrigator workshop | $ 5,620 | $ 682 | $ - | $ 6,302 |
| 5 | Report writing | $ 6,100 | $ 80 | $ - | $ 6,180 |
| | Cost | $ 30,760 | $ 873 | $ 3,163 | $ 34,796 |

## Labor

| Task | | Project Manager | Senior Economist | Project Engineer | Economist | Senior Reviewer | Estimated labor cost |
|---|---|---|---|---|---|---|---|
| | | $ 200.00 | $ 150.00 | $ 165.00 | $ 110.00 | $ 150.00 | |
| 1 | Develop baseline cash flow model | 4 | 32 | 8 | 8 | 2 | $ 8,100 |
| 2 | Develop case studies | 0 | 32 | 8 | 8 | | $ 7,000 |
| 3 | Develop uncertainty component | 0 | 16 | 4 | 8 | | $ 3,940 |
| 4 | Irrigator workshop | 8 | 16 | 8 | | 2 | $ 5,620 |
| 5 | Report writing | 4 | 24 | 4 | 4 | 4 | $ 6,100 |
| | Total hours | 16 | 120 | 32 | 28 | 8 | $ 30,760 |
| | Cost | $ 3,200 | $ 18,000 | $ 5,280 | $ 3,080 | $ 1,200 | |

## Other Direct Costs

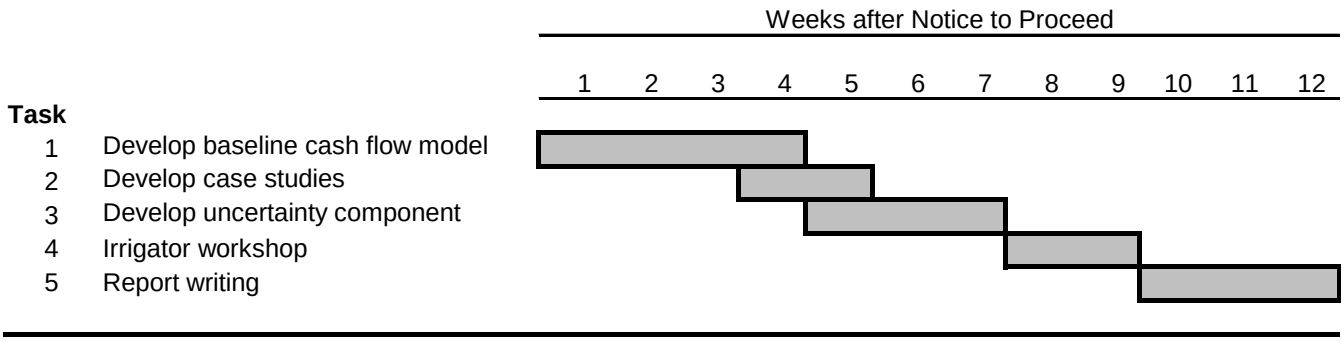
| Task | | Copies | Materials | Equipment and supplies | Mileage | Lodging and other travel costs | Estimated cost |
|---|---|---|---|---|---|---|---|
| | *Units* | No. | $ | $ | miles | $ | |
| | *Unit cost* | $ 0.20 | | | $ 0.51 | | |
| 1 | Develop baseline cash flow model | | | $ 50.00 | | | $ 50.00 |
| 2 | Develop case studies | | | | 120 | | $ 60.60 |
| 3 | Develop uncertainty component | | | | | | $ - |
| 4 | Irrigator workshop | 400 | $ 100.00 | $ 100.00 | 400 | $ 200.00 | $ 682.00 |
| 5 | Report writing | 400 | | | | | $ 80.00 |
| | Total | 800 | $ 100.00 | $ 150.00 | 520 | $ 200.00 | $ 872.60 |
| | Cost | $ 160.00 | $ 100.00 | $ 150.00 | $ 262.60 | $ 200.00 | |

## SCHEDULE

Provide a project schedule including key milestones for each task and the completion dates or time period from the Notice to Proceed (NTP). This dating method allows flexibility in the event of potential delays from the procurement process. Sample schedules are provided below. Please note that these schedules are examples and will need to be adapted to fit each individual application.

The proposed project schedule is shown below. The project is anticipated to be 12 weeks in duration.

**Schedule for Farm Financial Planning Analysis**




## PAYMENT

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

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