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FLEX Water Market
Education and Implementation Phase

December, 2015








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The FLEX Project Team members included:

- Ducks Unlimited
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  - Billy Gascoigne
- Aurora Water
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  - Dan Gallen
- Lawrence Jones Custer Grasmick LLP
  - P. Andrew Jones, Esq
  - Ryan Donovan, Esq
- Brown and Caldwell
  - Matt Lindburg, P.E.

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List of Abbreviations

ATM	Alternative transfer method
BC	Brown and Caldwell
C-BT	Colorado-Big Thompson
CWCB	Colorado Water Conservation Board
ER	Environmental and recreational
FCLD	Fort Collins-Loveland Water District
HE	Harvey Economics
LJCG	Lawrence Jones Custer Grasmick LLP
M&I	Municipal and industrial
NBER	National Bureau of Economic Research
NPIC	North Poudre Irrigation Company

Executive Summary

The FLEX Water Market is a concept that has been under development for several years and could provide a framework for implementing water transfers using alternative transfer methods (ATMs). The concept was born from concerns regarding permanent transfers of agricultural water to municipal and industrial (M&I) users as they expand their water supply portfolios in response to growing water needs.

The FLEX Water Market establishes a flexible, long-term, and sustainable water sharing partnership among agricultural water users, M&I users, and environmental and recreational (ER) interests. The FLEX Water Market is simply defined as a voluntary, contractual agreement between one or more M&I users, one or more agricultural water users, and one or more ER water users to change the use of a senior irrigation right to include multiple end uses -- *in addition to irrigation* -- and to establish a trading platform facilitating uses by all participants.

The goal of this project was to successfully implement the FLEX Water Market concept through education, facilitation, and consultation, with specific focus on developing FLEX markets in Water Division 1 with municipal, industrial, agricultural, and environmental/conservation partners. A description of the project objectives is provided below:

- **Provide Education, Facilitation, and Consultation**. The FLEX Project Team served as a resource to help parties seeking to explore or implement the FLEX Water Market concept.
- **Evaluate Index Based Pricing**. The FLEX Project Team evaluated ways to adjust water pricing based on the increasing value of water and the volatile market for agricultural commodities to aid in contract development and overall market uptake.
- **Explore Large-Scale Implementation of the FLEX Water Market in the Front Range**. The team promoted and discussed the implementation of the FLEX Water Market with large water providers, irrigators, and environmental water users in Division 1 along the Front Range.

The FLEX Project Team approached the project in accordance with the three project objectives listed above. The results of the team's efforts are summarized below.

- **Provide Education, Facilitation, and Consultation**. The FLEX Project Team engaged numerous parties that were interested in the FLEX Water Market concept. However, the parties and the team were unable to implement a FLEX Water Market transfer for a variety of reasons including volatile demand, pricing, high potential transaction costs, and technical issues associated with locations of supply vs. demand. One conclusion the team drew from this phase of the overall project is that economies of scale and reliability are important considerations when weighed against transaction costs. It is difficult to establish small scale, pilot FLEX Water Market based transactions in the face of relatively high transaction costs. The team's experience reinforces the importance of recommendations made in previous studies on ways to reduce transaction costs. It is likely that new, innovative thinking will be needed regarding solutions to reducing transaction costs if this and other ATM concepts are to realize broad acceptance for implementation.
- **Evaluate Index Based Pricing**. The FLEX Project Team reviewed existing literature on index-based water pricing as it relates to alternative transfer methods. While there is relatively abundant data published on historical water transactions, there was no mention of other water transfer programs where price indexing was used. Through this project a composite price index was developed based on pricing drivers in the South Platte Basin. The drivers included crop price,

costs of agricultural inputs, farm productivity, costs of providing municipal services, prices of oil and natural gas, and drought conditions. The composite price index was tested against historical prices of Colorado-Big Thompson (C-BT) supplies. The results of this analysis indicate that the composite price index tracks the C-BT price reasonably well, which offers assurances that the composite price index is a useful tool for determining the price escalator factor in FLEX Water Market agreements.

- **Explore Large-Scale Implementation of the FLEX Water Market in the Front Range**. The FLEX Project Team scheduled two meetings with water interests in the South Platte Basin. Some of the objectives of the first meeting were to familiarize the participants with issues that have been barriers to alternative transfers, potential solutions to the barriers, and the FLEX Water Market concept and to discuss potential issues associated with large scale implementation of the FLEX Water Market or any type of alternative transfer program. The meeting and discussion yielded numerous, informative opinions and thoughts regarding the future of ATMs and implementing them on a large scale. The purpose of the second meeting was to focus on regional or large-scale implementation of ATMs. The FLEX Project Team identified several themes that emerged from the meeting that described characteristics of an entity that could facilitate ATMs. The characteristics are presented below.
  - **Geographic boundaries:** The entity should be localized and should focus on pertinent water features such as M&I intakes, dry up points, delivery locations, etc. Service areas for individual ditch companies or a water district is probably an appropriate size.
  - **Entity Type:** A cooperative may be the most attractive organizational framework.
  - **Governance:** The governance of the entity should be selected by the participants or members.
  - **Funding:** Multiple sources would lead to more economic sustainability (e.g. member fees, grant funds, fees for water, state funding, etc.).
  - **Participants:** A variety of participants will lead to a more robust organization. Agricultural, M&I, ER users as well as third party funders should be included.
  - **Functions:** The entity could facilitate changes in use, augmentation plans, infrastructure "tollways", securing third party funding, facilitating transactions, etc.

Section 1

Introduction

1.1 Project Overview

The FLEX Water Market is a concept that has been under development for several years and could provide a framework for implementing water transfers using alternative transfer methods (ATMs). The concept was born from concerns regarding permanent transfers of agricultural water to municipal and industrial (M&I) users as they expand their water supply portfolios in response to growing water needs.

The FLEX Water Market establishes a flexible, long-term, and sustainable water sharing partnership among agricultural water users, M&I users, and environmental and recreational interests (ER). The FLEX Water Market is simply defined as a voluntary, contractual agreement between one or more M&I users, one or more agricultural water users, and one or more ER water users to change the use of a senior irrigation right to include multiple end uses -- *in addition to irrigation* -- and to establish a trading platform facilitating uses by all participants.

The FLEX Water Market is characterized by these highlights:

1. The potential to purchase a small percentage of a farm's overall water supply by an M&I or ER user and deliver this "base" amount via alternative methods (e.g. fallowing, growing crops with low water use, or deficit irrigation).
2. An agreement regarding intermittent leasing (short or long term) of the remaining water supply on the farm.
3. A focus on the use of recharge sites and other environmentally beneficial delivery methods and water management.

Development of the FLEX Water Market concept has been funded by the Colorado Water Conservation Board (CWCB) and various sponsors such as Ducks Unlimited, Aurora Water (City of Aurora), the Colorado Corn Growers Association, and Regenesis Management Group.

1.1.1 Goals and objectives

The goal of this project was to successfully implement the FLEX Water Market concept through education, facilitation, and consultation, with specific focus on developing FLEX markets in Water Division 1 with municipal, industrial, agricultural, and environmental/conservation partners.

The overall goal of the project was met by achieving several objectives. A description of the project objectives is provided below:

- **Provide Education, Facilitation, and Consultation**. The FLEX Project Team served as a resource to help parties seeking to explore or implement the FLEX Water Market concept.
- **Evaluate Index Based Pricing**. The FLEX Project Team evaluated ways to adjust water pricing based on the increasing value of water and the volatile market for agricultural commodities to aid in contract development and overall market uptake.
- **Explore Large-Scale Implementation of the FLEX Water Market in the Front Range**. The team promoted and discussed the implementation of the FLEX Water Market with large water providers, irrigators, and environmental water users in Division 1 along the Front Range.

1.1.2 Study team

Representatives of Ducks Unlimited, Aurora Water, Lawrence Jones Custer Grasmick, LLP (LJCG) and Brown and Caldwell (BC) were the primary researchers for this study and are referred to as the FLEX Project Team for the purposes of this report. In addition, Harvey Economics provided economic consulting services related to the development of an index based water pricing mechanism.

The project sponsors, Ducks Unlimited and Aurora Water, provided approximately 25% of the total project cost in matching funds, as well as in-kind services, while the CWCB's Alternative Agricultural Water Transfer Methods grant program funded the remainder of the project cost.

1.2 Previous Studies

The study summarized in this report is a continuation of previously-funded studies performed by most of the FLEX Project Team members in which the team explored alternative transfer mechanisms, barriers to wide-scale implementation of ATM projects, and potential strategies to overcome existing barriers.

1.2.1 First study – Development of practical ATM measures

In its May, 2011 report entitled "Completion Report: Development of Practical Alternative Agricultural Water Transfer Measures for Preservation of Colorado Irrigated Agriculture," (Colorado Corn Growers Association, et al.) the project team described a concept labeled the "FLEX Market" – a voluntary, market-based water sharing approach in which existing senior irrigation rights are used for M&I and ER uses in addition to the existing irrigation (agricultural) use.

As set forth in the 2011 report, the project team envisioned that an M&I user and ER user would partner to change the use of senior irrigation rights to include M&I and ER uses in addition to the existing irrigation rights. Once this change in use had been approved, either administratively or via the water court process, the participants would be free to enter into agreements regarding the delivery of the consumptive use attributable to the senior right on a periodic basis, in accordance with market conditions and legal confines. Ownership of the senior water right would stay largely with the agricultural user, while an M&I or ER user might have the possibility to purchase a small percentage of the senior water right as a means of funding the change in use case and giving those users an identifiable "stake" in the water right.

1.2.2 Second study – FLEX Water Market feasibility

The project team submitted a proposal for a second grant with a plan to convene groups of M&I users, ER users, agricultural users, and water professionals to discuss the FLEX Water Market concept. Specifically, the team's goal was to develop, using a consensus model, a Model FLEX Agreement to serve as a guide to parties seeking to implement the FLEX Water Market concept. The meetings proved to be particularly beneficial, because the participants provided frank answers regarding challenges of implementing ATMs. For example, agricultural water users described operational and cultural difficulties with fallowing (i.e. it is hard for a farmer to see his/her land resources not being used), annual planning timelines for farming that should be considered when making decisions about whether water should used for another purpose, etc. In another example, M&I water providers discussed how ATMs might fit into their water portfolio. M&I providers with a mature water portfolio may see ATMs as beneficial for drought protection or recovery. Other M&I providers with a less mature portfolio may use ATMs for base supplies. Many M&I providers expressed an interest in long term agreements.

In response to questions about whether the FLEX Water Market concept could survive water court scrutiny, the team worked with experienced water attorneys and engineers to develop model water right decree terms and conditions necessary to implement a FLEX Water Market. Finally, in a continued effort to drive towards practical implementation, the team proposed to perform a survey level analysis of three major South Platte River ditch companies, including an assessment of consumptive use potentially available for FLEX Water Market implementation, existing and needed infrastructure, and delivery mechanisms to potential delivery points or various end users (Colorado Corn Growers, et al., 2013).

Upon successful achievement of prior studies' objectives, the FLEX Project Team sought to implement a pilot FLEX Water Market and also conduct further research in areas that rose to importance during previous studies. These are the objectives and subjects of work researched in this study and described in this report.

1.3 Report Organization

This report is organized by the three general tasks funded by the CWCB grant and includes the following sections.

- **Section 1: Introduction.** Provides an overview of the project objectives, the FLEX Water Market, and previous studies.
- **Section 2: Implementation of FLEX Water Markets.** Describes efforts by the FLEX Project Team to facilitate the implementation of a FLEX Water Market with interested parties.
- **Section 3: Index Based Pricing.** Documents a literature review on water pricing and the development of an index based pricing mechanism for the South Platte Basin.
- **Section 4: Explore Large-Scale Implementation of the FLEX Water Market in the Front Range.** Describes collaborative meetings with water users and recommendations regarding regional, large-scale implementation of FLEX Water Markets and ATMs in general.
- **Section 5: Conclusions and Recommendations.** Provides a summary of the project, conclusions and recommendations from the FLEX Project Team.

Section 2

Implementation of FLEX Water Markets

2.1 Task Description

In this task, the FLEX Project Team served as a legal and technical resource to parties seeking to implement a FLEX Water Market. The specific work undertaken by the team was based upon inquiries and requests from third parties and the limits of available funding. Work under this task was limited to education, organization, facilitation, and consultation, with the goal of fostering development of FLEX Water Markets. Parties seeking assistance were responsible for negotiation; contracting; infrastructure; and project-specific legal, engineering, and water court/administrative applications (grant funding cannot be used for water court purposes).

The FLEX Project Team reviewed and approved all requests for assistance to be funded through this grant prior to approving expenditure of funds to assure that the assistance advanced the values and goals of the FLEX Project Team and the CWCB. Services were provided on a first come, first serve basis for approved projects, to the limit of grant funding for the task. The model FLEX Water Agreement (previously developed in another project) served as a template for parties seeking to implement the arrangement. In addition to the FLEX Water Agreement, the model Terms and Conditions for a water court decree were available for use.

Due to the complexity of a change of use of water rights from agricultural uses to agricultural and other uses, a primary element of the assistance to interested parties was engineering and legal expertise. BC provided engineering expertise, and LJCG provided consulting services and facilitation to interested parties.

Attorneys from LJCG provided consulting (not legal advice) on water law matters, and BC provided water-related engineering assessments of water rights held by interested parties. For example, BC provided a consumptive use assessment of an interested party's water rights in order to understand how much water might be available for a FLEX Water Market arrangement. BC also provided an estimate of water demands for a crop that required less water. The difference of the two values could be considered the amount that could potentially be used by an M&I or ER user in a FLEX Water Market arrangement. BC also considered what effects the change of use would have upon other water rights, such as the timing of return flows. LJGC provided water law related consulting to the interested party, so that they might better understand the process to change their water rights as well as the risks of a change of use.

2.2 Description of Engagements

The FLEX Project Team relied on their network of contacts in the water industry to identify and engage interested parties. Two sets of parties (each consisting of an agricultural water supplier and municipal/industrial end user) showed sufficient interest to engage in several meetings and to evaluate the technical components of a potential FLEX Water Market arrangement. In addition several other interested parties were engaged by the FLEX Project Team to explore potential water sharing agreements. A description of these efforts are described below.

2.2.1 The NPIC Shareholder – Fort Collins-Loveland Water District evaluation

A shareholder in the North Poudre Irrigation Company (NPIC) was interested in periodically fallowing one of his irrigated fields (approximately 140 acres) to produce water for a water sharing agreement with the Fort Collins-Loveland Water District (FCLD). The field is irrigated with shares from the North Poudre Irrigation Company (NPIC). To maintain confidentiality, this report will not name the shareholder but will provide a general summary of the FLEX Project Team's engagement with him and the FCLD.

FCLD is a water provider to over 14,000 homes and businesses in northern Colorado. FCLD also owns shares in the NPIC.

The NPIC provides water to their shareholders via a direct flow water right and through Colorado-Big Thompson supplies (C-BT). Each share of NPIC includes both a C-BT and a direct flow component. The direct flow component of the shares can only be used for agricultural purposes, while the C-BT component can be put to multiple uses. The District typically leases the agricultural component of their shares to agricultural water users, including the NPIC shareholder.

The contemplated FLEX Water Market would allow FCLD to use the agricultural component of their NPIC shares during dry years (or upon other certain events). The NPIC shareholder could also provide temporary recharge facilities for delivery of subsurface return flow obligations.

Meetings and facilitation

Members of FLEX Project Team have working relationships with both the NPIC shareholder and FCLD. Several discussions were informally held with both parties to explore their general interest in the FLEX Water Market. The parties expressed strong Interest in establishing a water sharing agreement that would reflect many of the characteristics of a FLEX Water Market.

A meeting among the FLEX Project Team, the NPIC shareholder, and Kim Frick from the FCLD was held on January 23, 2014. During the meeting, the NPIC shareholder's goals and objectives for a water sharing agreement along with FCLD's goals and objectives were discussed. Physical characteristics of the water sharing proposal (i.e. irrigated lands involved, source of water supply, method for delivering water to FCLD, etc.) were discussed as well. At the conclusion of the meeting, the parties agreed that the next step in the process would be to quantify the potential amount of water involved in the water sharing agreement.

High-level quantification of water supplies

BC provided a high-level historical use analysis to help the parties understand the potential amount of water that could be periodically transferred under the proposed water sharing agreement. A brief summary of the analysis is described below.

The NPIC shareholder's historical on-farm deliveries, cropping patterns and irrigation methods for the years 2000 to 2013 were considered in the consumptive use analysis. The NPIC shareholder provided these data inputs to Brown and Caldwell, and historical consumptive use was quantified using the StateCU model. The following bullets provide a summary of relevant information that was incorporated into the analysis:

- Historical crop mix included corn, sugar beets, barley, pinto beans, and alfalfa
- Annual on-farm deliveries ranged from 77 acre-feet to 289 acre-feet and averaged 179 acre-feet per year
- A center pivot was used to distribute irrigation water on the subject field.

A total of 142 acre-feet per year (on average) of consumptive use were attributed NPIC water rights used for irrigation on the farm proposed to be part of the water sharing agreement. However, the

objective of the historical use evaluation was to identify the proportion of the NPIC shareholder's historical consumptive use that was attributable to supplies derived from the direct flow right (as opposed to the C-BT portion) and that were designated for agricultural use. These supplies would potentially be available to lease or trade to the FCLD.

BC received direct flow/C-BT allocation records for the NPIC from the FCLD. The allocation records described the quantity of water delivered, per share, by the NPIC for agricultural use (via their direct flow right) and multi-use (via C-BT) on a per share basis.

BC quantified the historical consumptive use attributable to both C-BT and direct flow rights by multiplying the farm's annual consumptive use by the ratio of designated agricultural water per share to the total water per share shown in the allocation records provided by the district. A total of 82 acre-feet were attributed to C-BT water deliveries on average while the remaining 60 acre-feet were attributed to the direct flow right on average. Annual amounts of consumptive use attributable to the direct flow right ranged from 23 acre-feet to 116 acre-feet.

Conclusions from this engagement

Unfortunately, analysis of proposed water rights to be used for the water sharing agreement did not provide a sufficient amount of transferrable consumptive use to warrant the potential administrative costs required to change water for other uses. Considering costs of pursuing a change of water rights, the parties decided against further involvement. The fact that the parties declined to pursue the water sharing agreement further illustrates the potential negative impacts that high transactional costs can have on implementing FLEX Water Markets. A lesson learned from this engagement is that water sharing agreements involving larger amounts of water may be more attractive if transactional costs can be spread across a higher volume of water (i.e. utilizing economies of scale).

2.2.2 The Shaw evaluation

Mr. Shaw owns off-channel water storage facilities (the "Shaw Lakes") and water rights along Boulder Creek. Mr. Shaw was interested in ways that he could enhance the economic value of his water rights, and he engaged the FLEX Project Team to evaluate potential water sharing strategies that he could implement. The water sharing strategies would be consistent with a FLEX Water Market in that M&I and ER users could periodically make use of Mr. Shaw's water rights and/or storage facilities.

Description of water rights

Mr. Shaw owns shares in the Houck No. 2 ditch and historically used those shares for irrigating approximately 80 acres of pasture grass. Mr. Shaw was engaged in the process of changing those water rights to allow other uses. The Shaw Lakes, owned by Mr. Shaw, include two lined gravel pit reservoirs with a total of 523 acre-feet of storage. The lakes release water to Boulder Creek.

Meetings and facilitation

As with the NPIC shareholder-FCLD engagement, members of the FLEX Project Team communicated with Mr. Shaw several times about a water sharing agreement. On August 26, 2014, the FLEX Project Team met with Mike and Ginny Shaw to discuss water rights and engineering related characteristics and considerations regarding a potential water sharing agreement involving their water rights and storage facilities. At the time, a specific end user for the water had not been identified. However, the FLEX Project Team both identified and contacted potential end users for the water. A key issue identified at the meeting was the ability to deliver water from the Shaw Lakes to potential end users on the South Platte River.

Analysis of delivery capability

The objective of the delivery analysis was to evaluate conditions under which water could be delivered from the Shaw lakes along Boulder Creek to Aurora Water's Prairie Waters wellfield. The City of Aurora was a willing end user for the water, but needed a high level of certainty that the water could be delivered to an intake point. Also, the FLEX Project Team hypothesized that other water users between Shaw Lakes and the Prairie Waters wellfield could be potential end users for the water. For water from the Shaw lakes to be delivered to Prairie Waters, it would be released from the Shaw lakes to Boulder Creek, which runs into St. Vrain Creek and finally to the South Platte River. From the confluence of the South Platte River and St. Vrain Creek, the water would be delivered by exchange to the Prairie Waters wellfield.

BC investigated the conditions that would allow for the release and exchange of water from the Shaw Lakes to the Prairie Waters wellfield. A Technical Memorandum was prepared and is included in Appendix A of this report. The reader is referred to Appendix A for a description of the assumptions, tools, and specific results of the analysis.

The following observations were drawn from the analysis:

- Boulder Creek frequently experiences low flows, with flows less than 50 cfs seen a majority of the time between July and October.
- Though there are times throughout the year when Boulder Creek could be below 10 cfs, most of those time occur between April and October. July through September flows are frequently less than 10 cfs. During these low flow times, a significant portion of releases from the Shaw Lakes could be lost to infiltration and evaporation if release rates are not sufficiently high.
- The Rural Ditch dries Boulder Creek and would need a bypass structure, especially if releases from the Shaw Lakes are conducted in the summer. However, other delivery impediments such as South Platte exchange capacity could prevent summer releases much of the time. If releases from the Shaw Lakes are conducted during winter, spring, and fall, then difficulties associated with bypassing the Rural Ditch headgate will be lessened, if not eliminated.
- The Hewes Cook calling right has the highest potential for preventing exchange.
- The reliability of delivering water from the Shaw lakes to the Prairie Waters wellfield can be characterized by breaking up a typical year into three periods. The winter months (November to March) have high reliability. During the shoulder months of the irrigation season and times during high runoff and stream flow (April through June plus October), successful delivery can be achieved a majority of the time, ranging from 64 to 76 percent on average. Delivery during the irrigation months (July through September) would only be successful between 12 to 28 percent of the time on average.

Conclusions from this engagement

The results of the technical analysis showed that water could be delivered from the Shaw Lakes to water users on the South Platte somewhat reliably during parts of a typical year and periodically during other parts of the year. With this information the FLEX Project Team contacted a number of different potential end users in an attempt to facilitate a water sharing agreement.

An energy company expressed a high level of interest, however, that interest waned because of unforeseen circumstances. The value of oil on the global market lost more than half of its total value in a short period, causing drastic changes in production activity on the Front Range of Colorado. Specifically, the price of oil went from $110 a barrel in June of 2014 to less than $50 a barrel by March of 2015. In October of 2014, when the interest in a water sharing agreement was at its highest, the price of oil was still above $75 a barrel and oil production was not in remission. In addition, the energy company's management had concerns regarding public perception and was

interested in learning more about the support given to the FLEX Water Market concept and ATMs in general at the higher management levels of state agencies. By January 2015, the FLEX Project Team was informed by energy company representatives that production was going to be halted, and there was no longer interest in a water lease. Oil and gas companies are a major water user on the Front Range and are very active in the leasing market given their limited land and water right ownership. Leasing agreements can be attractive to energy companies, because they provide investment flexibility as they engage in a volatile marketplace.

Even after the energy company abandoned the proposed water sharing agreement, the FLEX Project Team worked diligently with Mr. Shaw to better understand his needs and identify additional end users. In addition, Mr. Shaw and the team considered how the Shaw Lakes could be used in a larger, regional ATM program to store and/or retime water supplies to better meet the potential needs of end users. Calls were held with key water interests in the area, including a large municipality. Concurrently, snowpack conditions improved greatly in the South Platte Basin, which were then supplemented with extraordinary spring precipitation throughout May and June of 2015. Rainfall in the month of May was the 4th highest total in the Basin in the last 120 years. With industry and municipal needs greatly diminished, a water sharing agreement between Mr. Shaw and an end user failed to materialize. In addition, the idea of using the Shaw Lakes as infrastructure in a regional ATM program waned in light of potential transaction costs.

2.2.3 Other limited engagements of the team

During the course of this work task, members of the FLEX Project Team communicated via phone calls and meetings with a variety of interested agricultural and industrial water users who were interested in the FLEX Water Market concept. While none of these communications resulted in a water sharing agreement, they presented a number of opportunities for education of water users but also for the FLEX Project Team in terms of potential applications of the FLEX Water Market concept.

One example of these engagements involved a feedlot owner/operator who had already planted a field to wheat and was interested leasing an amount of water commensurate with the difference between the historical consumptive use on the farm and the lower amount of consumptive use associated with a wheat crop. His intended end user was an energy development firm, and the lease would potentially be conducted pursuant to an SWSP under 37-92-308(5) in 2015. Infrastructure for this potential project was already constructed. Interest in the potential lease fell away, however, due to the drop in oil prices and production cited previously.

In another example, a water provider that supplies oil companies and other water users approached the FLEX Project Team for assistance in exploring the implementation of water sharing agreements like the FLEX Water Market. The water provider was concerned, however, about the costs for engineering, development of water sharing agreements and potential water court filings. He understood that the FLEX Project Team could provide services to cover part of those needs, but not all of them. He anticipated that approval (either via water court or other legal means) would be expensive, but the water involved in the potential agreement was relatively small. As a result, the engagement ended because of the potential high transaction cost relative to the amount of potential water supply involved.

2.2.4 Conclusions

The FLEX Project Team was obviously disappointed that a water sharing agreement was not struck as a result of their efforts. One conclusion the team drew from this phase of the overall project is that economies of scale and reliability are important considerations when weighed against transaction costs. It is difficult to establish small scale, pilot FLEX Water Market based transactions in the face of relatively high transaction costs. The team's experience reinforces the importance of

recommendations made in previous studies on ways to reduce transaction costs. It is likely that new, innovative thinking will be needed regarding solutions to reducing transaction costs if this and other ATM concepts are to realize broad acceptance for implementation.

Section 3

Index Based Pricing

Water pricing is one of the key factors that will determine the success of an alternative transfer. In fact, it is probably the most important factor. Irrigators are reluctant to enter into long term alternative transfer programs if they are doubtful that they will receive adequate compensation for their water. This is in part due to the uncertainty of the value of water and prices for agricultural commodities. As one agricultural representative noted, "Farmers often only make money one out of every five or even 10 years. They will be scared to enter into any static water agreement and miss out on that one lucrative year." In addition, potential end users are reluctant to enter into an alternative water transfer program if current-year water pricing structures lead to future overpayment for water. A fair and robust method for pricing water, both in the short and long terms, is crucial to the successful implementation of long-term alternative transfer programs.

Given the importance of water pricing to the success of alternative water transfers, the FLEX Project Team conducted research on ways to adjust the price of water over time so that the needs of both parties in a long term water transaction can be satisfied. The research was conducted in two phases. The first phase included a literature review and investigation into existing methods for pricing water. The second phase included the development of a water pricing index that considers factors important to agricultural and municipal/industrial water users in Colorado.

3.1 Investigation of Existing Pricing Mechanisms

The FLEX Project Team reviewed existing literature on index-based water pricing as it relates to alternative transfer methods. In short, while there is extensive literature on historical water market transactions, many of which include transactions involving the Front Range, relatively little information was found regarding the use of indexes as a pricing mechanism in alternative transfers.

The review of existing pricing mechanisms is described below and consists of two parts. Section 3.1.1 summarizes the FLEX Project Team's review of literature on water market transactions and Section 3.1.2 provides an overview of a recent publication by DiNatale Water Consultants prepared for a similar alternative transfer methods project.

3.1.1 Summary of recent literature on water market transactions

A March 2007 National Bureau of Economic Research (NBER) working paper offers perhaps the most complete analysis of water markets in the West (Brewer, et al., 2007) The authors of this study compiled historical data available from the *Water Strategist* to compare volume and price amounts across single year leases, multi-year leases and sales, totaling 3,232 water transfers from 1987 to 2005. The transfers included those within the same industry (i.e., agriculture to agriculture) and across industries (i.e., agriculture to municipal). The results confirm some generally held beliefs: (1) prices are higher for agriculture-to-urban transfers; (2) prices for urban use are growing relative to agriculture use over the study period; (3) agriculture is the origin of most water that is transferred; and (4) there is a trend towards the acquisition of water for longer periods of time, with increased use of sales and multi-year leases, for which buyers generally will pay a premium.

The NBER study builds upon previous work, including a 2006 study by Thomas Brown (2006). Brown also used data from the *Water Strategist*, but at least a portion of the research analyzed water transactions at smaller geographical scales than the NBER study, with substantial attention paid to the Colorado Front Range, including the Colorado-Big Thompson, Twin Lakes Reservoir and Canal, and Windsor Reservoir and Canal markets. His conclusion: prices vary substantially among markets that are geographically close to each other. Perhaps of more importance is Brown's analysis of what is driving the market price in both sales and lease water transactions. The model constructed by Brown, as admitted by the author, yields modest explanatory power. The inquiry established a significant correlation between higher lease prices in drier climates, in counties with larger populations, and when the water is to be used for municipal purpose, but failed to find a significant correlation between the amount of water transferred and the year of the transaction.

An Australian study (Bjornlund, et al., 2005) also examined the likely drivers of price in water leases from 1993-2003. That study found that agricultural commodity prices, though having some impact on the price for leased water, such impact was limited as compared to what the researchers predicted. The authors there found that climatic events (precipitation and evaporation) and macroeconomic indicators (exchange rate, foreign exchange rates, and GDP) have more significant impacts on price. Another study by some of the same authors (Bjornlund and Henning, 2002) found that, among other factors, the relative bargaining power of the parties was significant. Though direct comparison between this study and transfers in the American West is imperfect because of Australia's different water administration institutions, this study is still informative in that it ties lease prices back to commodities grown.

A U.S. study by Colby, et al. (1993) found that price for water was a function of priority of the right, the volume of water traded, and the buyer's position as a municipality or major industrial company. Finally, a recent study of the Middle Rio Grande Basin (Payne and Smith, 2013) found that water right prices are influenced by housing prices, per capita income in the buyer's county, buyer type, point of diversion, and transaction volume, but found that significant price dispersion still persists.

If one of the goals of the FLEX Market approach is to increase certainty with respect to pricing in the water market, these studies are relevant because they demonstrate the number of factors that can increase price variability in the water market, and they underscore the difficulty in isolating those variables that are price determinate in any region, basin, or transaction. One indicator, albeit an imperfect one, may be an existing index of water market transactions. Such an index already exists, known as the WRPIx, and is maintained by the firm WestWater Research.

The WRPIx may offer a baseline to which potential sellers (or lessors) could reference, but the index is based on historical transactions in the market for water. Historically, the market for water has suffered from several defects that violate basic economic notions of competitiveness – relatively few buyers and sellers, high transaction costs, lack of information, uneven bargaining power, and potential externalities (return flow, etc.), meaning that the market prices captured by the index may be skewed (either positive or negative). Nevertheless, an index such as WRPIx, does rest on actual transactions that assume individual buyers and sellers agreed on a price that satisfied their own interests. That price conveys relevant information indicative of circumstances surrounding previous transactions and therefore, may be useful for identifying trends in prices.

3.1.2 Overview of DiNatale article

In support of a similar ATM pilot project, DiNatale Water Consultants (2012) recently published a report on water partnerships. The report, focusing on the FRICO system, included surveys of FRICO shareholders, as well as a summary of results from surveys conducted by Thorvaldson (2010) and Pritchett, et al. (2012). The report also provided results from surveys of municipal and industrial providers. The primary economic component of the study was a simulated water market laboratory

experiment. It's important to note DiNatale's stated need for this approach – citing a lack of existing price data. The basic set-up of the experiment was this – the participants (FRICO board members) were split into two groups, cities and farmers. The farmers were then broken down into sub-groups – low-value producers, medium-value producers, and high-value producers. Climatic controls were introduced to mimic dry, normal, and wet years. The parties were allowed to trade water rights in various "rounds", and different rules were introduced in the experiment in later rounds.

Two primary treatment variables were tested in subsequent rounds of the experiment, introduction of unrestricted leasing, simulating a situation where water could be leased from agriculture back to municipalities and vice versa, and the introduction of a bulletin board that informed other participants of the prices at which other deals were made. With respect to the first treatment variable, the experiment demonstrated that the introduction of unrestricted leasing leads to less water being transferred out of agriculture (and a corresponding increase in the use of water in agriculture). Further, when leasing was allowed, cities purchased fewer water rights and relied more on the leasing market. Importantly, the introduction of unrestricted leasing drove down prices, a result increased number of sellers. The second treatment variable, the effect of the bulletin board, was not analyzed as part of this report and the results will be made available at a later point. This speaks to some of the concerns irrigators have with current market norms - their sensitivity that their willingness to lease will be reported back to municipalities (effectively reducing the price they would receive) and their concerns that, without information on other sales, irrigators lack information with which to initiate price negotiations.

3.1.3 Conclusion

While there is relatively abundant data published on historical water transactions, there was no mention of other water transfer programs where price indexing was used. The research products relying on the historical data offer valuable insights into market trends, particularly into drivers of price in the water market. The general conclusion is there is wide price dispersion in the market for water, and there are numerous variables that factor into the clearing price. The WRPIx may reveal trends in market prices for sales and leases. Though imperfect, the index does reveal clearing prices for relevant Front Range markets.

As a result of the literature review, the FLEX Project Team was encouraged that the development of an index based pricing mechanism would be of value given the lack of information found regarding water transfer programs that use price indexes.

3.2 Development of Index Based Pricing

At the outset of a long-term water lease, there are two components of price that the parties will negotiate: (1) a base price representative of the then-current conditions and other specific contextual factors and (2) a mechanism for the parties to, with a high degree of confidence, adjust that base price over time. The focus of the FLEX Project Team was to develop an "escalator", or index, for the price of water reflective of anticipated changes, *over time in the future*. Failure to account for these changes over time can block agreement on long-term leases.

To assist the FLEX Project Team in developing an index based pricing mechanism for water, Ed Harvey and Ben Norman with Harvey Economics (HE) was contracted. As the FLEX Project Team worked with HE to refine the scope of the project, an important distinction came to light – the difference between base price, i.e., the initial price paid in year one of a multi-year lease, and escalating factor, i.e., a method to determine how the base price should be adjusted in future years based on circumstances not known at the time the lease is entered.

3.2.1 Study considerations

The base price is affected by a host of factors, which tend to be highly contextual – whether the farm is profitable, the nature and priority of the subject water rights, the participants in the potential lease and their intended use of the water (i.e., M&I, ER, etc.), the geographic location of the water rights, climatic conditions at the time the agreement is entered, etc. After several phone conferences between the FLEX Project Team and HE, it became clear that developing a model to predict base price was beyond the scope of this project.

The FLEX Project Team believes developing a model to estimate a range of base prices to initiate and support negations between a potential lessee and lessor is a worthwhile effort. Data on water transfers is primarily self-reported and captures predominately sale prices, as opposed to lease prices. What price information is available is largely proprietary and suggests that lease price varies greatly based on a number of factors. Understanding the relationship between these factors and lease prices is necessary to facilitate temporary transfers of water between different uses. Such a project is an immense undertaking that could take years to design and complete.

The FLEX Project Team and HE decided to focus resources on the price escalator. The price escalator is equally important as the base price. This is especially true in long term leases, where both lessor and lessee require some assurance that they do not overpay or receive too little compensation in subsequent years. Furthermore, the escalator by its nature is designed to be based in part on indicators that are well established, generally available to the public and visible, making it a more realistic goal to achieve during the term of this grant.

The FLEX Project Team and HE held a kickoff meeting on July 8, 2014 at LJCG's offices to discuss the project objectives and expectations. At the kickoff meeting, the study team developed a list of prerequisites or attributes for the inputs to a successful price index.

- The index had to include factors that were logical drivers of water price in the region, which we defined as the South Platte Basin north of the Denver metropolitan area. Many economic indicators could closely track the price of water over time, but if they were not logically connected to water such that they made intuitive sense to ATM and FLEX Water Market participants, the study team and HE suspected that the index would not get buy-in from participants.
- The index had to be clear and transparent. This requirement again goes to the need for buy-in and trust among would-be FLEX Water Market and ATM participants. If the index is viewed among potential lessees and lessors as being overly complicated, favoring one party over another, or based solely on proprietary information, it would reduce their confidence in basing future price adjustments on the index.
- The index had to include information that has been published in the past. Not only does this requirement also satisfy the trust building component of the index, but a sufficient record of historical data points is needed to accurately construct an indexing model.
- Finally, the index had to include information that is likely to be published in the future. The success of the index lies in its ability to predict future conditions based on past performance. If a key informational input were no longer available, a FLEX Water Market lease agreement could be left in the position of having to recalculate future price terms and leaves the agreement susceptible to failure.

At the July 8, 2014 kickoff meeting, the FLEX Project Team and HE had a discussion centered on the variables that were believed to drive the price of water in the South Platte. The discussion was organized around the various perspectives of lessor and lessee. The anticipated categories of FLEX Market participants – agricultural water rights owners, M&I, and ER could conceptually be either a

lessee or lessor. For instance, in the usual scenario where an agricultural producer is considering leasing water, the team reasoned that factors such as crop price, input costs and productivity were driving forces in determining whether he or she would lease water. Importantly, these were also factors on which there is reliable data that meets the criteria discussed above.

Similarly, when an M&I user is considering leasing water from an agricultural producers, it is often concerned with oil and gas prices or the costs of delivering services to its citizens. The team and HE discussed available metrics that met the criteria above. In a scenario where an ER user is involved in the water transfer, the team struggled to find a data source that satisfied the above criteria. The team and HE explored potential data sources including information available from the CWCB instream flow program and the Colorado Water Trust as a proxy for estimating ER price drivers.

The FLEX Project Team and HE also discussed what indices were used in prior disclosed transactions. This was a beneficial conversation and displayed the complexity of the objective the team was attempting to achieve and the various methods employed by others to overcome similar obstacles.

3.2.2 The composite price index

The final deliverable for this task was a written report from HE detailing a composite price index based on pricing drivers in the South Platte Basin. A copy of the report is included in Appendix B. The reader is referred to the report for a detailed description of method and results, but the report and the composite price index are summarized in this section.

In addition to the four criteria outlined at the kickoff meeting, HE developed several other criteria to evaluate potential data sources that capture price drivers, including simplicity, intuitiveness, applicability to local area, volatility, source, whether the information was regularly available, and whether the source identified more closely with the lessor or lessee. HE then ranked the various data sources for price drivers according to these criteria.

The composite price index was based on seven "component" indices:

- The Crop Price Index
- Prices Paid by Farmers Index
- Farm Productivity Index
- Municipal Cost Index
- Oil Price Index
- Natural Gas Price Index
- Drought Indicator

These component indices satisfy the criteria set by the FLEX Project Team and HE. The indices have been regularly available and are expected to be in the future. They are available from independent and reputable sources. Their effect on the price of water is intuitive and they are relatively simple. Notably, the composite pricing index reflects conditions in the South Platte Basin in Northeastern Colorado.

HE calculated the three-year moving average for all the component indices and then normalized the indices to year 2011 (i.e. 2011 value was set equal to 100). HE averaged and equally weighted the three-year moving average for each component index to generate the composite price index.

HE tested the historical values of the composite price index over the 2002 to 2013 timeframe to the historical price of C-BT units as a way to test the composite price index's ability to track prices for water in a market where price has been well published. C-BT units have certain characteristics that are different from native water supplies, but the C-BT market in many respects "anchors" the price

for other types of water in the South Platte Basin. The results of this analysis indicate that the composite price index tracks the C-BT price reasonably well, which offers assurances that the composite price index is a useful tool for determining the price escalator factor in FLEX Water Market agreements.

Section 4

Explore Large-Scale Implementation of the FLEX Water Market in the Front Range

4.1 Task Description

Initially, and as described in the original scope of work for this project, the FLEX Project Team sought to organize a series of meetings with large water providers, irrigators, and environmental water users in Division 1 to promote and discuss the potential for large-scale implementation of the FLEX Water Market concept and ATMs in general. As the project proceeded, the FLEX Project Team began to believe that a discussion on the regional implementation of the FLEX Water Market concept would be advanced if a successful pilot project was operating and could be used as a model to scale up regional implementation. The team and the CWCB agreed to focus attention and resources towards an implementation project to frame the regional discussion.

As described in Section 2 of this report, the team consulted with numerous entities interested in implementing a FLEX Water Market agreement. However, the interested parties ultimately decided to forego the establishment of a water sharing agreement due to a variety of reasons.

One of the lessons learned was that some of the barriers to individual implementation projects could be overcome by a robust regional network of large water providers or a regional management entity to help facilitate FLEX Water Market transfers. The FLEX Project Team had come full circle with a better understanding of the mutually beneficial relationship between individual FLEX Water Market participants and larger water entities. A need exists for greater regional organization, including not only physical infrastructure, but also institutional capacity, capital, and regional planning.

With this understanding in mind, the FLEX Project Team scheduled two meetings with water interests in the South Platte Basin. One meeting occurred early in the project and the second meeting occurred late in the project.

4.2 Description of Meetings

4.2.1 Initial meeting

The initial meeting hosted by the FLEX Project Team was in the format of a "Water for Breakfast" workshop (Brown and Caldwell periodically hosts workshops entitled Water for Breakfast as an educational opportunity for clients and others). The meeting was held on November 14, 2013. Several attendees from across municipal, industrial, agricultural, and state government attended.

The meeting format consisted of two sessions with a break in between. The objectives of the first session were to familiarize the participants with issues that have been barriers to alternative transfers, potential solutions to the barriers, and the FLEX Water Market concept and to discuss potential issues associated with large scale implementation of the FLEX Water Market or any type of

alternative transfer program. The first session had two overall goals. One was to obtain information regarding considerations for large-scale implementation of ATMs and to also get different interest groups thinking about large-scale implementation. The second was to promote and educate participants about the FLEX Water Market to generate interest in conducting a pilot project. The objectives of the second session were to educate participants on the specific components of the FLEX Water Market contract and decree terms and conditions, provide an opportunity to ask questions, and to inform them of the assistance available to them through the ATM grant if they would like to pursue implementation of a FLEX Water Market.

Before the meeting, several questions were sent to attendees to consider regarding large-scale implementation of the FLEX Water Market and ATMs. The questions were used as a basis for discussion at the end of the first session. The questions attendees were asked to consider are shown below:

- What do you see are the challenges of implementing ATMs on a large scale?
- How do you see water from ATMs being either supplied or utilized? Regular deliveries? Periodic delivery for drought recovery or dry year supply?
- Do you feel a sense of urgency to establish ATM arrangements?
- Geographically, where do you think ATMs make the most sense?
- What needs to happen to make ATMs more attractive to your organization?
- How should water be priced? Should it be based on annual negotiations? Or tied to a long-term formula or index?

Approximately 40 people attended the initial meeting, and the discussion around ATMs was robust and thoughtful.

During the first session, FLEX Project Team members gave a presentation on ATMs, the FLEX Water Market, and the challenges of implementation. In addition, FLEX Project Team members participated in a panel discussion on challenges associated with large-scale ATM implementation. Following the discussions the attendees were engaged in a collaborative discussion regarding the questions provided before the meeting (see above).

The bullet list below summarizes the discussion among participants and the FLEX Project Team during the session and highlights important points made during the meeting. It is probable that the discussion points and opinions were not necessarily endorsed by all of the session participants or the FLEX Project Team. The dialogue, however, was very cordial and friendly, and there was no obvious indication of controversy.

- Need for Cooperation
  - Sometimes, competition among water providers can diminish the overall potential of ATM, recharge, or other water supply projects.
  - Cooperation among water providers should be encouraged.
- Needed Infrastructure
  - The ability to store water developed under ATMs will be critical. Additional storage will be needed. Smaller storage vessels in strategic locations along the South Platte River would be useful for helping to store and exchange supplies.
  - The South Platte Basin Implementation Plan may provide recommendations for additional storage or cooperative projects. These may help facilitate future large scale implementation of ATMs.
  - The State could develop or help facilitate cooperative projects.

  - The location(s) where ATM water is developed will be critical to understanding infrastructure needs. This will be dependent on the ditch companies/irrigators who are willing to enter in to ATM programs.
  - Water quality is an important consideration. Water quality of the South Platte diminishes going from upstream to downstream. Water treatment requirements will depend on where ATM water comes from.
- Price and Competition
  - Currently, municipal water providers feel priced out of the market for temporary leases due to the oil and gas industry's willingness to pay very high prices for water.
  - Municipal water providers may be willing to participate in an ATM or leasing program alongside oil and gas, but in the short term, price may limit their ability to lease supplies. The oil and gas demand is a short term need that municipal providers can eventually replace or grow into as oil and gas demands decrease.
  - The easiest "buy and dry" transactions have already been conducted.
- Changing how Agriculture Thinks About ATMs
  - "Water as a cash crop" was the way that ATMs were initially conceptualized to agricultural water users. This concept has gotten some traction, but it is really about risk management. The ability of agricultural water users to hedge risks associated with volatile commodity markets presents an opportunity for ATMs.
  - We need to change the way we talk about ATMs in the agricultural community. We need to focus on the benefits of risk management.
  - The risk management context for ATMs can also be appealing to M&I providers as well.
  - Large scale implementation of ATMs is not likely to happen in the agricultural community. Rather, it is likely that implementation will happen initially as smaller transactions. Agricultural water users will need to see success stories before ATMs become commonplace.
  - Permanent or long term, individual ATM agreements might be a hard sell in the agricultural community.
- Permanence of ATM Programs
  - Conservation easements coupled with Interruptible Water Supply Agreements may be a good way to ensure that land is kept permanently in an irrigated status while preserving the ability to use water for other purposes.
  - Many farms are owned by individuals who do not live on the farm (absentee landowners). Are these types of individuals going to be interested in ATMs? Some may be – the CWCB has some experience with absentee landowners who have purchased farms primarily to preserve open space.
  - In the next 20 years, 80% of irrigated land will change ownership. Revenue associated with conservation easements may help ease the tax burdens on land/water transactions.
  - On occasion, appraisals do not accurately reflect the value of irrigation water. Appraisals need a more accurate valuation of water so that the values of conservation easements are more accurately quantified.

4.2.2 Second meeting

With the second meeting focusing on regional scale implementation of ATMs, the FLEX Project Team sought to gain more insight on regional entities that could facilitate and manage ATMs. The team determined that the most efficient approach to explore the potential for a regional ATM entity was to engage the general managers of Northern Colorado Water Conservancy District, Central Colorado Water Conservancy District, and Lower South Platte Water Conservancy District. These entities cover large areas of the South Platte River north of Denver and are familiar with both policy and infrastructure issues in the region. Moreover, these entities' status as statutory conservancy districts makes them likely candidates to be involved in the creation and administration of ATM programs.

Prior to the meeting, the FLEX Project Team assembled some basic information on ATM methods, legal mechanisms for authorizing ATMs, existing and planned infrastructure in the South Platte Basin that could help facilitate ATMs, and information on potential regional entities that could facilitate and manage ATMs. The assembled information was formatted as a meeting handout and was distributed to the participants in advance of the meeting. A copy of the handout is included in Appendix C.

The meeting was held on August 26, 2015. During the meeting, several general questions were asked of the participants to help guide the discussion. The discussions were very productive and open, and the FLEX Project Team was pleased and appreciative of the input provided by the participants.

The questions presented to the participants are listed in bold below. Important points and observations that were made during the discussion about each question are included as well.

- How are you involved in ATMs?
  - Conservancy districts are interested in ATMs because the current, chaotic pattern of buy and dry is destructive to ditch companies and communities. We need a model of how ATMs can work, though. This has not happened to date.
  - Difficulties in permitting large water projects are contributing to the frequency of ongoing buy and dry transactions.
  - While ATMs avoid buy and dry, they still result in a decrease in agricultural production. However, ATMs are better than buy and dry.
  - The South Platte Basin Implementation Plan identifies the potential to derive 35,000 acre-feet per year of supply from ATMs. ATMs could be a nice complement to other water supply programs. For example, interruptible supply agreements can be an attractive ATM strategy that is implemented in dry years. ATMs with senior surface water rights could potentially be paired with well augmentation programs to enhance conjunctive water management of both surface and groundwater supplies.
  - Recently, ATMs have been difficult to implement for at least two reasons. First, crop prices have been high, and irrigators can see a higher economic return using their water for farming purposes. Second, energy companies have been willing to pay high prices for water, which has priced other potential end users of ATMs out of the market.
  - Permanency of ATMs has been an issue. Cities want permanency, but agricultural producers are reluctant to commit to a permanent deal. Conservation easements can permanently keep water on the land, but conservation easements may not adequately reflect the value of water. Water cannot be appraised separately from the land (perhaps this is an area for a change in laws or regulations).

- What is the appropriate geographic scope for a regional ATM entity?
  - Ditch companies are essential to successful implementation of ATMs. Individuals who are interested in ATMs will need ditch company support to deliver water. Ditch boards that are more entrepreneurial would be more likely to organize a regional ATM program.
  - Entities will likely need to be rather large to aggregate supplies. Smaller units within the entity could focus on ditch companies. The entity would need to have stable supplies, which would make it more attractive to municipalities who are seeking permanence of supply.
  - A larger entity could potentially be a part of a regional water reuse plan.
- Could a conservancy district be a regional ATM entity?
  - Conservancy districts have appointed boards, and agricultural producers are likely to want an elected board. The Northeast Colorado Water Cooperative is an example of a regional entity that has a Board of Directors elected from the membership. It is a producer-driven organization.
  - Conservancy districts may be concerned about expanding their responsibilities and getting too large. However, conservancy districts could play an important supporting role in facilitation, applying for grant funds, etc.
  - The entity would likely need sufficient financial backing to purchase water rights or to cover potential costs to create an ATM program. The entity could partner with other entities (open space organizations, grant funds, etc.) to participate in ATMs. While infusing cash from the regional entity or from partners into ATMs can get programs off the ground, ATMs need to be economically sustainable on their own.
  - To gain support from downstream water users, it is possible that compensatory storage or some other measure may be needed to mitigate real or perceived negative impacts from large-scale ATM programs.
- Could an entity be developed in District 2?
  - A District 2 entity might be difficult to form. An ATM program would be more likely to succeed if an enterprising ditch company and M&I supplier could develop their own program.
  - Dispersed locations of M&I infrastructure and dry up points and the unique attributes of ditch systems in District 2 may lead to operational challenges for a District 2 entity. It is possible that smaller entities, formed based on unique, geographic characteristics, would have a better chance of success.
  - A key to success would be to provide incentives to farmers in terms of reliable water supplies. Ditch systems with water rights that are periodically curtailed could be interested in an ATM arrangement that lowers their risk of water supply shortage. Strategies that pair ATMs with increased irrigation well use could be attractive. If ATMs were used for firming rather than base supplies for M&I users, these types of strategies could work better for agriculture.
- What infrastructure is in place? What is needed?
  - A pumpback pipeline with an intake located in downstream reaches of the South Platte could help facilitate ATMs, but there is a fear that it would open up more lands to buy and dry. If the pipeline could only be used for ATMs, perhaps it would have more support. A regional entity could serve as the “gatekeeper” to aggregate supplies from ATMs for the pipeline. The group identified a potential negative consequence of this - the value of water

might be negatively impacted for irrigators interested in selling their water if they are unable to use the pipeline and access the municipal water market.

- Storage facilities of moderate size (10,000 to 20,000 acre-feet) at various locations along the river could be useful for exchange, provision of return flow requirements, delivery of water derived from ATMs, etc. Operational flexibility for a larger entity (or multiple entities) could be greatly enhanced by additional, dispersed storage facilities. The State could potentially create some of these storage facilities.
- The Northeast Colorado Water Cooperative has been exploring ways to use pumping stations and pipelines to provide water to ditches that dry the river as a way to enhance exchange capacity through these "bottlenecks".
- Exchange capacity will be important, but water providers and others are quickly claiming capacity.

After the meeting concluded, the FLEX Project Team reviewed the discussion points to evaluate the completeness of the information gained regarding a potential regional entity and large-scale implementation of ATMs in Division 1. The team identified several themes that emerged from the meeting that described characteristics of an entity that could facilitate ATMs. The characteristics are presented below.

- **Geographic boundaries:** The entity should be localized and should focus on pertinent water features such as M&I intakes, dry up points, delivery locations, etc. Service areas for individual ditch companies or a water district is probably an appropriate size.
- **Entity Type:** A cooperative may be the most attractive organizational framework.
- **Governance:** The governance of the entity should be selected by the participants or members.
- **Funding:** Multiple sources would lead to more economic sustainability (e.g. member fees, grant funds, fees for water, state funding, etc.).
- **Participants:** A variety of participants will lead to a more robust organization. Agricultural, M&I, ER users as well as third party funders should be included.
- **Functions:** The entity could facilitate changes in use, augmentation plans, infrastructure "tollways", securing third party funding, facilitating transactions, etc.

The FLEX Project Team felt that the discussion from the second meeting resulted in a fairly clear description of the type of entity that could have success in facilitating a regional ATM program and also described a number of potential issues and solutions regarding conducting ATMs on a regional scale.

Section 5

Conclusions and Recommendations

5.1 Conclusions

The FLEX Project Team was pleased with the results of this project, although the lack of closing an actual FLEX Water Market transfer was an obvious disappointment. As described earlier in this report, the drop in oil prices and an extremely wet spring (the 4th wettest in 120 years) collapsed the market for water transfers. Given the level of interest the team received, it is very possible that a transaction would have gone forward in the absence of the unforeseen market circumstances.

5.1.1 Summary of project conclusions

The team concluded that a number of worthwhile products resulted from this work that will benefit groups seeking to form a FLEX Water Market (or other type of ATM) and the State as a whole. Below is a summary of those conclusions:

- The team experienced firsthand the complications of trying to establish a water transaction in a market with a high degree of outside influence and volatility. In part, this was due to having an energy company as a participant. It is possible that a municipality would not be as impacted by some of the market drivers (i.e. the price of oil) that affected our team's ability to close a deal. That being said, nearly all willing lessors engaged by the FLEX Project Team were interested in a lease agreement with an energy company given the price premiums necessary to cover the high transaction costs.
- For this project, a high degree of time and resources were dedicated to implementing a FLEX Water Market transaction between an individual agricultural user and end user. A regional entity to facilitate ATMs could greatly streamline the process, aggregate geographically dispersed supplies, realize an economy of scale and attract potential market participants in a way that the FLEX Project Team could not, given the limited scope of work and funding.
- A key point of negotiation for long term water sharing agreements that has been voiced by agricultural, M&I, and ER users is the need for a fair and robust method for adjusting the future price of water. The composite water pricing index developed by Harvey Economics will provide a useful tool for this purpose.
- The discussions related to large-scale implementation of ATMs yielded a wide variety of issues but also many solutions. The characteristics of a regional entity for ATM facilitation that resulted from the second meeting (see Section 4.2.2) is particularly useful in contemplating the path forward to implementing ATMs.

5.1.2 Description of related initiatives

As the FLEX Project Team reflected on the results of this project and prior engagements in the field of ATM research, it realized that a wide variety of other initiatives have been launched either directly or indirectly resulting from the CWCB's support of the FLEX Project Team's past efforts. Below is a description of some of these initiatives.

- Formed in 2013, the Poudre Water Sharing Group is seeking to encourage and facilitate water sharing agreements among agricultural and domestic water providers by developing template agreements and strategies for implementing pilot projects.
- Members of the FLEX Project Team have been involved in efforts to introduce and negotiate legislation to address some of the impediments to ATMs that agricultural, M&I, and ER users have identified in prior work.
- The FLEX Water Market concept was highlighted in the South Platte Basin Implementation Plan and Colorado's Water Plan as a way for implementing ATMs in the future. Members of the FLEX Project Team provided input on language to be included in these plans.
- In 2014, members of the FLEX Project Team assisted an agricultural water user in an ATM-based temporary transfer. Water for the transfer was derived by partially fallowing several of the agricultural water user's fields. While this effort was not conducted as a direct result of the project described in this report, the FLEX Project Team members who participated benefitted from the prior body of FLEX Water Market related research in identifying potential barriers and solutions for ATMs.

5.2 Recommendations

The following are several recommendations and considerations related to the FLEX Water Market and ATMs in general resulting from the work on this project.

- The focus of the CWCB's ATM grant program in recent years has been to implement a temporary water transfer under an ATM framework. The FLEX Project Team agrees that this is the right general direction for the program, and the team worked hard to implement an actual transfer under this project. Water market volatility, in part driven by wet hydrology, prevented the team from implementing a transaction. Given the difficulties experienced by the team in implementing an actual transaction, it may be beneficial for the CWCB to put additional focus or equal weight to establishing long-term water agreements via the ATM grant program even if an actual water transfer does not occur during a grant-funded project.
- In the past, ATM programs have generally been characterized as a stand-alone alternative for providing future water supply needs. To date, no ATM programs have been developed that fit this concept. During the FLEX Project Team's discussions regarding large-scale implementation of ATMs, several ideas were presented that frame ATMs differently than stand-alone programs and may be a useful way to think of and implement ATMs in the future. Examples include the following:
  - Previously, ATM researchers thought that agricultural water users would be attracted to ATMs because they could treat their water as another "cash crop". However this characterization of ATMs from an agricultural producer's standpoint has not gained much traction. Agricultural producers have suggested that using ATMs to help minimize risks of water shortage might be a more attractive concept. For example, an irrigator might be attracted to an ATM program if they could periodically lease their surface water supplies in return for augmentation supplies to allow more pumping during dry years.
  - ATM programs may not necessarily provide a certain amount of water supply every year in the future (i.e. a firm yield). Rather, ATM programs may be part of integrated water supply plans that rely on ATMs during drought conditions via interruptible water supply agreements.
- The South Platte Basin Implementation Plan and Colorado's Water Plan place great importance on the establishing ATMs as a significant, reliable, and more commonplace source of supply to

meet our future water demands. However, to date it has been a struggle to implement ATM projects. The State has supported the potential implementation of ATM projects trough grant programs and by developing a framework for approving pilot ATM projects outside of water court. Projects that take advantage of the State's support have originated independently with individual water providers or other water interests. It is possible that a task force or committee focused on implementing ATMs could be beneficial. The task force or committee could be appointed by the South Platte Basin Roundtable or by the Governor's office. The committee could help coordinate South Platte Basin activities and communications related to ATMs, help facilitate larger ATM projects, work with interested ditch companies to develop ATM programs, etc. An example similar to this (in function) is the Groundwater Technical Committee that the South Platte Basin Roundtable formed to evaluate high water table issues in the vicinity of Gilcrest and Sterling. The committee is currently evaluating and coordinating a potential pilot project in the Gilcrest area to change water management practices in ways that lower the water table. An ATM could be a part of this project. A committee like this focused on implementing ATMs on a larger scale in the South Platte Basin could be useful for identifying promising ATM projects, providing a forum for discussing ATMs, and could be an entity that could lead the development of ATM projects.

- The existing framework of statutes and water law allow ATMs to take place. However, amendments to statutes could potentially help facilitate implementation. The FLEX Project Team's prior report on the FLEX Water Market feasibility study (Colorado Corn Growers Association, et al., 2013) provided a number of ideas related to statutory changes that could be considered (see Section 12 of that report). These sorts of changes may not be universally supported by water users and stakeholders who participated in this and prior studies by the FLEX Project Team. However, they do provide a vehicle for discussion of ATM implementation barriers and ways to solve these issues. The recommendations in Section 12 in the aforementioned report are shown below for convenience to the reader.
  - **Incentives and Protections for Applicants and Mutual Ditch Companies**. Statutory measures designed to encourage ditch wide changes in use. Some combination of the following:
    - Delayed Volumetric Limits. Recognition that for ditch wide change in use cases, no volumetric limits on use of senior right apply until share is first used for changed uses.
    - SWSP Approval. Applicants who have completed a system wide analysis entitled to participate in temporary approval (SWSP) (CWCB Pilot) based upon the terms of the ditch wide decree. Such applications would be presumptively valid and would be accelerated for approval.
    - Water Trades. Applicants who have completed the process are entitled to trade water with other users in the same basin through an abbreviated SEO approval process.
    - Funding. System wide applicants are entitled to apply for grants from a newly established program to fund infrastructure allowing alternative transfers.
    - Docket preference. Preference on the court docket over other water court applications for speedy resolution.
    - Entitlement to groundwater diversions. Right to install "headgate wells" - groundwater diversions in immediate proximity to river -- delivering to the ditch under defined terms and conditions.
  - **Redefining Uses**.
    - Use Types. Create broad "use types" by statute to substitute for named end users – e.g. "M&I Use" or "ER Use." Changes in use would be approved for the use type, and

delivery at specific locations, allowing a variety of users (to be determined later) to take water at delivery point. Increasing the number of potential end uses and users for a changed senior water right would provide additional incentive for water users to engage in changes of use.

- FLEX Use. Create a new use definition entitled FLEX Use that permits application to all lawful uses, or a set of lawful uses defined in the statute. Delivery of consumptive use would be to specified locations, where multiple end users (TBD) could take delivery of FLEX supplies. It may be possible to tighten abandonment provisions for FLEX supplies to address concerns re: non-use and hoarding.

– **Consumptive Use Quantification**. Recognition that consumptive use could be quantified and return flow requirements established in the absence of any specific use. This would permit ditch companies and water users to change the use of a right without the need of contracted end users, which could come later.

Section 6

Limitations

This document was prepared solely for Ducks Unlimited and the Colorado Water Conservation Board in accordance with professional standards at the time the services were performed and in accordance with the contract between Ducks Unlimited and Brown and Caldwell dated August 20, 2013. This document is governed by the specific scope of work authorized by Ducks Unlimited; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Ducks Unlimited and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Further, Brown and Caldwell makes no warranties, express or implied, with respect to this document, except for those, if any, contained in the agreement pursuant to which the document was prepared.

All data, drawings, documents, or information contained this report have been prepared exclusively for the person or entity to whom it was addressed and may not be relied upon by any other person or entity without the prior written consent of Brown and Caldwell unless otherwise provided by the Agreement pursuant to which these services were provided.

Section 7

References

Bjornlund, Henning. 2002. Signs of maturity in Australian water markets. *New Zealand Property Journal*, July 2002, pp. 31-46.

Bjornlund, Henning and Peter Rossini. 2005. Fundamentals Determining Prices and Activities in the Market for Water Allocations. *Water Resources Development*. Vol. 21, No. 2, pp 355-369.

Brewer, Jedidiah, Robert Glennon, Alan Ker, and Gary Libecap. 2007. Water Markets in the West: Prices, Trading, and Contractual Forms. National Bureau of Economic Research Working Paper 13002. Cambridge, MA. Available at http://www.nber.org/papers/w13002.

Brown, Thomas C. 2006. Trends in water market activity and price in the western United States. *Water Resources Research*, Vol. 42.

Colby, B. G., Crandall, C. and Bush, D. 1993. Water right transactions: market values and price dispersion. *Water Resources Research*, 29, pp. 1565-1572.

Colorado Corn Growers Association, et al. "Completion Report: Development of Practical Alternative Agricultural Water Transfer Measures for Preservation of Colorado Irrigated Agriculture." Colorado Water Conservation Board Competitive Grant Program, May, 2011.

Colorado Corn Growers Association, et al. "FLEX Market Model Project Completion Report." Colorado Water Conservation Board Competitive Grant Program, June, 2013.

DiNatale Water Consultants, Inc. 2012. Water Partnerships. Available at: http://dinatalewater.com/pdf/water_partnerships.pdf

Payne, Matthew T. and Mark Griffin Smith. 2013. Price determination and efficiency in the market for water rights in New Mexico's Middle Rio Grande Basin. Water Resources Development. Vol. 29. No. 4., pp. 588-604.

Pritchett, James, Christopher Goemans, Jennifer Thorvaldson. 2012. Water as a Crop: Are South Platte Farmers Willing to Participate in Innovative Leasing Agreements?, *Colorado Water* Vol. 29, No. 1.

Thorvalsdon, Jennifer Lynn. 2010. Water Use in the Western U.S.: Irrigated Agriculture, Water Leases and Public Preferences. Available at http://dare.colostate.edu/grad/theses/ThorvaldsonJ2010.pdf.

Appendix A: Assessment of delivery capability for Shaw evaluation

Brown AND Caldwell

Technical Memorandum

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T: 303.239.5400
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Prepared for: FLEX Implementation Team

Project Title: FLEX Water Market – Education and Implementation Phase

BC Project No.: 144876

Subject: Evaluation of Water Delivery Issues for Shaw Implementation Project

Date: March 4, 2015

To: Greg Kernohan and Dan Gallen

From: Matt Lindburg and Danny Elsner

Copy to: Ryan Donovan and Andy Jones

Study Objective

The objective of this study is to evaluate conditions under which water could be delivered from Mike Shaw's lakes (the "Shaw lakes") on Boulder Creek to the Prairie Waters Project intake on the South Platte River. The locations of the Shaw lakes and the Prairie Waters Project intake are shown on Figure 1. Water released from the Shaw lakes would be conveyed down Boulder Creek and then St. Vrain Creek to its confluence with the South Platte River. From the confluence, the water would then be delivered by exchange to the Prairie Waters Project well field. The study examined the following questions

1. With regard to Boulder and St. Vrain Creeks:
    a. What are the typical flow conditions on Boulder and St. Vrain Creeks?
    b. Are there times of year when releases from the Shaw lakes could not physically be delivered to the confluence of St. Vrain Creek and the South Platte River?
    c. Are there diversions downstream of the Shaw lakes that do not have bypass structures and that dry up the stream?
2. With regard to the South Platte River:
    a. What are the major calling rights that would prevent exchange to the Prairie Waters well field?
    b. What times of year would the reliability of exchange be the best or worst?

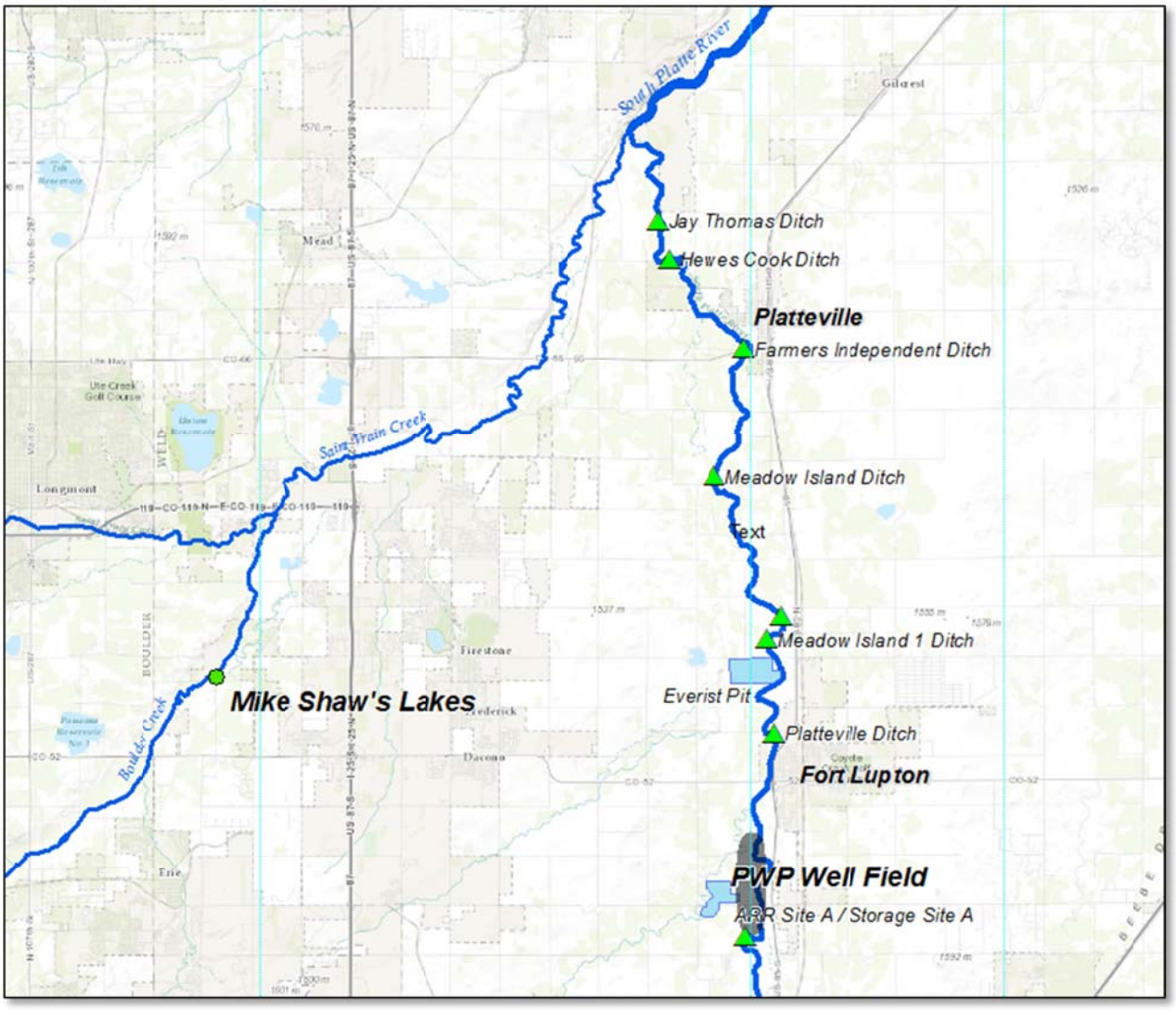


Figure 1. Overview Map

Summary of Analysis

Several factors can influence the success with which water could be released from the Shaw lakes, conveyed via Boulder and St. Vrain Creeks, and exchanged up the South Platte River to the intake of the Prairie Waters Project intake. Three primary concerns emerged as the analysis progressed:

- Boulder Creek periodically has very low flow, and conveyance losses could be large if release rates are small.
- The Rural Ditch can be a dry-up point on Boulder Creek, and it does not have a constructed bypass structure.
- Certain water rights on the South Platte River could prevent exchange from the mouth of the St. Vrain to the Prairie Waters Project well field during the summer months.

During much of the year, Boulder Creek flows average around 50 cfs. During spring runoff, average flows are higher. During August, average flows are lower at around 20 cfs. Figure 2 shows average daily flow rates of Boulder Creek at its mouth. The Shaw lakes are around 3 miles upstream of the mouth. In addition, the Rural Ditch headgate is located upstream of the Boulder Creek gage used for this analysis.

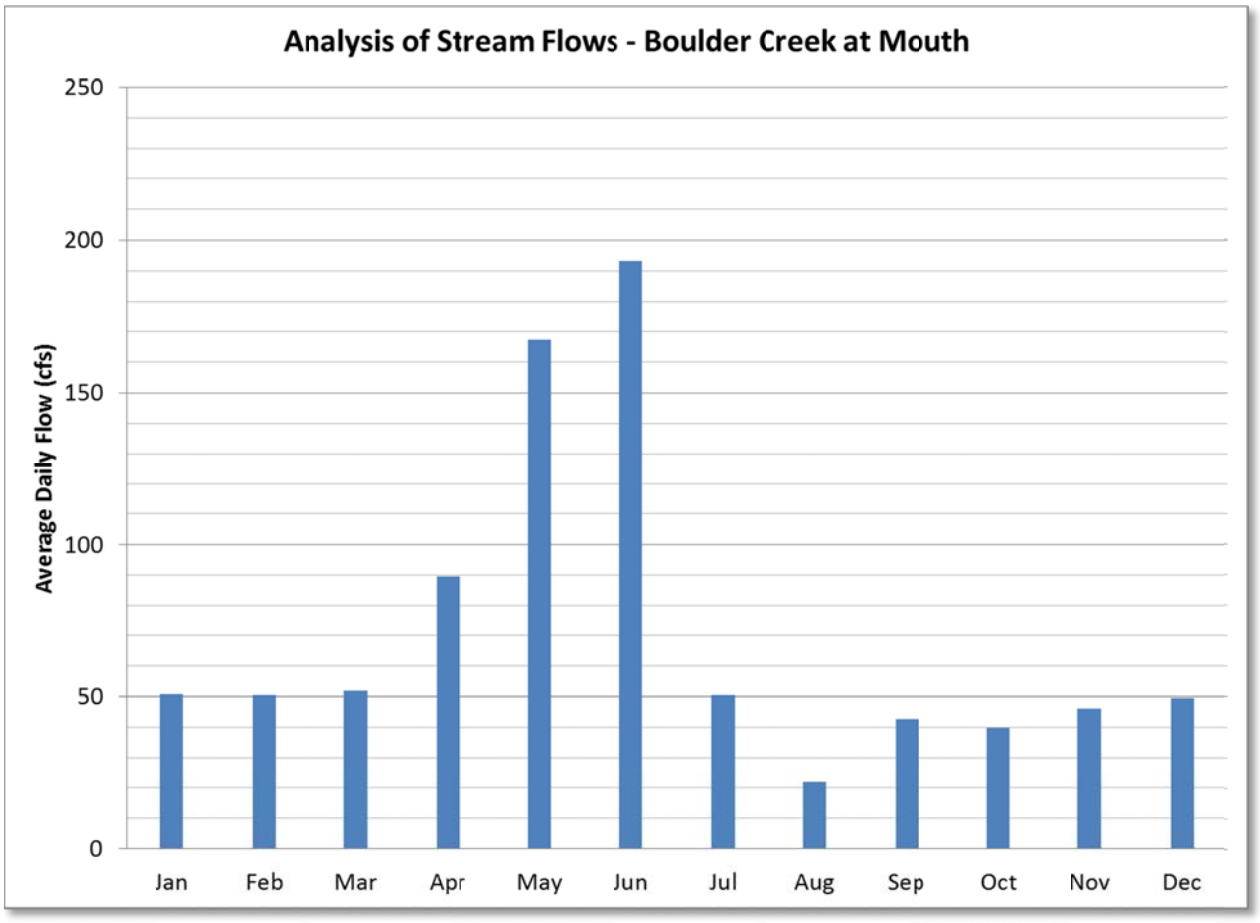


Figure 2. Monthly Average Daily Flow at the Mouth of Boulder Creek

On a daily basis, Boulder Creek near its mouth can have little to no flow (this occurs frequently during July, August, and September). During these times, a significant portion of releases from the Shaw lakes could potentially be lost to bank storage or evaporation if release rates are low.

Rural Ditch can be a dry-up point on Boulder Creek. It currently does not have a constructed bypass. Bypass is accomplished either via overflows at the headgate or via leakage through the diversion dam. The Division Engineer recommends that a bypass structure be constructed if releases from the Shaw lakes are conducted on a regular basis and need to be shepherded down Boulder Creek. Rural Ditch diversions occur primarily during the irrigation season, however, and delivery issues associated with dry-up of Boulder Creek would not be a concern during winter months and would be less of a concern in the spring and possibly the fall months.

Once water is delivered from Boulder Creek to St. Vrain Creek, it would probably be delivered to the South Platte River at typical loss rates of between 0.25% and 0.5% per mile.

Calling rights on the South Platte River can prevent exchange from the mouth of the St. Vrain to the Prairie Waters Project well field. The most significant of these is the Hewes Cook Ditch (aka Western Mutual). The

Hewes Cook Ditch frequently calls during the irrigation season, sometimes continuously for more than a month. When this ditch calls (or other ditches between the St. Vrain and Prairie Waters Project well field), water delivered to the mouth of the St. Vrain could not be exchanged upstream beyond the calling right. During spring and fall months, the Hewes Cook calls more infrequently, and during the winter, it does not call at all.

An analysis was conducted using daily Boulder Creek flows and daily assessments of exchange potential to evaluate times when both Boulder Creek flows are up (greater than 10 cfs at the mouth) and when calls are not being placed on the South Platte that would prevent exchange of releases from the Shaw lakes. The results of this analysis are shown below.

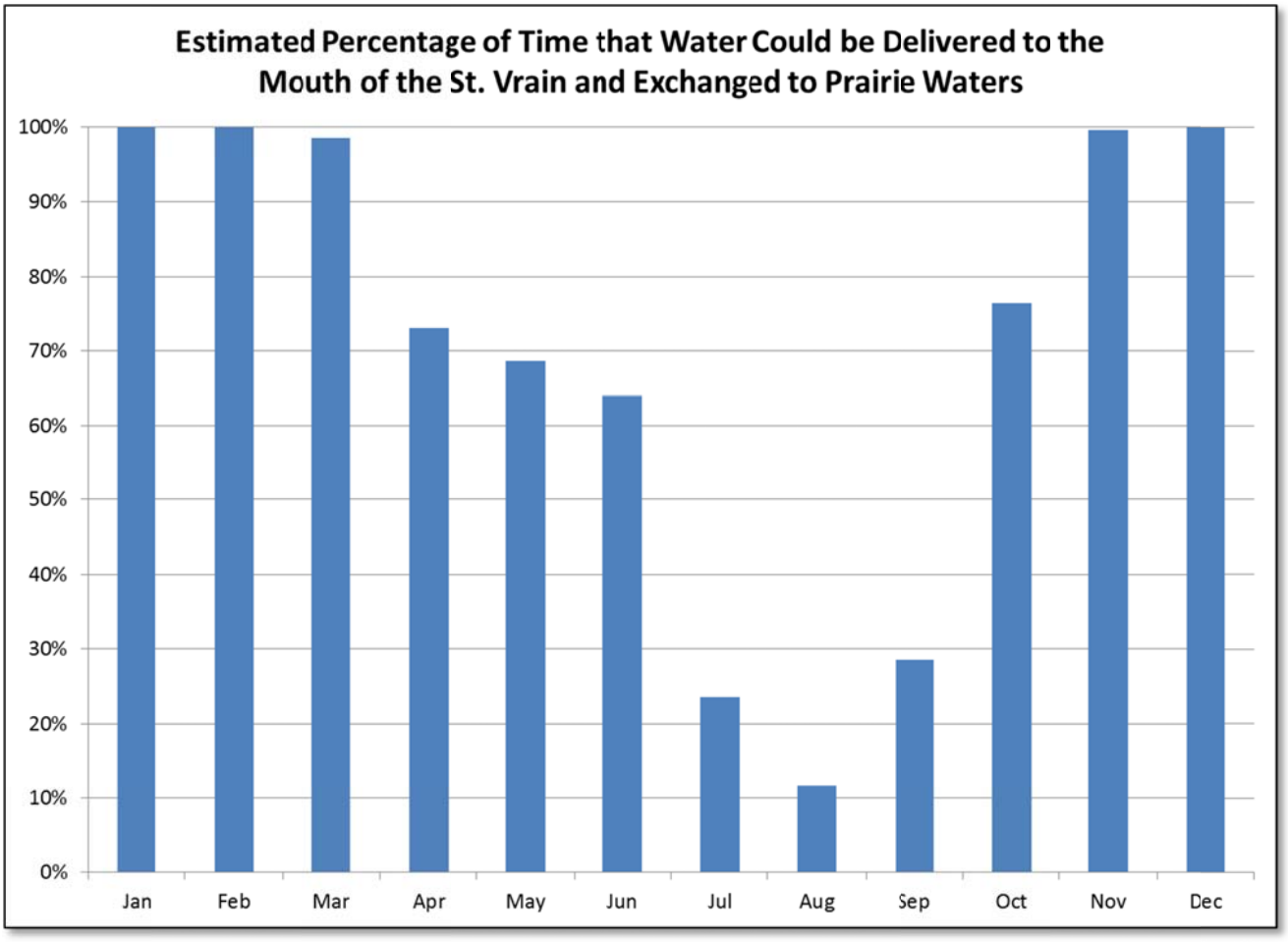


Figure 3. Summary of Delivery Analysis between the Shaw Lakes and the Prairie Waters Project Well Field

The following are answers to the questions posed at the beginning of this memo:

1a. Boulder Creek frequently experiences low flows, with flows less than 50 cfs seen a majority of the time between July and October.

1b. Though there are times throughout the year when Boulder Creek could be below 10 cfs, most of those time occur between April and October. July through September flows are frequently less than 10 cfs. During these low flow times, a significant portion of releases from the Shaw lakes could be lost to infiltration and evaporation if release rates are not sufficiently high.

1c. The Rural Ditch dries Boulder Creek and would need a bypass structure especially if releases from the Shaw lakes are conducted in the summer. However, other delivery impediments such as South Platte exchange capacity could prevent summer releases much of the time. If releases from the Shaw lakes are conducted during winter, spring, and fall, then difficulties associated with bypassing the Rural Ditch headgate will be lessened, if not eliminated.

2a. The Hewes Cook calling right has the highest potential for preventing exchange.

2b. The reliability of delivering water from the Shaw lakes to the Prairie Waters Project well field can be characterized by breaking up a typical year into three periods. The winter months (November to March) have high reliability. During the shoulder months of the irrigation season and times during high runoff and stream flow (April through June plus October), successful delivery can be achieved a majority of the time ranging from 64 to 76 percent on average. Delivery during the irrigation months (July through September) would only be successful between 12 to 28 percent of the time on average.

Appendix B: Harvey Economics report on composite water pricing index

Harvey Economics ♦ 469 South Cherry Street, Suite 100 ♦ Denver, Colorado 80246Harvey Economics ♦ 469 South Cherry Street, Suite 100 ♦ Denver, Colorado 80246

MEMORANDUM

TO: FLEX MARKET STUDY GROUP

FROM: ED HARVEY AND BEN NORMAN

DATE: NOVEMBER 20, 2014

RE: FLEX MARKET PRICE INDEX REPORT

This memo report fulfills a Harvey Economics (HE) contract with Ducks Unlimited, acting on behalf of the FLEX Market Implementation and Education Study. HE, working under the direction of FLEX Market Study Group, performed a study of water price indices applicable to the Lower South Platte Basin in Colorado which began in late May 2014. This Basin is assumed to include Weld, Larimer, Logan, Sedgwick and Washington Counties.

Introduction

The FLEX market concept was developed to facilitate alternative water transfers in the Lower South Platte Basin. This approach focuses on a reduction of legal constraints and other transaction costs. These constraints and costs, such as change of use cases and consumptive use calculations, discourage potential water transfers due to complexity, time requirements and cost. Through streamlining, the FLEX market concept improves the attractiveness of this alternative transfer mechanism. However, there are other hurdles facing alternative transfers and the FLEX market, one of which is agreement on price. The lessor and the lessee must agree on at least two aspects of price, the base price and the means to escalate price over the time period of the contract.

The determinants of base price which drive the parties to an agreement are a combination of various influences on price, such as farm profitability, and site-specific and deal-specific factors. The water right characteristics, the location of the diversion point, and the nature of the parties, i.e. irrigator, petroleum company, etc. are important considerations in reaching a mutually acceptable base price. The derivation of a model to predict base value would be a very challenging undertaking requiring significant time and financial resources, and so a different direction was chosen for this study.

Harvey Economics (HE) was tasked with developing an escalator for the price of the water for a longer-term FLEX Market agreement, which we assumed to be 10 years or more. After the initial base price is agreed upon between lessor and lessee, an agreement must be reached about how the base water price will be adjusted in future years. This escalator is almost as important in reaching a deal as the base price because either party may worry that they will be “short-changed” in a long-term deal, and therefore an agreement may not be reached. Over time, the prevailing price of water can and will change and the parties will want to track that change. An escalator is used to ensure that the price of water in the agreement tracks the future price of water so that neither side in the deal is

unfairly disadvantaged. To this end, escalators are built around the underlying factors that drive the price of the good, in this case, water.

HE used a multi-step approach to the task:

- Firstly, we reviewed other indices that have been used for water leases. HE considered various approaches to index construction and specific indices which might be applicable.
- Secondly, HE used the information gleaned from the indices that have been used, to establish criteria for developing an appropriate index
- Next, we selected a set of indices which might capture future price changes, in conformance with the selection criteria.
- Next, we developed a single composite index.
- Finally, HE tested the index against a measure of historic water price in the Lower South Platte Basin.

Data on indices used was obtained through searches and from participants in these leases. The data sources used for the escalator index are described in the individual component sections.

Review of other indices

HE reviewed actual on-going long-term water leases that are located in a geographically relevant area of the arid West, suitable for comparison in this study. HE identified eight transactions, five of which are located in Colorado. The choice of these transactions was neither scientifically chosen or exhaustive; HE was aware of these deals, believed they were relevant to this study, and could obtain the relevant details about them. The amount of water leased per transaction ranged from 30 AF to 100,000 AF. Of these, seven included an indexed, generalized price adjustment. The transaction with the shortest lease term, five years, did not include an adjustment. Most of the transactions rely on indices developed by Federal agencies, such as the Consumer Price Index and Producer Price Index which are products of the Bureau of Labor Statistics, or the GDP Implicit Price Deflator which is developed by the Bureau of Economic Analysis. A single, flat rate increase simply agreed upon by the parties was used in one instance. The Municipal Cost Index, a privately developed index, was used in one of the transaction; it is discussed later in this report. A summary of these leasing approaches is provided in Exhibit 1.

Exhibit 1.
Alternative Price Indexing Approaches from Selected Water Leases

Lease Parties	Date	Amount of Leased Water (AF)	Initial Price	Price Adjustment Index Approach	Duration of Agreement
Aurora - Avondale	2012	1,500 + 500	$500K + $200/AF	3% flat/yr. each year	Up to 10 years take or pay
Aurora - Rocky Mountain Energy Center	2007	3,000	$2.5M + $530/AF	Core CPI - all urban	10 years
Aurora - Pueblo West	2010	?	?	Municipal Cost Index	Long-term
PVIC - Well Aug Sub. of Central CO Water Conservancy District	2014	206 +/-	$309k + $1,500/AF w/adj.	None	5 years
Coachella Valley Water District - MWD of S. California	2001	100K	$125/AF adj.	PPI for Materials and Components	50 years
Palo Verde Irrigation District - MWD of S. California	2004	25,000 - 118,000 AF	$3,170 per acre enrolled Plus $602/fallowed acre in 2005	2.5% per year first 10 years, 5% maximum per year for the remainder of the program, subject to the CPI for urban LA/Riverside/Orange County	35 Years
Gilpin County - Dory Lake POA	1996	30 (storage)	$300/AF	GDP Implicit Price Deflator	Continuous
S. Nevada Water Authority - Church of LDS	2006	2,001	$20k + $130/AF	CPI Denver/Boulder CPI - Urban	20 years

Note: The amount of water or the base price of the Aurora-Pueblo West water lease was not publicly available.

Source: Individual water leases from the various parties, obtained in Summer 2014.

These water price indices appear to emphasize three things: (1) water price in each of the deals changes over time; (2) the escalator selected is a recognized and published measure of inflation; and (3) the overall approach seems to be based on simplicity or ease of use. HE appreciates the benefits of simplicity and the recognition that the base price must change over time. However, the use of an inflation measure by itself is believed to be unlikely to capture the various influences which impact water value to the lessor and lessee in an alternative water transfer. For example, crop prices or water availability do not typically follow inflation trends. Over a ten or twenty year period, water prices in a specific area like the Lower South Platte Basin are likely to higher or lower than a simple inflation rate, suggesting that one party or the other will have reaped an advantage with the broad-brush inflation index, albeit acknowledging that prices can change over time.

Based on this review of indices from other water leases, HE determined that none of them were suitable for the FLEX Market agreements in the Lower South Platte Basin. We then embarked on the development of a suitable index.

Price Drivers

HE began this process by conceptualizing the price drivers, i.e. the underlying factors that influence changes in the price of water in the Lower South Platte Basin. Factors such as the availability of water (drought versus wet year), crop prices and farm costs of production would appear to influence an irrigator's view of the value of his or her water. Since many farming operations rely on petroleum products and natural gas prices affect fertilizer costs, those would also be price drivers, intuitively. But besides agricultural producers, a proxy for cost should be developed for the other side of the FLEX market transaction to protect both parties. Costs driving municipalities should also be included as a price driver, since they are logical lessees. There are a host of different measures for capturing these price influences, so an important consideration was selecting specific measures that will meet the needs of a composite water price index for the Lower South Platte Basin.

HE identified individual selection criteria for picking data series or indices which should be considered in a composite index. Criteria for a good price driver include simplicity, intuitiveness and applicability to the local area. Simplicity refers to the ease of including the price driver data in the calculations of the final index; the more complicated the calculations, the less likely that the index will be updated properly. The intuitive criterion is important due to logic and expectations; an intuitive price driver is one that logically should be included whether it is simple or complex as it clearly ought to have an impact on prices. Additionally, if people understand a particular driver and expect it to be included in the index, its inclusion will increase the likelihood that the index will be understood and accepted. The matrix of selection criteria for the water price drivers and the specific drivers selected for this study is presented in Exhibit 2.

Exhibit 2.
Selection Criteria Matrix for Water Price Drivers in the Lower South Platte Basin

Price Drivers	Regularly Available Data	Reputable Source	Lessor or Lessee Side	Simplicity	Intuitiveness	Independent	Volatility	Applicibility to Local Area
Crop Prices								
Using the prices of wheat, forage, corn and millet from the USDA	✓	✓	Lessor	Moderate	High	✓	Moderate	High
Cost of Production								
Prices Paid by Farmers Index from the USDA	✓	✓	Lessor	High	High	✓	Moderate	Low
Farm Productivity								
Farm Productivity Index from the USDA	✓	✓	Lessor	High	High	✓	Moderate	Low
Municipal Costs								
Municipal Cost Index from American City and County Magazine	✓	✓	Lessee	High	High	✓	Low	Low
Price of Oil								
West Texas	✓	✓	Lessor	High	Moderate	✓	High	Moderate
Price of Natural Gas								
Henry Hub	✓	✓	Lessor	High	Moderate	✓	High	Moderate
Drought Indicator								
US Drought Monitor	✓	✓	Both	Moderate	Moderate	✓	High	High

The price drivers must be regularly available data from a reputable source for the foreseeable future. To adjust the future price of water in the agreements, the index must be updated with the future values of the price drivers. It is also important that the price drivers be "at arms' length" or independent from either of the parties in the agreement. For example, if water rates charged by a city that is a party to an agreement are set by the city council, the city could adjust their rates to influence the price of water in the agreement. Volatility is also a criterion that needs to be considered when selecting price drivers. A price driver that undergoes extreme price swings introduces more uncertainty and risk into the price index and into the lease price of water. Applicability to the local area is also important because the price drivers should represent changes in prices and costs that the parties actually face. However, because the data for the price driver comes from a different area does not mean that it is not applicable to the local area. For example, the price of oil is generally measured as West Texas Intermediate, but those prices impact the petroleum product prices throughout the entire USA. Finally, the price drivers should represent both sides of the agreement. Some of the drivers should represent the costs and prices faced by the lessor and some the costs and prices faced by the lessee.

Some of these criteria appear to be contradictory, for example, the more applicable to the local area a price driver is, the less regularly available it will be, in general. Similarly, the more simplistic a price driver is, the less likely it is to reflect the complexity of the situations facing the lessors and lessees. And, in some cases, an intuitive price driver may have no impact on the change in the price at all. A balance must be struck amongst all the criteria to develop the best combination of price drivers for the desired index.

Based on these criteria, HE selected some general price drivers. An index for producer revenue and costs, and for farm productivity is necessary to reflect the situation faced by a producer. An index of the changes in municipal costs would indicate the conditions faced by a municipality. Indices for the prices of energy and for drought conditions represent the circumstances faced by both parties. HE determined the best indices to match these general price drivers and applied the selection criteria to them.

Environmental and recreation benefits of the water do not typically drive water prices in a lease transaction because they are non-cash benefits and do not consumptively use the water. Even though environmental and recreational water users are active in water lease transactions, they are usually price followers, accepting or rejecting the market values established by other water use sectors.[1] Therefore, water price changes over time are not driven by these special users and so are not included here. The matrix shows that these seven price drivers meet most or all of the selection criteria. The next step is to determine how these price drivers influence changes in the price and to combine them into one composite index. A fuller description of each component price index is provided below.

[1] Anne Janicki, Colorado Water Trust. Personal communication, September, 2014.

Components of the Composite Index

The chosen price drivers are described in Exhibit 3. In all cases the data underlying the price drivers is publicly available and expected to remain so into the future.

Exhibit 3.
Selected Information about the Price Drivers for the Lower South Platte Basin

	Start Date	Latest Date	Source	Schedule of Publication	2000 Value	Latest Value
Crop Price Index	1999	2013	Various publications. USDA National Agricultural Statistical Service. http://www.nass.usda.gov/	Monthly	51.2	128.1
Prices Paid by Farmers Index	1964	2014	Agricultural Prices, USDA NASS. http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1002	Monthly	54.2	107.0
Farm Productivity Index	1948	2011	Agricultural Productivity in the US. USDA Economic Research Service. http://www.ers.usda.gov/data-products/agricultural-productivity-in-the-us.aspx#.U2ARmoFdUoc	Annual	96.5	100.8
Municipal Cost Index	1978	2014	Municipal Cost Index, American City and County Magazine. http://americancityandcounty.com/mciarchive/	Monthly	158.5	232.7
Oil Price Index	1984	2014	West Texas Intermediate Crude Oil Price. Index Mundi. http://www.indexmundi.com/commodities/?commodity=crude-oil-west-texas-intermediate&months=360	Monthly	31.9	103.9
Natural Gas Price Index	1991	2014	Henry Hub Natural Gas Price. Index Mundi. http://www.indexmundi.com/commodities/?commodity=natural-gas&months=360	Monthly	107.7	131.3
Drought Indicator	2000	2014	Weekly Reports, GIS Data Archive. United States Drought Monitor. http://droughtmonitor.unl.edu/MapsAndData/GISData.aspx	Weekly	146.7	35.2

The last two columns in the table above are index values for each price driver. Once the price drivers are established, they must be combined to create the price index. HE looked at the relationships between the various price drivers and the price of water in the Lower South Platte Basin. In some cases, there exists an inverse relationship between the price driver and the price of water, meaning that as the price driver increases, the price of water would decrease. A detailed description of each element of the composite index follows.

Crop Price Index

The price that farmers receive for their crops is an indicator of the amount of revenue that they will forego by leasing their water. As the crop price index increases, the price of water is expected to increase since farmers will require more money for water leasing to be more attractive than farming. HE's crop price index is composed of the crop prices for the four major crops grown (wheat, corn, forage and millet) in the Lower South Platte Basin. The index is calculated using the weighted (by value) average price for each of these four crops. Crop price data are obtained from USDA data for Colorado. These prices apply locally since percentage changes in price from year to year will be similar for producers regardless of location.

Prices Paid by Farmers Index

The prices paid by farmers index is developed by the USDA to represent the average costs of inputs purchased by farmers and ranchers to produce agricultural commodities. It includes everything from fuel to fertilizer to interest on farm loans. This index is an inverse price driver (meaning that as the price driver increases, the price of water would decrease) because as the costs to produce the commodities increase, the amount of money necessary to make a producer choose water leasing over farming decreases.

This index is mathematically inverted before inclusion in the composite index. To invert the index, one is divided by the index value, to change the direction of the index movement while maintaining the relative size of the movement. For example, if the index changed from 4 to 8, the inverse would change from one quarter to one eighth.

Farm Productivity Index

This index estimates the productivity growth in the US farm sector after accounting for all of the inputs to the production process. It is an indicator of how much more or less an American farmer can produce given the same amount of inputs, now, compared to some point in the past. As this index rises, farmers are able to produce more with a given set up inputs and hence will require more money to choose leasing over farming.

Municipal Cost Index

The Municipal Cost Index is produced by American City and County Magazine and is designed to show the effects of inflation on the cost of providing municipal services. As the cost of providing municipal services increases, an increasing price paid for water will represent the same percentage cost to municipalities. Farmers will expect them to pay more for water since that municipality is paying more for everything.

Oil Price Index

This index consists of the prices for West Texas Intermediate crude oil. As the price of oil moves up, the cost of farming will increase, lowering the amount required to entice a producer to lease. This index is mathematically inverted before being used in the composite index.

With hydraulic fracturing occurring in northeastern Colorado in 2014, the base price for water leases will certainly be affected in areas where it is active. Oil prices certainly affect exploration activity and serve as a proxy here. . However, “fracking” is relevant mainly in site-specific circumstances since the location of the need vs. the water supply drives the interest. Further, the level of fracking activity might not be a consistent, long term phenomenon. A measure of exploratory activity is not considered relevant by itself to this particular index.

Natural Gas Price Index

The natural gas price index is based on natural gas prices at the Henry Hub in Louisiana. Similarly to the oil price index, as the price of natural gas increases, the cost of farming will increase, lowering

the amount required to entice a producer to lease. Again the index is inverted as it is incorporated into the composite index.

The price indices for both oil and natural gas are included because they account for the majority of the energy use by agricultural producers. The oil is used as gas and diesel fuel for equipment and natural gas is the primary factor in the production of nitrogen fertilizer.

Drought Indicator

The drought indicator is based on data provided by the United States Drought Monitor Weekly Reports. Using these data, HE calculated an index based on the relative severity of the drought conditions as compared to the historical average drought conditions in the Lower South Platte Basin. HE aggregated the weekly drought reports to create an irrigation season average drought level for the Lower South Platte Basin for each year. The long-term average drought level was also calculated for the same area. Then, for each year, HE calculated the ratio of that year's drought level to the long-term drought level to determine if a particular year was wetter or dryer than average. The index was constructed using these relative drought levels. As water becomes more scarce compared to what locals are used to (a higher drought indicator), water will be more valuable and the price of water will rise.

Composite Index

To create the composite index, HE calculated the three-year moving average for all the component indices to smooth out any single year aberrations. All the indices were normalized to 2011 (the 2011 value was set as equal to 100) before they were incorporated into the composite index. HE then averaged three-year moving average for each component index with equal weighting to generate the final composite index. The final composite index and the underlying price-driver indices are presented in Exhibit 4.

Exhibit 4.
The Component Indices and Composite Index, Three-Year Moving Averages

Year	Crop Price Index	Prices Paid by Farmers Index	Farm Productivity Index	Municipal Cost Index	Oil Price Index	Natural Gas Price Index	Drought Indicator	Composite Index
2002	56.5	180.9	95.2	71.7	348.3	104.3	220.9	**154.0**
2003	60.4	176.9	95.4	73.1	345.7	97.6	259.9	**158.4**
2004	61.8	171.9	96.9	76.0	299.6	86.5	387.2	**168.6**
2005	61.7	163.3	98.6	79.9	234.5	61.8	257.8	**136.8**
2006	62.5	154.0	99.8	83.4	180.5	57.4	303.9	**134.5**
2007	68.1	144.1	100.1	86.5	147.9	53.9	201.3	**114.6**
2008	80.9	130.3	100.6	89.7	123.6	53.9	208.1	**112.4**
2009	95.8	121.3	101.1	91.9	127.0	67.9	80.5	**97.9**
2010	96.8	114.6	101.0	94.2	123.1	79.2	55.0	**94.8**
2011	96.7	110.4	100.7	96.2	124.6	97.5	45.5	**95.9**
2012	105.6	102.7	100.7	99.3	106.9	112.1	172.0	**114.2**
2013	128.1	96.2	101.5	101.7	99.3	117.6	289.8	**133.5**

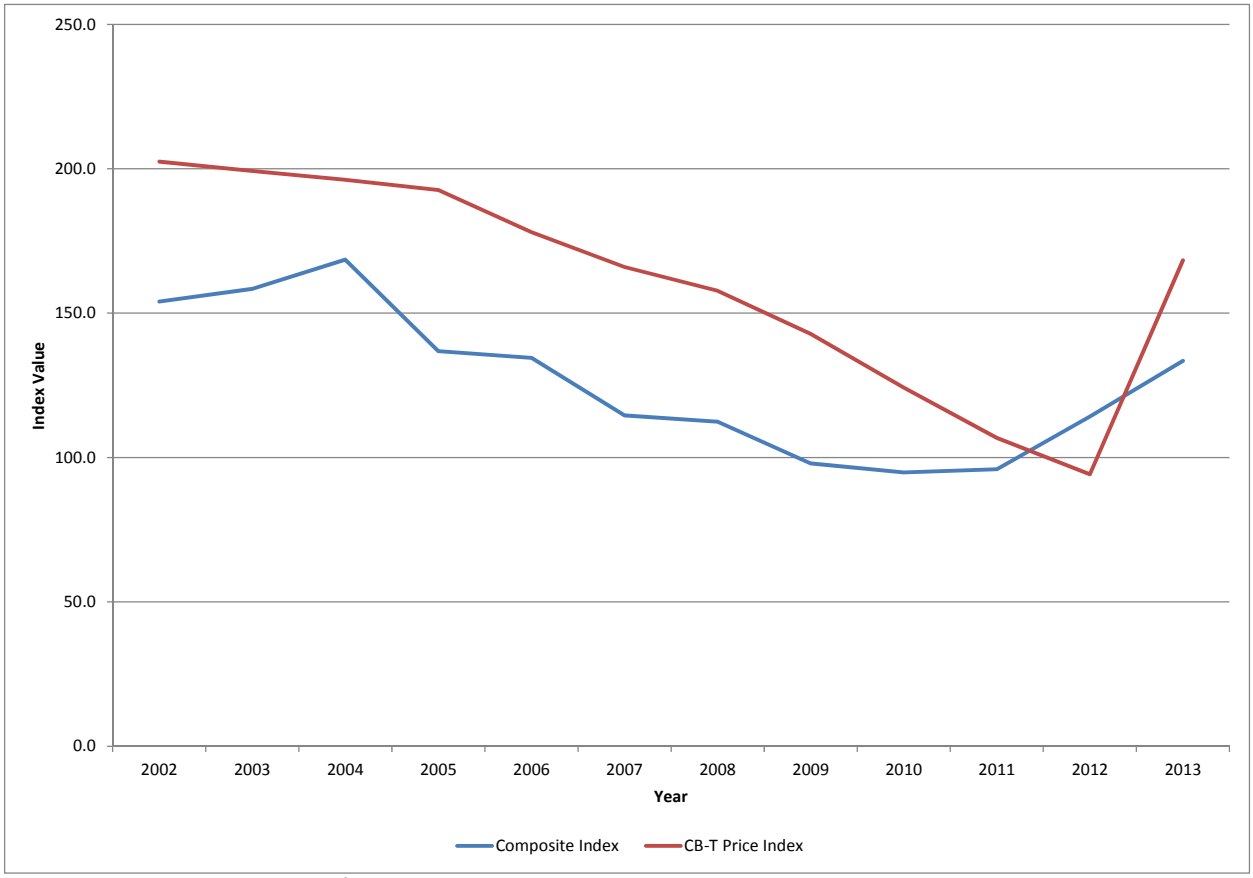
Note: Shaded areas are preliminary.

Source: Harvey Economics, 2014.

Evaluation of the Composite Index

HE compared the historical values of the Composite Index to the historical price of Colorado-Big Thompson (C-BT) unit sales, as shown in Exhibit 5.

Exhibit 5.
Composite Price Index and CB-T Share Price (2002 – 2013)



Source: Harvey Economics, 2014.

The C-BT unit price represents the sale value of a particular water resource in the Lower South Platte Basin. In this region, these are a reasonable gauge of the change in water values over time.[2] As can be seen in the chart, the composite index and the C-BT share price tend to move in the same direction. C-BT shares do not represent all the water sales or leases in the Lower South Platte Basin, but many potential lessors and lessees may anchor their price expectations to the C-BT share price. The CB-T share price is the most visible indicator of the price of water in the Lower South Platte Basin and is a reasonable proxy for changes in that price.

[2] C-BT is recognized as a particular water resource with special characteristics which are not the same as other water resources in the same region. Even so, the trends or changes in water value should be representative for the purposes of this report.

This comparison suggests that the Composite Index tracks the changes in C-BT unit prices reasonably well. Since the Composite Index is intended to represent all water resources and not just C-BT, it is understandable that precise tracking is not evident. This test validates the Composite Index as a useful price adjustment tool for FLEX Market transactions.

Composite Index Use and Application

This composite index was designed to track changes in the price of water in the Lower South Platte Basin. It should be used as a price adjuster for a long-term water leasing arrangement to ensure that the agreed upon lease price changes in accordance with the changes in the price of water. This is a risk reducing tool to ensure that changes in the price of water do not unduly harm either party in prospective water lease agreements.

There are two chief methods of incorporating a composite index into a water leasing agreement, annually and periodically. In the annual method, the lease price is adjusted annually using the index, the resulting price is paid that year and the price is adjusted again next year. In practice, the index values generally are only available for the previous year (e.g. the annual value for 2013 for many of the price drivers is not available until 2013 is over, and in many cases, some calculations are made) so the price adjustment is one year behind.

The second method of implementation, the periodical method, keeps the price at the same level for a period of time (e.g. 10 years), then at the end of that period, the price is adjusted once and then kept the same for the next period. This can cause a large change in the price between periods, but allows both sides to know the price they will be paying or receiving with certainty every year during the period.

There are advantages and disadvantages to each method. The annual method has smaller adjustments, but adjusts every year so next year's price is unknown, while the periodic method has larger adjustments, but price is fixed every year during the period. Which method is most suitable for a particular agreement is best left to the participants.

The volatility or size of the periodic change of the index might be an issue for some lessors or lessees. Limits on the change applied every ten years or each year, either a floor or a ceiling, can help mitigate this concern. On the other hand, if the water values are indeed changing that much, the parties might want to capture that.

This tool was designed for water leases of at least 10 years duration. Economic cycles, energy booms or busts or other short term phenomena will influence water price trends, for instance, but these short term price influences are not accounted for in this evaluation.

An example of how this index would be applied might be instructive. Assume a 10-year deal renewable was struck in 2002 at $200 per acre foot per year for an interruptible lease with a $1000 per acre foot payout in the years in which the water was taken. In 2003, these prices would be adjusted for the price changes. The factor of adjustment would be the ratio of composite index values in those respective years, or 158.0/154.0 or 1.028. This 2.8 percent increase result in an increase to $205.60 per acre foot and $1,028 per acre foot, respectively.

As it was designed for water in the Lower South Platte Basin, the composite index should not be used for other commodities or for water outside this area. While they may be similar, the price drivers for water in different locations will be distinctive to that particular location.

The Composite Index should also not be used to estimate base water values in an alternative water transfer. Although some of the factors might be relevant to such a determination, other factors might be far more relevant in a particular deal. In price setting, there are many avenues to the wrong value, but only one to the value which is acceptable to both lessor and lessee.

Additional factors, including individual circumstances on both the lessor and lessee side, can also have an impact on the future prices, but these types of drivers cannot be generalized across all leases. With all the specific circumstances surrounding any individual deal, no analysis can determine every factor that played a role in determining the agreed upon price. This analysis focused on the general factors that drive the price in the majority of deals.

Hence, interested parties should be particularly careful about mis-application of this Composite Index. Such a mistake will likely mislead the parties about price setting or price changes, thus unfairly disadvantaging one of the parties.

Conclusion

HE investigated the water market in the Lower South Platte Basin and found some general price drivers that underlie the price of water in the area. We then combined these price drivers into a composite index designed to track water prices in the Lower South Platte Basin. This composite index will be useful as an escalator for changes in water lease prices over time in to ensure that one side is not unfairly disadvantaged by changes in the price of water. The application of this tool must be judicious and only used in long term water leases for the Lower South Platte region. The main challenge when designing a composite index is to get the correct balance between accuracy and simplicity. The goal was to use the minimum number of components required to track the actual changes in price of water in the Lower South Platte Basin. We believe we have achieved that goal.

Appendix C: Handout from meeting with General Managers of Water Conservancy Districts

Section 1: Goals

Alternative transfer methods (ATM) offer a viable and important solution to the complex water resource challenges faced by Colorado's South Platte Basin. ATMs can bolster water supplies in areas or times of water shortages while minimizing the impacts on local communities.

The South Platte Basin Implementation Plan (SPBIP) explains that ATMs are "meant to 'minimize the impact on the local economy, provide other funding sources to the agricultural user, and optimize both the agricultural and nonagricultural benefits of the remaining lands'" (SPBIP, 2015). ATMs allow agricultural users to view their water rights as a "crop" and cities may view agricultural fields as "reservoirs" holding water supplies for times of shortages.

By allowing agricultural producers to manage their own water rights, ATMs effectively provide alternatives to the "buy and dry" approach where agricultural lands are dried up for the sale of water rights. While any transfer method has the potential to reduce the yield of irrigated acres, ATMs lessen the effect of the transfer in a localized area and can help sustain agriculture by preserving irrigated lands and offering revenue sources to agricultural users (SPBIP, 2015).

To research and develop methodologies for executing successful ATMs, Ducks Unlimited and Aurora Water received grant funding from the Colorado Water Conservation Board for the FLEX Water Market Education and Implementation project. The project aims to provide education, facilitation, and consultation for parties seeking to explore or implement the FLEX Market concept, evaluate index based pricing and explore large-scale implementation of the FLEX Market in Colorado's Front Range.

Ducks Unlimited, Aurora Water, LJCG and Brown and Caldwell scheduled a series of meetings with interested parties to accomplish the FLEX project goals. The first meeting, Water for Breakfast, focused on introducing and describing the FLEX Market and templates of contract documents and decree terms and conditions were provided to interested parties. Water for Breakfast also offered an opportunity for parties to voice concerns, describe their water needs and supplies, and their perceived role for FLEX Market supplies.

The second and third meetings will include representatives of the Lower, Central Colorado, and Northern Water Conservancy Districts (e.g. thought leaders in water supply issues). The second project meeting will focus on reviewing the goals set forth in the South Platte Basin Implementation Plan for water from ATM projects. Specifically, parties will review ATM methods, legal mechanisms, infrastructure needs and entities available for facilitation of ATMs. Parties will also develop concepts for potential regional ATM implementation and identify the most encouraging prospects. The final project meeting will focus on further developing promising ideas identified in the second team meeting, and identifying initial or critical action items needed to move towards further study and/or implementation of ATMs.

Section 2: Methods

Various methods exist for implementing alternative transfers. Rotational fallowing, reduced consumptive use (CU) cropping and regulated deficit irrigation are three primary methods for executing alternative transfers. The table below details the advantages, challenges, legal framework and implementation of these three primary ATMs.

Table 1. Alternative Transfer Methods

Method	Benefits	Challenges	Does the Required Legal Framework Currently Exist?	If so, what is required to implement the measure?	Has the measure been implemented successfully?	What legal changes could improve the process?
Rotational Fallowing	• Allows for agricultural land to remain in production while providing a transferrable water supply • Can be applied on a large or small scale	• Large degree of organization required to adequately assign responsibilities for program • Farmer distaste for not utilizing a valuable resource (irrigated land) during fallowing years	• Yes. §37-92-305, C.R.S. explicitly recognizes a fallowing program as a type of change in use subject to Water Court approval, and provides guidance to the Water Court regarding terms and conditions. • Approval of a fallowing program may also be available under §37-9-308(4), §37-9-308(5), §37-9-309, and § 37-60-115(8)	• Water Court Application for Change of Water Rights • Substitute Water Supply Plan ("SWSP") §308(4) • SWSP - §308(5) • Interruptible Water Supply Agreement (IWSA) §309 • Pilot Study § 37-60-115(8)	• Limited, primarily in Arkansas Basin	• Unclear
Reduced CU Cropping	• All of the benefits of deficit/limited irrigation are applicable to alternative cropping. • A rotation of lower water use crops may fit easily into an agricultural producer's operations.	• An alternative cropping transfer program would need to go through a Water Court proceeding and would face many of the same challenges as deficit irrigation. • Methods would need to be developed for verifying the amount of transferrable consumptive use. • The market for lower water use crops may not be as attractive as a higher water use crops. • Some lower water use crops may require different equipment or inputs than higher water use crops.	• Probably. §37-92-305 does not explicitly recognize reduced CU cropping or deficit irrigation, but these practices are likely to be considered a "change in use" authorized by the statute. • Approval of a reduced CU program may also be available under §37-9-308(4), §37-9-308(5) or §37-9-309	• Water Court Application for Change of Water Rights • Substitute Water Supply Plan "SWSP") §308(4) • SWSP - §308(5) • Interruptible Water Supply Agreement (IWSA) §309	• No, no known applications	• Clarification in Statute recognizing these practices explicitly could eliminate argument
Regulated Deficit Irrigation	• All of the irrigated land that an agricultural producer owns could still be farmed. • Farming input costs could be reduced.	• Agricultural producers may be concerned that crop yields would be less. • Unclear how the State Engineer would administer the transfer. There are efforts underway to quantify saved	• Probably. §37-92-305 does not explicitly recognize reduced CU cropping or deficit irrigation, but these practices are likely to be	• Water Court Application for Change of Water Rights • Substitute Water Supply Plan	• No, no known applications	• Clarification in Statute recognizing these practices explicitly could

Table 1. Alternative Transfer Methods						
Method	Benefits	Challenges	Does the Required Legal Framework Currently Exist?	If so, what is required to implement the measure?	Has the measure been implemented successfully?	What legal changes could improve the process?
	Demand for agricultural inputs is generally maintained (although potentially at a lower level), and impacts to the local economy from the transfer are minimized. • The farming business would gain more diversity of income while still raising crops. • Because the land continues to be irrigated, the land holds its value, which benefits the farmer and the county (assessed land values stay the same).	consumptive use accurately and in a way that could be used by the Department of Water Resources (DWR) for verification. Some of these efforts are being funded by the ATM grant program. • A transfer based on deficit or limited irrigation would need to go through Water Court. Because deficit irrigation transfers are not yet commonplace, it is possible that the initial Water Court cases dealing with deficit or limited irrigation will have many issues to resolve. • Additional costs may be incurred by agricultural producers to purchase equipment or other technologies to monitor or quantify transferrable consumptive use and to demonstrate that historical return flows are being provided in the correct timing and amount. • It may be necessary to cooperate with several other agricultural producers to accumulate enough transferrable water that it would be attractive to a municipality or industry. • Data collection to accurately identify the saved volume of CU.	considered a "change in use" authorized by the statute. • Approval of an intentional deficit irrigation program may also be available under §37-9-308(4), §37-9-308(5) or §37-9-309	"SWSP") §308(4) • SWSP - §308(5) • Interruptible Water Supply Agreement (IWSA) §309		eliminate argument

Generally speaking, at this time many challenges face any ATM methodology. Agricultural producers have concerns regarding the costs, operation and accounting involved with ATMs and reservations regarding the impact these practices may have on the value of their water rights. End users' concerns generally revolve around the reliability of both the consistency and volume of ATM water. Additionally, there seems to be a disparity in the desired lease rate and what an end user is willing to pay.

Section 3: Legal

Various legal mechanisms will be necessary to execute alternative water transfers. The table below details the authorization required, term, associated restrictions, notice requirements and time and costs associated with each legal mechanism.

Table 2. Legal Mechanisms for Facilitating ATMs

	Water Court Application	Substitute Water Supply Plan ("SWSP") - § 308(4)	SWSP -§ 308(5)	Interruptible Water Supply Agreement ("IWSA") - § 309	Pilot Study - § 37-60-115(8)
Authorization	Water Court	State Engineer	State Engineer	State Engineer	CWCB, with consultation from State Engineer
Term	Potential for perpetuity, until future change case	Approval of SWSP lasts for one year, applicant must reapply every subsequent year (after three years, must demonstrate that the delay in not obtaining water court decree is justifiable)	Approval of SWSP lasts for one year, applicant must reapply every subsequent year, up to a max of 5 years	10 years, with ability to renew for up to two additional 10-year periods (30 years total)	Up to 10 years
Restrictions	Use limited by the terms of the Decree; stipulations with objectors, and FLEX agreement	Must have a pending water court application to apply for a SWSP under this section	No pending water court application is necessary to apply for a 308(5) SWSP, but the plan (and any depletions) must not extend past 5 years	Option cannot be exercised more than 3x in a ten year period	Requires fallowing and leasing for temporary municipal use; cannot fallow the same land more than 3 years in a 10 year period; cannot fallow more than 30% of a single irrigated farm, cannot also be in a SWSP or IWSA
Notice Requirement; Opportunity for Objectors to Comment	Resume notice required; objectors have until the last day of the second month following the month in which application is filed	Applicant must give notice to all opposers in pending change case; opposers have 30 days to provide comments	Applicant must give notice to parties subscribed to SWSP notification list; parties have 35 days to provide comments	Applicant must give notice to parties subscribed to SWSP notification list; parties have 35 days to provide comments; application must include detailed engineering report	Applicant shall give notice to SWSP subscribers; conference with applicant, State Engineer and CWCB
Time and Cost	Can take several years from application to decree, expensive	Designed to be more flexible than water court application; generally approval in a few months, costs vary	Designed to be more flexible than water court application; generally approval in a few months, costs vary	Designed to be more flexible than water court application; generally approval in a few months, costs vary	Board may provide financial assistance; CWCB shall afford "reasonable opportunity for comment"

Section 4: Infrastructure

Appropriate and adequate infrastructure will be necessary to ensure the success of ATMs in the South Platte Basin. The tables below detail planned infrastructure projects in Water Districts 1, 2 and 64 that could facilitate ATMs within the Basin.

Table 3. Planned/Existing Infrastructure to Facilitate ATMs in the South Platte Basin

Water District	Planned/Existing Infrastructure Project
District 1	Groves pumping station and pipeline
	Ducks Unlimited recharge wetlands
	Parker WSD future facilities
	United WSD existing and planned facilities
	CCWCD Orchard recharge project
	OWW recharge
	PSCO pipeline near Fort Morgan
	NISP facilities
	Barnett Reservoir
District 2	PVIC-Milton Pump Station
	PVIC-Recharge Facilities
	PVIC-Augmentation Station
	Prairie Waters Project
	United WSD existing and planned facilities
	Thornton's Northern Pipeline project
District 64	Ovid Reservoir
	Parker WSD future facilities
	Existing recharge facilities such as Tamarack or Heyborne

Section 5: Entities

Various regulating entities exist for facilitating ATMs. The table below lists the powers and advantages as well as the challenges of the primary regulating entities.

Table 4. Entity Types

Entity Type	Statutory Section	Formation	Purpose	Requirements and Management	General Powers of Authority	Financing	Boundaries	Advantages	Challenges
Water Authority	§ 29-1-204.2	• Formed by contract between combination of municipalities, special districts, or other political subdivisions • Entity becomes a separate municipal subdivision	• Development of water resources, systems, or facilities for the benefit of the inhabitants of such contracting parties	• Required Board of Directors • Cannot terminate the entity so long as entity has outstanding debt	• Develop water resources for benefit of inhabitants • Enter contracts • Construct, acquire, manage, maintain water systems, facilities, works improvements or drainage facilities to acquire, hold, lease real property (as lessor or lessee) • Condemn property for right-of-way • Incur debts and liabilities • Fix fees for functions and services • Permit other municipalities or special districts to enter the Contract • Rehabilitate surface property affected by the constructed of water pipelines through plant cover, soil stability, and other measures	• Debt of the authority is not the debt of the forming municipalities • Such debt does not constitute an indebtedness under the Colorado constitution		• Maximize the efficacy of existing infrastructure • Utilizing the knowledge of existing water professionals for the operation and accounting of ATM water	• Cooperation between competing interests
Water Enterprise	§ 37-45-101 et seq.	• Any "district" (any state or local governmental entity that has authority to conduct water activities) with bonding authority may establish water activity enterprises	• Provide a forum through which ATMs will be administered in the South Platte Basin.	• Enterprise must receive less than 10% of its annual revenues from in grants from all state and local governments combined. • Each water enterprise shall be wholly owned by a single district and shall not be combined with any other district • The governing body of the district is the governing body of the enterprise	• Provide secure water supply for domestic use • Provide water for agricultural use • Supply water for industrial and fish and wildlife purposes • Treat, reclaim, conserve, recharge, augment, exchange and reuse water supplies • Provide wholesale services and wastewater services	• Authority to issue its own revenue bonds • Lands included in the district are subject to the same mill levy and other taxes as other lands in the district, exclusive of section 20(4) of article X of the constitution (TABOR)		• Can collect revenue for services rendered	• Public perception of governmental authority intervening with a personal property wright
Conservancy District	§ 37-45-101 et seq.	• Formed by petitions and district court approval	• Develop, use and conserve the water resources of the state to benefit all industries of the state and the public	• Numerous requirements regarding management including management by a Board of Directors	• Preventing floods • Regulate stream channels • Regulate flow of streams • Protect property from inundation • Conservation, development, and utilization of water for agricultural, municipal, and industrial uses thereof • Can create sub-districts with same process for formation and powers as parent	• Authority to levy several classes of taxes as well as special assessments	• TABOR Limited		

Table 4. Entity Types

Entity Type	Statutory Section	Formation	Purpose	Requirements and Management	General Powers of Authority	Financing	Boundaries	Advantages	Challenges
Cooperatives (Limited Cooperative Association)	§ 7-58-101 et seq.	• Formed by organizers filing Articles of Organization	• May be formed for "any lawful purpose, whether or not for profit." • Board of directors may authorize the issuance of shares for member/ corporation benefits • Individual irrigators may decide to participate (or not) in leases corporation negotiates • Voting power can be made proportional to the value of water rights made available	• Managed by Board of directors	• Broad powers to do business- buy, sell, own, lease, borrow, contract, sue, be sued	• Financed with member contributions and revenue from operations • May borrow money		• Flexibility • Private – not a governmental or quasi-governmental entity	• Restricts the voting power of its members to one vote each • Competition and cooperation between competing interests
For-Profit Corporations	§ 7-101-101 et seq.	• Formed by organizers filing Articles of Incorporation	• "Any lawful business"	• Managed by Board of directors	• Broad powers to do business- buy, sell, own, lease, borrow, contract, sue, be sued	• Financed with shareholder contributions and revenue from operations • May borrow money		• Flexibility • Private – not a governmental or quasi-governmental entity	• Subject to income taxes • For profit entity
Water Conservation Districts		• Created by the General Assembly with enacting legislation • See, eg. § 37-50-101 et seq., Republican River Water Conservation District	• Defined by the general assembly	• Defined by the General Assembly, generally, numerous requirements regarding management including management by a Board of Directors	• Defined by the general assembly	• Defined by the general assembly, generally includes power to levy taxes		• Governmental entity	• Governmental entity

COLORADO

Colorado Water Conservation Board

Department of Natural Resources

Brown AND Caldwell

DUCKS UNLIMITED

AURORA WATER

LJCG