Colorado's Water Supply Future

Colorado Water Conservation Board

Alternative Agricultural Water Transfer Methods Grant Program Summary

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Alternative Agricultural Water Transfer Methods Grant Program Summary

As Colorado's population continues to grow in the coming decades, it is likely that increased transfers of agricultural water rights will occur in order to satisfy increased municipal and industrial (M&I) water demands. The Colorado Water Conservation Board (CWCB), Interbasin Compact Committee (IBCC), and the Colorado Water Congress have indicated their support of alternatives to traditional transfers resulting in permanent dry-up in order to minimize the negative socioeconomic impacts to rural communities that so often result from such transfers.

One of the outcomes of the Statewide Water Supply Initiative (SWSI) 2 study was the recognition that the State of Colorado might be able to provide incentives for M&I providers to consider alternative methods for their water supply options. In response, the Legislature passed Senate Bill 07-122, which authorized the CWCB to develop a grant program to facilitate the development and implementation of alternative agricultural water transfer methods (ATMs).

Since its inception in 2007, the CWCB's Alternative Agricultural Water Transfer Methods Grant Program has awarded $1.5 million to various water providers, ditch companies, and university groups for the funding of six unique projects; five of which have been underway during 2009–2010. As illustrated in SWSI 2, rotational fallowing, Interruptible Service Agreements (ISAs), water banks, purchase and leasebacks, deficit irrigation, and changing crop type are the kinds of options that are available as alternatives to permanent agricultural transfers.

With the exception of purchase and leasebacks and some limited occurrences of short-term leasing, these ATMs are just beginning to be explored as viable options for meeting M&I water demands in Colorado. While promising, there are technical, legal and institutional, financial, and other issues associated with ATMs. Through the ATM Grant Program, CWCB and others are currently exploring ways to address these issues utilizing incentives to gain greater awareness, interest, and participation from agricultural water users and municipalities with alternative agricultural water transfers.

The objectives of this memorandum are to further the understanding of the feasibility of implementing ATMs in Colorado by:

1. Providing an overview of ATM concepts;

2. Providing a summary of the ATM projects funded by grants awarded by CWCB;

3. Providing an overview of the current state of agricultural transfers in the South Platte Basin and the Arkansas Basin and assessing the viability of future transfers in various regions of those basins; and

4. Identifying and summarizing barriers to successful implementation of ATMs and summarizing the ways in which grant-funded ATM projects have made progress toward finding solutions to the identified barriers to implementation.

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Acronyms

ACWWA	Arapahoe County Water and Wastewater Authority
AF	acre-feet
AFY	acre-feet per year
ATMs	alternative agricultural water transfer methods
BOR	U.S. Bureau of Reclamation
Burlington	Burlington Ditch, Reservoir, and Land Company
CAWA	Colorado Agricultural Water Alliance
CCGA	Colorado Corn Growers Association
cfs	cubic feet per second
CSU	Colorado State University
CU	consumptive use
CWCB	Colorado Water Conservation Board
DOW	Division of Wildlife
DSS	Decision Support System
DWR	Division of Water Resources
ECCV	East Cherry Creek Valley Water and Sanitation District
ET	evapotranspiration
FRICO	Farmers Reservoir & Irrigation Company
GIS	geographic information system
Henrylyn	Henrylyn Irrigation District
HI	Hydrologic-Institutional
IBCC	Interbasin Compact Committee
ISAs	Interruptible Supply Agreements
LAVWCD	Lower Arkansas Valley Water Conservancy District
LSPIRDP	Lower South Platte Irrigation Research and Demonstration Project
M&I	municipal and industrial
mg/L	milligrams per liter
MWD	Metropolitan Water District
NPIC	North Poudre Irrigation Company
PBWW	Pueblo Board of Water Works
ppm	parts per million
PVID	Palo Verde Irrigation District
PWP	Prairie Waters Project
PWSD	Parker Water & Sanitation District
RICD	recreational in-channel diversion

RO	reverse osmosis
SDS	Southern Delivery System
SEO	State Engineer's Office
SMWSA	South Metro Water Supply Authority
SPDSS	South Platte Decision Support System
STAG	State and Tribal Assistance Grant
SWSI	Statewide Water Supply Initiative
TDS	total dissolved solids
USGS	U.S. Geological Survey
UWSD	United Water and Sanitation District
WISE	Water Infrastructure and Supply Efficiency
WSSC	Water Supply and Storage Company

Section 1 – Overview

1.1 Introduction

In a recent Colorado Water Conservation Board (CWCB) report, Colorado's population is projected to increase by nearly 80 percent, from about 5.1 million people in 2008 to 9.1 million in 2050, under medium economic growth conditions (CWCB 2011a). The majority of these new people will reside on the Front Range. By 2050, the South Platte/Metro Basin alone is forecasted to grow from 3.5 million people (in 2008) to slightly more than 6 million, again with medium economic growth. To continue to meet the demands of this growing population, Colorado will need approximately 633,000 acre-feet (AF) of additional water statewide for municipal and industrial (M&I) needs by 2050 (CWCB 2011a). Most of this demand will be met through three main water supply strategies: conservation, agricultural transfers, and new water supply development.

As part of the Statewide Water Supply Initiative (SWSI), CWCB identified water providers' specific projects and processes that are planned for implementation to meet future water demands. Based on updated analyses completed in 2010, CWCB found that if 100 percent successful, these projects could yield approximately 490,000 AF under the medium growth scenario (CWCB 2011b). Even if completely successful, there still remains a water supply gap. Over the past several years, many of these water projects have been proceeding through the federal permitting process with no guarantee of their success. If these projects and others that are premised on the development of new water supplies are not built, future water demand will have to be met mostly through a combination of permanent agricultural transfers and conservation. While conservation will occur, a larger portion of future water supply needs would likely be met through agricultural transfers.

Due to the likelihood that increased transfers of agricultural water rights will occur in the coming decades in order to satisfy M&I water demands, there is a desire to identify alternatives to traditional transfers resulting in permanent dry-up in order to minimize the negative socioeconomic impacts to rural communities that so often result from such transfers. The CWCB, Interbasin Compact Committee (IBCC), and the Colorado Water Congress have indicated their support for the facilitation of alternative agricultural transfers that do not result in permanent dry-up. It is important to note that the current water court transfer process is heavily weighted towards dry-up of irrigated lands in order to transfer the historical consumptive use (CU) water.

The objectives of this memorandum are to further the understanding of the feasibility of implementing alternative agricultural water transfer methods (ATMs) in Colorado by:

1. Providing an overview of ATM concepts (Section 2.1);

2. Providing a summary of the ATM projects funded by grants awarded by CWCB (Section 2.2);

3. Providing an overview of the current state of agricultural transfers in the South Platte Basin (Section 3.1) and the Arkansas Basin (Section 3.2) and assessing the viability of future transfers in various regions of those basins; and

4. Identifying and summarizing barriers to successful implementation of ATMs and summarizing the ways in which grant-funded ATM projects have made progress toward finding solutions to the identified barriers to implementation (Section 4).

As described previously, Colorado is expected to experience significant increases in population and associated M&I demand by the year 2050, in particular along the Front Range in the South Platte and Arkansas Basins. Various statewide planning documents have reached the conclusion that agricultural transfers will likely be a component in any statewide or regional (basin-specific) portfolio of water supply solutions. These factors emphasize the need to develop ATMs. The following sections describe several ATM concepts presently being studied in Colorado.

Section 2 – Alternative Agricultural Transfer Methods and Grant Projects

2.1 Alternative Agricultural Transfer Methods

Traditional agricultural water transfers have been and will continue to be an important part of water providers' plans for meeting their future water demand as long as there are farmers and ranchers willing to sell their water rights. Realizing this, there is a concern that some water transfers may have negative third-party effects such as impacts to the agricultural supply, service, and processing sectors that are fundamental to agriculture-based rural economies. It is also understood that there are other factors contributing to the reduction of farming and ranching in Colorado. For example, CWCB (2011c), in its assessment of 2050 irrigated acres, took into account the following factors in addition to agricultural to municipal water transfers:

- Urbanization of existing irrigated lands
- Water management decisions
- Demographic factors
- Biofuels production
- Climate change
- Farm programs
- Subdivision of agricultural lands and lifestyle farms
- Yield and productivity
- Open space and conservation easements
- Economics of agriculture

To better understand and to help address this trend, the CWCB investigated alternatives to traditional purchase and transfer of water from irrigated lands to new uses in the *Statewide Water Supply Initiative—Phase 2 Report* (CWCB 2007). This report examined trends in irrigated acreage, dynamics leading to agricultural transfers, economic and social consideration, and a discussion of five alternative methods to permanent transfers of water rights for M&I purposes. As the SWSI 2 report states, "The goal of the alternative transfer is 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." Listed below are the ATMs identified and discussed in the report:

- Interruptible Supply Agreements (ISAs)
- Rotational fallowing (short- and long-term)
- Water banks
- Reduced crop CU
- Purchase and lease-back

While some of these alternative methods have been implemented in Colorado to a limited extent, traditional water transfers continue to dominate the market in Colorado. As stated in the SWSI 2 report (CWCB 2007), "It is not the intent to interfere with or criticize traditional transfers of agricultural waters since these are a property right and...are needed to meet the [2050] M&I water needs. It is the intent, however, to illustrate how and when alternatives to traditional agricultural transfers may present benefits to not only the parties to the transfer, but other third party beneficiaries."

Furthermore, "[w]hile any transfer method is likely to reduce agricultural production (yield or number of irrigated acres), exploration and implementation of alternative transfer methods may lessen the effect of the transfer within a defined geographic location and may help sustain agriculture by providing additional revenue sources to the agricultural user" (CWCB 2007). Clearly, as municipal water demands continue to increase, irrigators will continue to see an increased interest in their water rights from cities. Moreover, as the demand for a limited amount of water increases, it will be necessary for all water users to optimize the use of a limited resource.

Historically, cities have often relied upon temporary watering restrictions on residential landscaping to reduce demands and provide for emergency reserves in case of continued drought. Through the implementation of ATMs, the irrigators may begin to view their water rights as another "crop" to be marketed and cities may begin to view the cornfields as "reservoirs" holding much-needed water supplies in times of shortage. While possible, most municipal and domestic water providers will probably not be interested in selling taps for homes that rely on a 20-, 30-, or 40-year water lease agreement that could potentially not be renewed (recognizing that permanence may be achieved through methods such as ISAs, transferring a portion of a water right, etc.). Even with the potential for renewal of long-term

lease arrangements, water providers have concerns regarding the uncertainty of the long-term lease costs. More likely, alternative methods that are temporary in nature such as rotational fallowing and water banking may be best applied to drought mitigation, drought recovery, an emergency supply, and long-term conjunctive use (i.e., the integrated management of surface water and groundwater supplies). Possibly most important, revenues generated through the various agreements between irrigators and cities can provide much needed capital to invest back into the farm or irrigation systems. Some of the key benefits derived from ATMs include:

- Relationships between irrigators and municipalities—water sharing
- Provides irrigators with needed capital to upgrade farm or irrigation system equipment or infrastructure
- Provides irrigators with a temporary increased income that may be used for payment of debts or increased disposable income
- Helps to optimize the use of a limited water resource
- Sustain rural agricultural communities and economies
- Preserve productive agriculture open spaces
- Provide for greater food security
- Provides wildlife habitat

Descriptions of these ATM concepts identified above, adapted from the SWSI 2 report and other documents, are presented in the following sections.

2.1.1 Interruptible Supply Agreements

ISAs may consist of temporary, long-term, or permanent arrangements in which agricultural water is transferred for other purposes in other locations while irrigation is temporarily suspended. Exercising an ISA is typically triggered on an as-needed basis and could include dry-year needs, drought recovery needs, and even wet-year needs. An ISA would include limitations as to the frequency in which the supply could be exercised throughout the term of the agreement. Current law (Section 37-75-309 CRS) allows the State Engineer to administratively approve temporary ISAs as long as they are not triggered more than three times in a 10-year period. A longer term ISA that could involve more frequent interruption of the agricultural use would require water court approval. The terms of such an ISA are within the parties' discretion, as is the schedule of payments that might reflect frequency or repetition of exercise of the option.

A Colorado example of this type of ATM is the ISA between the City of Aurora and the Rocky Ford Highline Canal, which was first carried out in 2004 and again in 2005 as a Substitute Water Supply Plan. To effectuate the ISA two contracts were implemented. First, a contact with the ditch company providing for the company's support of the lease as well as improvements to the facilities of the company for the benefit of both lessors and non-leasing farmers. Second, individual contracts with each leasing farmer were developed. In 2004, the lease water was used for drought recovery of Aurora's water supply, and in 2005 the lease was shared with Colorado Springs Utilities to supplement both cities' water supply recoveries. In 2008, Aurora and the Rocky Ford High Line Canal Company executed a 10-year renewable leasing agreement by which Aurora will make payments to the canal company in lease and non-lease years and the canal company will support future leasing to Aurora.

2.1.2 Rotational Fallowing

The rotational fallowing concept consists of a type of interruptible agricultural transfer arrangement involving several agricultural parties and one or more M&I, environmental, or recreational users. For example, as a means to provide additional water to meet new demands or to replace the existing yield of nonrenewable groundwater supplies (a potential future need considered for the South Metro and northern El Paso County areas in the 2010 gap analysis update), each agricultural participant would agree not to irrigate a certain percentage of their land for certain years or each year of the term of the agreement that could relate to the number of agricultural users or the irrigated area participating in the rotational fallowing program. Rotational fallowing arrangements are probably best suited for drought and drought recovery, as well as conjunctive use with groundwater to firm existing M&I supplies, but might also be used to provide a base water supply for new/replacement demands. Most likely, if the yield from a rotational fallowing arrangement was used to provide water to a new and growing demand, a long-term, renewable, or even a perpetual agreement would be essential.

At this time, examples of successful rotational fallowing programs include a long-term agreement between the Metropolitan Water District (MWD) and the Palo Verde Irrigation District (PVID) in southern California, in which PVID growers fallow between 7 and 35 percent of their land annually with multiple growing seasons, yielding 25,000 AF to 111,000 AF to MWD each year (CWCB 2007). In Colorado, engineering and economic studies have been underway since 2006 to facilitate the development of the Super Ditch Company rotational land fallowing-water leasing program in the Lower Arkansas Valley. This program is discussed in greater detail later in this report.

2.1.3 Water Banks

In addition to interruptible supply contracts and rotational land fallowing (i.e., rotational crop management contracts), a water bank was authorized by the Colorado legislature in 2003. Water banks have had varying degrees of success in the Western U.S. and have been applied to stored surface water, direct delivery water (i.e., run-of-the-river), and stored groundwater. In

general, water banks act as a legal mechanism to transfer water from water rights owners that may not need water in a given year (lessor) and water users having an annual or short-term demand (lessee) versus a long-term supply need.

Water banks may operate in a variety of ways. Important operational considerations include:

- **Model Type:** Water banks may operate as a deposit/withdrawal model or as a clearinghouse model. In the first, anyone qualified may "deposit" and the bank subsequently manages "withdrawals." This may involve a commitment to keep water available for some length of time or until withdrawn. In the second model type, the institution functions as a broker that helps transferors and transferees find each other, usually imposing standard forms, information and assurance requirements, and rules.

- **Funding:** The bank may act with its own funding and with its own specific objectives in mind, or act solely as a service provider (i.e., impartial to any water transaction).

- **Pricing:** The bank may set prices at pre-defined levels, allow prices to float subject to a known index or market condition, or the parties may negotiate a price.

- **Arrangement Duration:** A transaction time between water "moving" among a transferor and a transferee can be short, as with banks that wheel direct flow waters, to indefinitely long, as may be the case for groundwater based banks.

A pilot water bank was established in the Arkansas Basin of Colorado in 2003, but had little or no usage. As described by CWCB (2007), "The lack of usage may be related to the restrictions placed on the type of water (only stored) and no demand due to lack of infrastructure to deliver to source of demand and restrictions on the market (only in basin uses)." Despite the limited usage of the pilot water bank, subsequent legislation allowed for the creation of water banks in any of the state's river basins.

No other formal water banks have been successfully established in Colorado as of 2010, but currently the Colorado River Water Conservation District, the Southwestern Water Conservation District, The Nature Conservancy, and several Front Range water providers that divert water from the West Slope are working with CWCB staff to explore how a water bank could help Colorado prevent and/or address and respond to a Colorado River Compact curtailment and its effects on Colorado water users. The proposed water bank seeks to provide a means for pre-compact (i.e., pre-1922) water rights to be used to allow critical post-compact water uses to continue under a compact curtailment order. Specifically, certain lands that are irrigated by pre-compact water rights would be temporarily fallowed, and these water rights would be used to offset depletions associated with critical post-compact water uses.

2.1.4 Reduced Crop Consumptive Use

In a report developed by the CWCB, the Colorado Water Institute, and CDM, the Colorado Agricultural Water Alliance (CAWA [2008]) explains the distinction between changes in agricultural irrigation practices that can and cannot yield water that is transferable to other uses:

> Under current laws and customs, opportunities for producing significant amounts of transferable water for municipal and industrial (M&I) uses through agricultural conservation measures are constrained by certain physical, legal, and economic factors. To understand these limitations, it is essential to separate the concepts of irrigation efficiency and [agricultural] water conservation. Under current Colorado laws and practices, water saved through irrigation efficiency measures, such as upgrading from flood irrigation to sprinklers or water salvaged through removing phreatophytes, cannot be transferred to other uses or used to expand irrigated acres [beyond those acres allowable in the water right decree]. In [the CAWA report], **[agricultural] water conservation** refers to practices that reduce historical consumptive use, while irrigation efficiency refers to practices that decrease nonconsumptive losses such as runoff or deep percolation of irrigation water.
>
> When considering the potential for agricultural water conservation, it is important to understand the distinctions between saved and salvaged water, as opposed to water that is made available by reducing the consumptive use from irrigated crops. Much of the debate over water conservation indicates that imprecise use of terminology creates confusion and often obscures the real policy considerations. Improvements in irrigation efficiency do not necessarily result in an increase in water available for other uses in Colorado. Saved and salvaged water, as currently construed in Colorado, do not include the concept of water potentially conserved through the reduction of crop consumptive use.
>
> A new term, *Conserved Consumptive Use Water*, is proposed to describe water that is part of the consumptive use of a water right that is removed from an irrigated cropping system. The transfer of this water, while possible under Colorado water law, has not yet been tested in water court or codified by the legislature. [Several of the projects funded by the CWCB are furthering the research and practicality of these transfers.]

In addition, the CAWA (2008) report identifies the following scenarios for generating conserved consumptive use water:

1. Irrigated acres are decreased,

2. Crop selection is changed from a summer crop to a cool season crop,

3. Crop selection is changed to one with a shorter growing season,

4. Deficit irrigation is practiced, applying some amount less than full or historical evapotranspiration over the growing season, or

5. Evaporative losses from the field surface are reduced as a result of conservation tillage, mulching, and or drip irrigation that are a component of the evapotranspiration from applied irrigation water.

The preceding list is consistent with SWSI 2, which considered two potential "methods that reduce CU by reducing the amount or yield of crops planted and irrigated. It is this reduced crop CU, not the reduction in gross diversions (e.g., changes from flood irrigation to sprinkler irrigation, etc.) that can be potentially transferred to a new use" (CWCB 2007). A key benefit of these alternative irrigation and/or cropping methods is that presumably all the irrigated land is maintained at some level of agricultural production throughout the lifetime of the transfer.

It is possible that changes in irrigation application methods and/or timing of irrigation can result in a reduction of CU as compared to historical CU on the same agricultural parcel. As defined by Hansen et al. (2010), limited irrigation (aka "deficit irrigation") refers to "the application of less water than required to meet the full water demand of the crop, with an emphasis on applying the limited water during critical crop growth stages to optimize the beneficial effects of the water." A reduction in per acre CU from either method potentially could be transferred to an alternative "off-farm" use (i.e., M&I, environmental, recreational).

The second approach to reducing crop CU involves changing the historical crop type (perpetually or for a limited term) from crops having relatively high annual CU to crops having lower CU requirements. **Table 1** below provides estimates of annual CU rates for a variety of crops at a number of locations across the Front Range and Eastern Plains of Colorado.

Table 1. Estimated Season Crop Water Requirements (Consumptive Use) in Eastern Colorado (inches/season)[1]

	Alfalfa	Sugar Beets	Grass Hay/ Pasture	Corn, Grain	Sorghum, Grain	Dry Beans	Wheat, Winter	Soybeans	Spring Grains
South Platte Basin									
Byers	32.1	—	27.5	—	20.5	—	16.4	—	12.5
Greeley	31.6	29.3	26.6	—	19.5	18.4	16.4	—	—
Longmont	30.9	25.5	26.2	21.7	—	15.8	18.5	—	11.4
Sterling	35.2	30.0	28.0	—	—	—	12.5	—	14.3
Republican Basin									
Burlington	35.6	30.0	31.1	26.0	21.5	19.2	19.0	—	—
Cheyenne Wells	36.1	30.4	31.7	25.8	—	—	18.6	—	—
Holyoke	35.2	29.9	—	25.4	—	18.7	—	16.4	15.2
Wray	35.2	30.0	30.9	25.4	16.1	18.8	—	10.4	15.2

Table 1. Estimated Season Crop Water Requirements (Consumptive Use) in Eastern Colorado (inches/season)[1] (cont.)

	Alfalfa	Sugar Beets	Grass Hay/ Pasture	Corn, Grain	Sorghum, Grain	Dry Beans	Wheat, Winter	Soybeans	Spring Grains
Arkansas Basin									
Colorado Springs	30.0	—	26.0	20.5	16.0	—	14.1	—	—
Holly	39.3	34.8	34.7	29.4	25.2	—	19.7	—	—
Lamar	39.1	34.3	34.2	26.8	22.6	—	19.3	—	11.8
Rocky Ford	37.8	32.7	32.9	27.7	—	—	—	—	14.2
Springfield	37.4	32.3	32.6	26.7	22.7	18.8	18.6	—	10.4
Trinidad	33.3	—	28.1	21.3	—	—	16.1	—	—
Average	**34.9**	**30.8**	**30.0**	**25.2**	**20.5**	**18.3**	**17.2**	**13.4**	**13.1**

[1] Sources: CAWA (2008), Table 4-2 (Holyoke only); Schneekloth and Andales (2009), Table 1 (all others)

According to Hansen et al. (2010), "Corn and alfalfa are the dominant crops produced under irrigation in Colorado, representing about 80 percent of the irrigated acres." Based on the data presented in Table 1, these two crops have average seasonal CU requirements across the Front Range and Eastern Plains of 34.9 inches and 25.2 inches, respectively. While the individual location data shows that savings will vary from place-to-place, it is evident that planting and irrigating alternate crops such as dry beans or winter wheat could lead to significant savings of crop CU water.

A Colorado example of reduced crop CU is the Aurora Continued Farming Program in the lower Arkansas Valley. This is a pilot program started in 2004 and an example of a method in which agricultural land may be kept in viable production following an agricultural transfer. Under this program Aurora invested in high efficiency (drip systems or sprinklers) irrigation technology for the farm lands enrolled in the program and provides 0.5 AF per acre per year of augmentation water to keep these lands in production. Findings to date include:

- In Aurora's Rocky Ford II transfer, Aurora realized a 1.76 AF per acre CU yield from the water rights. By dedicating 0.5 AF per acre to the continued farming, Aurora was still able to transfer to municipal uses 1.26 AF per acre of water.

- The irrigators have changed farming practices and grow low consumptive crop types (melons and onions) compared to the high consumptive crops historically grown (corn and alfalfa).

- Depending on the chosen crop, the irrigators have supplemented the 0.5 AF per acre of augmentation water with other available water sources, but there appears to be a substantial water savings overall.

- Through the use of the drip irrigation systems, the crops are provided with amount of water needed at the time it is needed; the fertilizer is applied with the irrigation water. This has

translated into healthier and more productive plants with larger and more uniform crop yields.

- Water quality improvements. Traditional furrow irrigation has high return flows that may be high in salinity and other pollutants. Through the use of these highly efficient irrigation systems the return flows are reduced along with the accompanying contaminants.

As demonstrated by the Aurora example, a hybrid system of low CU crops coupled with limited irrigation (intentional under-irrigation) methods could further leverage the possibilities of this type of ATM. Transfers from this alternative would likely provide a fixed per annum water yield that could provide a supply necessary to increase an M&I user's firm annual yield.

An important consideration with this type of cropping approach to CU reduction is that there must be a market for the lower CU crops in order for the associated water transfer to truly benefit all of the involved parties. These concepts are being investigated further as part of the Lower South Platte Irrigation Research and Demonstration Project (LSPIRDP), a partnership between the Parker Water and Sanitation District (PWSD) and Colorado State University (CSU). Such transfers may pose some fundamental legal issues regarding the nature and extent of irrigation water rights. Additional information about this effort is provided later in this report.

2.1.5 Purchase and Leaseback

The final alternative considered in the SWSI 2 report as a means to provide additional M&I, environmental, and recreational water supplies is Purchase by End User with Leaseback under Defined Conditions and is perhaps the most common means presently used within Colorado. A purchase and leaseback arrangement, while commonly implemented for a fixed term of 5 to 10 years or annually as excess supplies are available, can be a permanent agreement where the municipal, environmental, or recreational interest purchases agricultural water rights with the agreement that the new owner will lease back water to the farmer (or ditch system) under specified and pre-determined hydrologic circumstances. For example, a municipality may be limited to making a call on this new supply only during dry years or when there is a compact call in place. The farmer may lease the water during hydrologically average and wet years.

Purchase and leaseback arrangements can be viewed as a more permanent variation of ISAs that provide more certainty to the purchaser. If the new owner of the water right begins using the water for "new" and growing demands (versus just for firming pre-existing supplies), a purchase and lease-back arrangement could eventually result in the permanent dry-up of irrigable lands or regions and in this case could be characterized as a "soft landing" transition period when moving from irrigated to non-irrigated farmland. Annual leases by M&I providers of previously purchased irrigation rights take place in both the South Platte and Arkansas River Basins. Examples include the following:

- Arkansas Basin
  - Pueblo Board of Water Works (PBWW) and the Bessemer Irrigating Ditch Company (Bessemer Ditch). PBWW has purchased over 5,440 shares in the Bessemer Ditch and has offered the sellers a long-term lease of the shares through 2029. Over 98 percent of the shares purchased are being leased back to the sellers.
  - PBWW annual excess water supply leasing program.
  - Aurora and Rocky Ford High Line, Holbrook Canal.
  - Colorado Springs Utilities and Colorado Canal. Colorado Springs Utilities markets surplus water back to Colorado Canal as well as augmentation plans, effectively creating a two-way market.
  - Tri State Generation and Transmission Association and Amity Canal.
  - Multiple excess municipal water supply leases with Division of Wildlife (DOW) and State Parks.
- South Platte Basin
  - City of Thornton and Water Supply and Storage Company (WSSC).
  - City of Fort Collins and North Poudre Irrigation Company (NPIC).

2.2 ATM Grant Recipient Projects

One of the outcomes of SWSI 2 was the recognition that the State of Colorado might be able to provide incentives for M&I providers to consider alternative methods for their water supply options. In response, the Legislature authorized the CWCB to develop a grant program to facilitate the development and implementation of alternative agricultural water transfer methods (Senate Bill 07-122).

Since its inception in 2007, the CWCB's Alternative Agricultural Water Transfer Methods Grant Program has awarded $1.5 million to various water providers, ditch companies, and university groups for the funding of six unique projects, five of which have been underway during 2009–2010. As illustrated in SWSI 2, rotational fallowing, ISAs, water banks, purchase and leasebacks, deficit irrigation, and changing crop type are the kinds of options that are available as alternatives to permanent agricultural transfers. With the exception of purchase and leasebacks and some limited occurrences of short-term leasing, these ATMs are just beginning to be explored as viable options for meeting M&I water demands in Colorado. While promising, there are technical, legal and institutional, financial, and other issues associated with ATMs. Through

the ATM Grant Program, CWCB and others are currently exploring ways to address these issues utilizing incentives to gain greater awareness, interest, and participation from agricultural water users and municipalities with alternative agricultural water transfers.

The recipients of funding from the Alternative Agricultural Water Transfer Methods Grant Program are identified in **Table 2** below, along with the amount of grant funding awarded to each by the CWCB.

Table 2. Recipients of CWCB Alternative Agricultural Water Transfer Methods Grants

Name	Grant Funding
Parker Water & Sanitation District (PWSD) and CSU	$477,500
Colorado Corn Growers Association (CCGA)	$349,650
Lower Arkansas Valley Water Conservancy District (LAVWCD) Super Ditch Company	$320,000
Farmers Reservoir & Irrigation Company (FRICO)	$202,500
CSU Extension Office	$80,350
High Line Canal Company	$70,000
TOTAL	**$1,500,000**

The following sections provide a brief synopsis of each entity's approach to identifying viable ATMs. **Appendix A** provides additional details regarding the status of each project as of October 2010.

2.2.1 Parker Water & Sanitation District and Colorado State University

In its evaluation of the reduced CU ATM concept, SWSI 2 reported that "Determination of the transferable amount would be complicated…To date limited research has been conducted in Colorado to assess crop [evapotranspiration (ET)] under deficit irrigation schedules" (CWCB 2007). The LSPIRDP is a 4-year study that is seeking to remedy this data shortfall by quantifying potential consumptive water use savings resulting from the use of deficit irrigation practices. By reducing the CU of irrigated crops, an incremental volume difference between historic and future CU can be computed. With approval of the State Engineer's Office (SEO), it is believed that this volume of water could be transferred to municipal use. In addition to field-scale research, the test program is being implemented on three demonstration farms to ensure that working farmers understand the proposed practices and that the practices are operationally and economically practical. Phases 1 through 3 of the project are complete and were documented in a report submitted to CWCB in January 2010.

As described by Hansen et al. (2010), Phase 1 of the study sought to identify "[c]ropping systems with potential to reduce consumptive use by at least 20 percent compared to continuous corn with full irrigation." The following cropping systems were selected as alternatives to permanent dry-up of irrigated land:

- **Limited Irrigation** – A form of deficit irrigation that seeks to maximize water productivity through timing of irrigation applications at critical crop growth stages and through managed soil depletions for systems with less than adequate capacity or limited quantities of water.

- **Rotational Cropping** – Rotations that combine annual crops under full irrigation with fallow periods or with non-irrigated crops.

- **Partial Season Irrigation** – Irrigation to meet full demand of the crop for a portion of the growing season in combination with periods of no irrigation. This approach has particular relevance to perennial forage crops like alfalfa.

Phase 2 involved an extensive field study to test the alternative irrigation practices identified above. Hansen et al. (2010) reported the following findings related to crop CU savings, presented here as ET reductions:

> Rotational cropping systems were effective at reducing ET, with average ET reductions of 30–40 percent compared to continuous corn. Rotating irrigated crops with dryland crops was a more water efficient approach than rotating with non-cropped fallow land because of high water loss during fallow to evaporation and drainage. Corn produced after a fallow period or dryland crop had a higher yield and water use efficiency [crop yield per acre per inch of ET] than continuous corn, illustrating the benefits of crop rotation to maximize water use efficiency.
>
> Both rotational cropping and limited irrigation of sugarbeet in rotation with an annual forage crop saved 40 percent of the reference crop ET. Sugarbeet is drought tolerant and shows good adaptability to limited irrigation. Soybean had moderate yield but is a lower water use crop than corn even under full irrigation. Under limited irrigation, soybean had higher water use efficiency…Its growth and performance suggested it may be a good alternative crop for water conserving cropping systems in the South Platte River Basin.

To summarize, both limited irrigation and rotational cropping systems are effective at reducing crop CU, with average reductions of 30 to 40 percent compared to continuous corn. Remaining phases are in progress, with the original schedule in the grant application anticipating delivery of a final project report to CWCB at the end of 2010.

2.2.2 Colorado Corn Growers Association

Working with Ducks Unlimited and the City of Aurora, the CCGA is investigating a variety of ATMs. The transfer methods are being applied to three demonstration projects—the DT Ranch ISA, the Lower South Platte Co-op, and a Private Water Market—two of which involve wetlands. These wetlands provide a number of benefits, including recharge to the South Platte alluvial aquifer, which can be used in an augmentation plan for out-of-priority groundwater

pumping. The third demonstration project is exploring a marketing mechanism for facilitating ATMs. Additional details about the demonstration projects are included in Appendices A and B.

The study will also produce a business plan, which will be made available to other water users to help facilitate practical utilization of alternative transfer methods. As of June 2010, technical and legal analyses associated with the CCGA project are complete, as is one of the demonstration projects (CCGA et al. 2010). The remaining two demonstration projects and other analytical aspects of the project are underway, with project completion anticipated by the end of April 2011.

2.2.3 Lower Arkansas Valley Water Conservancy District

The ATM grant funding awarded to the LAVWCD provides for continued economic and engineering analyses of the Super Ditch Company, which would provide a means for irrigators under a group of ditch companies to collectively lease agricultural water for other uses, including municipal use. Rotational fallowing is likely to be the primary means of alternative transfer, with participating irrigators from seven canals:

- Bessemer Ditch
- Catlin Canal
- Fort Lyon Canal
- High Line Canal
- Holbrook Canal
- Otero Canal
- Oxford Farmers Canal

In October 2010 the Super Ditch Company and the City of Aurora came to agreement on a term sheet for potential future water leases. These leases may occur during periods of drought or drought recovery. Aurora, in compliance with other regional agreements, may lease up to 10,000 AF of agricultural water during a given year. The Super Ditch Company and the Pikes Peak Regional Water Authority have also reached agreement on a term sheet.

Interim summaries of project findings for the Super Ditch were submitted to CWCB in June 2010. According to a schedule update submitted by the Super Ditch team, the final report should be submitted to CWCB on or before June 30, 2011. Additional details about the development of the Super Ditch Company are included in Section 3.2.1 and Appendices A and B.

2.2.4 Farmers Reservoir & Irrigation Company

FRICO is investigating a number of alternative agricultural water transfer methods, including rotational fallowing, ISAs, lease back agreements, and changes in cropping patterns. Much like the PWSD/CSU study, the objective of these methods is to reduce CU for purposes of transferring the "saved" CU to municipal or industrial users. The project also includes the evaluation of a water bank concept that would utilize existing FRICO infrastructure to store

excess municipal supplies in FRICO surface or groundwater storage and then convey it to other agricultural and municipal users when needed. SWSI 2 (CWCB 2007) identified two key hurdles to water bank success:

- A trading hub, such as a large regional reservoir and distribution/delivery system, is necessary to provide for storage and distribution of banked water to a large, regional customer base.

- Developing a water bank in a location that does not either have the necessary infrastructure to deliver water to new demands or where such infrastructure cannot be cost-effectively installed is likely futile.

These factors, combined with the lack of usage of the pilot water bank in the Arkansas Basin, suggest that water banking may not be feasible at the basin level. However, there appears to be more potential success for large irrigation companies located at or near the urban-rural interface, particularly those with existing storage facilities and infrastructure in place to facilitate the efficient wheeling of water throughout the system. Located in the North Metro area, FRICO would seem well positioned to take advantage of these factors.

Another issue that will likely influence FRICO's and other irrigation companies' approaches to ATMs is the pending Colorado Supreme Court decision regarding the appeal of Case No. 02CW403. This case involves an application for water rights filed by FRICO, Burlington Ditch, Reservoir, and Land Company (Burlington), Henrylyn Irrigation District (Henrylyn), East Cherry Creek Valley Water and Sanitation District (ECCV), and United Water and Sanitation District (UWSD). The co-applicants filed for several water right claims in 2002. There were 47 statements of opposition filed to the application, and a 16-day trial was held in April and May of 2008.

The application included a claim for decreed rights of exchange on the South Platte River and for alternate points of diversion and places of storage for FRICO, Burlington, and Henrylyn. It also included a claim by FRICO, UWSD, and ECCV for approval of a plan for augmentation and for changes in use of Burlington and FRICO shares used in FRICO's Barr Lake Division. The change in use included a system-wide analysis for quantification of the FRICO and Burlington shares.

The Findings of Fact, Conclusions of Law, and Decree signed on May 11, 2009 by Judge Roger Klein approved the application but with use and volumetric limitations on the changes in use that were far more restrictive than the co-applicants requested. As a result, the co-applicants appealed the decision to the Colorado Supreme Court and oral arguments are set for January 2011. The result of this ruling has been increased concern by agricultural water rights holders who may submit their ditch systems and irrigation water rights to water court proceedings to

facilitate ATMs, as their existing water rights may be declared to yield less than anticipated amounts of historical CU.

In June 2010, FRICO submitted a memorandum to CWCB documenting the current findings for Tasks 1 through 4 of the ATM grant-funded project (FRICO 2010); further details from this memorandum are provided in **Appendix B**. Additional analyses are still underway for these and other tasks outlined in the project grant application. It is anticipated that ongoing work will be completed by early 2011, with a final report delivered to CWCB in May 2011.

2.2.5 Colorado State University Extension Office

SWSI 2 (CWCB 2007) outlined the following concerns for several of the ATMs, including ISAs, rotational fallowing, and water banks:

> [S]oil, weed, labor, and equipment management issues must be considered on the fallowed lands. A farm operation involves not only the planting, irrigating, and harvesting of crops, but the hiring of labor and maintenance of equipment. In addition, the management of soil erosion and weed control will be issues on irrigated fields that are temporarily removed from agronomic production.

In response to the recognition of these concerns, the CSU Extension Office is conducting a 4-year study to assess various technical aspects of returning fallowed land to production and maintaining or improving crop yields on those lands. The project involves field-scale research on plots either planted to corn or fallowed and then sequentially brought back into corn production. These plots are located on farms under the Rocky Ford High Line Canal and the Holbrook Canal. The study includes investigations of weed and erosion control measures during fallow years and monitoring of soil nutrients and salinity once production resumes.

An important conclusion that the researchers have made for the Lower Arkansas Valley is that "Without a cover crop or significant investment in herbicides, weeds (e.g., Kochia, Pigweed, Bindweed, Bull Nettle) will likely dominate fallow sites in this region" (Cabot et al. 2010b). Concurrently, a modification of one of the demonstration sites in 2010 allowed the CSU Extension team to "document a favorable yield of forage sorghum (17.4 T/ac) on a dryland basis." Such field-based results and conclusions emphasize the benefits that the CSU Extension study can provide to irrigators contemplating entering into ATM agreements in the region.

The first 2 years of this study have been completed, and findings to date are summarized in annual reports submitted to CWCB in June 2010 (Cabot et al. 2010a) and November 2010 (Cabot et al. 2010b). The project will be ongoing through 2012, with status reports anticipated annually.

2.2.6 High Line Canal Company

The Highline Canal Company plans to conduct a project to explore implementation of various means of alternative water transfer including interruptible water supply agreements, long-term

land fallowing, spot market leases (for use during drought), and water banking. Water developed under these methods will be provided to other users via existing irrigation infrastructure or via a proposed pipeline. The project includes engineering studies to determine the amount of water that could be transferred and the location, timing, and volume of historical irrigation return flows that would need to be maintained in order to prevent injury to downstream water users. Water made available will be leased to other water users. As shown in Table 1, a grant was awarded to the High Line Canal Company in 2008, but their project is not yet under contract as of early 2011.

Section 3 – State of Agricultural Transfers in South Platte and Arkansas Basins

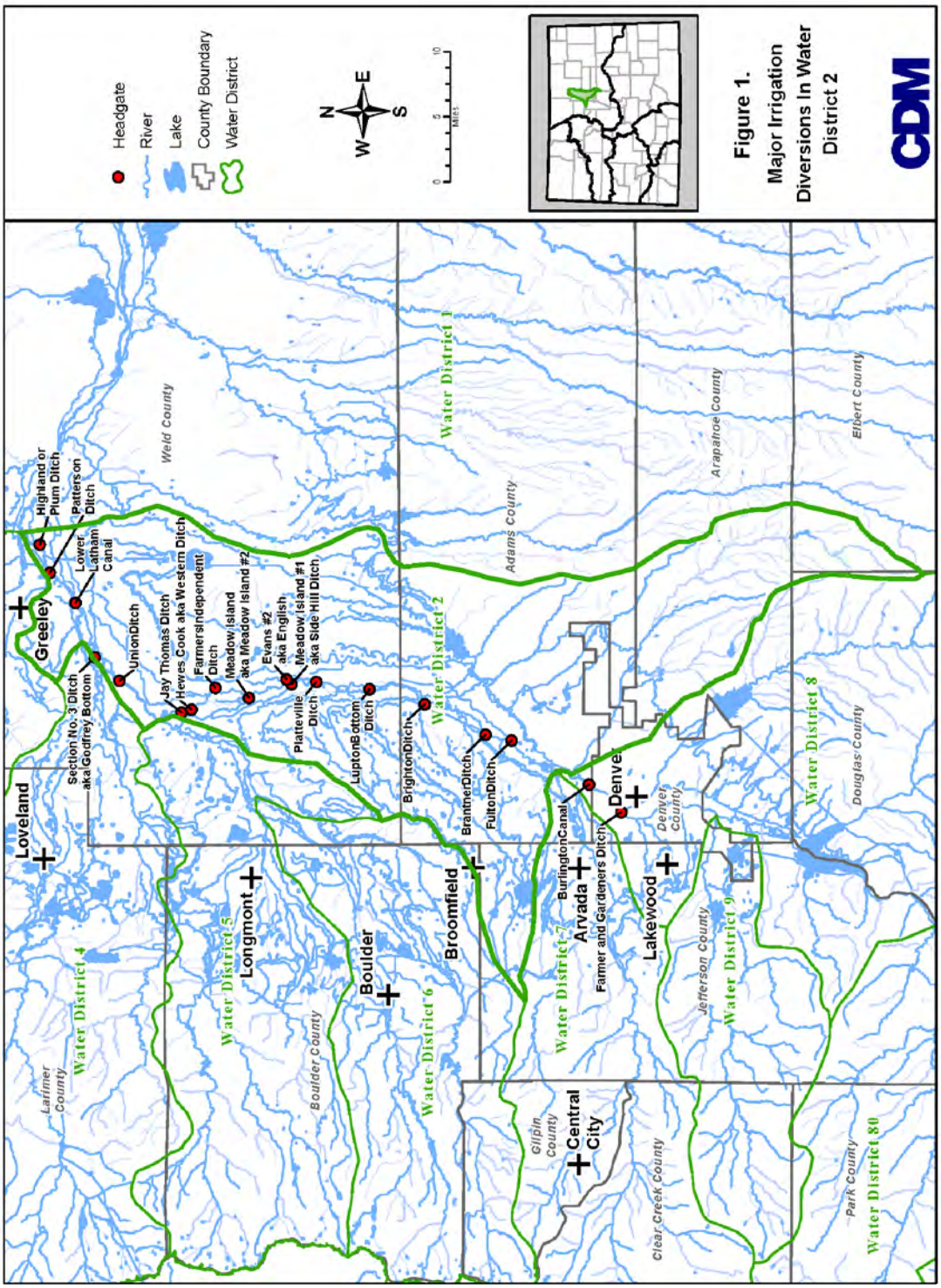
3.1 Overview of Agricultural Transfers in South Platte River Basin

The following sections discuss the present state of agricultural transfers throughout the South Platte River basin and identify water districts in which ATMs have a greater likelihood of success.

3.1.1 South Platte River, Water District 2, Commerce City to Kersey

In this reach of the South Platte River, there is considerable activity to acquire water rights and related historical CU for municipal purposes. **Figure 1** shows the boundaries of Water District 2 and identifies the locations of major diversion structures. This reach of the river has over 2,270 cubic feet per second (cfs) of water rights decreed for irrigation with priorities equal or senior to November 20, 1885. The upper canal is the Burlington Canal with 377 cfs equal or senior to November 20, 1885. The lower canal is the Lower Latham Canal with 287 cfs equal or senior to October 24, 1881. In between the canals are 13 other canals with priorities as senior as April 1, 1860 and as junior as April 29, 1882. This area irrigates around 90,000 acres using a duty of water of 1 cfs per 40 acres. These water rights and priorities are shown on the straight-line diagram for District 2 prepared for the South Platte Decision Support System (SPDSS) and included in **Appendix C**.

Many of the canals or ditches have priorities in the 1860s and 1870s and there are three dry up points on the river identified by the Division of Water Resources (DWR) below senior canals and include the Burlington Canal, Jay Thomas Ditch (June 1, 1865), and Lower Latham. These dry-up points are also shown on the Water District 2 straight-line diagram. These dry-up points create impediments to exchanges of water upstream and would require some local storage of CU water from dry-up until exchange conditions develop with higher stream flows.


Headgate
River
Lake
County Boundary
Water District
N
W
E
S
Figure 1.
Major Irrigation
Diversions In Water
District 2
CDM
Highland or Plum Ditch
Patterson Ditch
Lower Latham Canal
Union Ditch
Jay Thomas Ditch
Hewes Cook aka Western Ditch
Farmers Independent Ditch
Meadow Island aka Meadow Island #2
Evans #2 aka English, Meadow Island #1 aka Side Hill Ditch
Platteville Ditch
Lupton Bottom Ditch
Brighton Ditch
Brantner Ditch
Fulton Ditch
Burlington Canal
Farmer and Gardeners Ditch
Section No. 3 Ditch aka Godfrey Bottom
Greeley
Loveland
Longmont
Boulder
Broomfield
Denver
Arvada
Lakewood
Central City
Weld County
Adams County
Arapahoe County
Elbert County
Douglas County
Denver County
Jefferson County
Clear Creek County
Park County
Gilpin County
Boulder County
Larimer County
Water District 1
Water District 2
Water District 4
Water District 5
Water District 6
Water District 7
Water District 8
Water District 9
Water District 80

Some of the water rights associated with the 15 canals and ditches in Water District 2 have been acquired and the use changed to municipal use in previous water court actions; others have been acquired and are presently going through change in use proceedings. Additionally, some of the water rights that have been purchased are being leased back to farmers until a change in use to municipal use is needed to meet growing demands. The more senior water rights have received over $20,000 per AF of historical CU based on information related to recent sales.

In this reach of the South Platte River, there is infrastructure in place to deliver water from below Barr Lake to the area served by ECCV, located south of Aurora and east of Cherry Creek Reservoir. ECCV has also entered into an agreement with Arapahoe County Water and Wastewater Authority (ACWWA) to sell excess capacity in its pipeline to the authority for delivery of water to its service area in Centennial. ACWWA will purchase water from UWSD, which will acquire the necessary senior water rights and change them to municipal use. UWSD will also provide water to ECCV from changed irrigation rights.

As of late 2010, the City of Aurora has nearly completed its Prairie Waters Project (PWP) that will pump water from the South Platte River near Brighton to Aurora Reservoir. This project will recover reusable effluent controlled by Aurora that is in the South Platte River but also could be used to pump water acquired from senior water right owners in this reach of the South Platte. To facilitate these operations, Aurora has purchased water rights from a number of canals or ditches in Water District 2.

There are other entities looking to purchase water rights in the area including the South Metro Water Supply Authority (SMWSA). It is anticipated that this reach of the South Platte River will be subject to several traditional water right changes in use—resulting in permanent dry-up—and is therefore not very amenable to ATMs for use of irrigation water rights for municipal use. The land irrigated would be useful for gravel pits or subdivision since it is in the growth corridor of the Front Range. On the other hand, the FRICO Barr and Milton systems are located in Water District 2. Depending on the outcomes of the Case No. 02CW403 appeal and the ongoing FRICO ATM study described in Section 2.2.4, ATMs in the form of a water bank or other ISAs may yet prove to be viable in this reach of the South Platte River.

Another significant activity occurring in this part of the basin is the Water Infrastructure and Supply Efficiency (WISE) Partnership where over the last several years, Aurora Water, Denver Water, and the SMWSA have been discussing and negotiating terms to enhance the reliability of water supplies for the Denver Metro area by using excess system capacities and unused reusable water. Denver Water and Aurora Water have identified interruptible, though significant, amounts of available reusable water in both systems as well as excess capacity in Aurora's PWP to convey and treat those supplies. If the WISE Partnership comes to fruition, the project could provide revenue to Aurora to defray costs of the PWP to the City's customers, to provide a strategic reserve supply to Denver Water, and ultimately provide as much as 60,000 acre-feet per year (AFY) in average annual yields to SMWSA entities in normal and wet years.

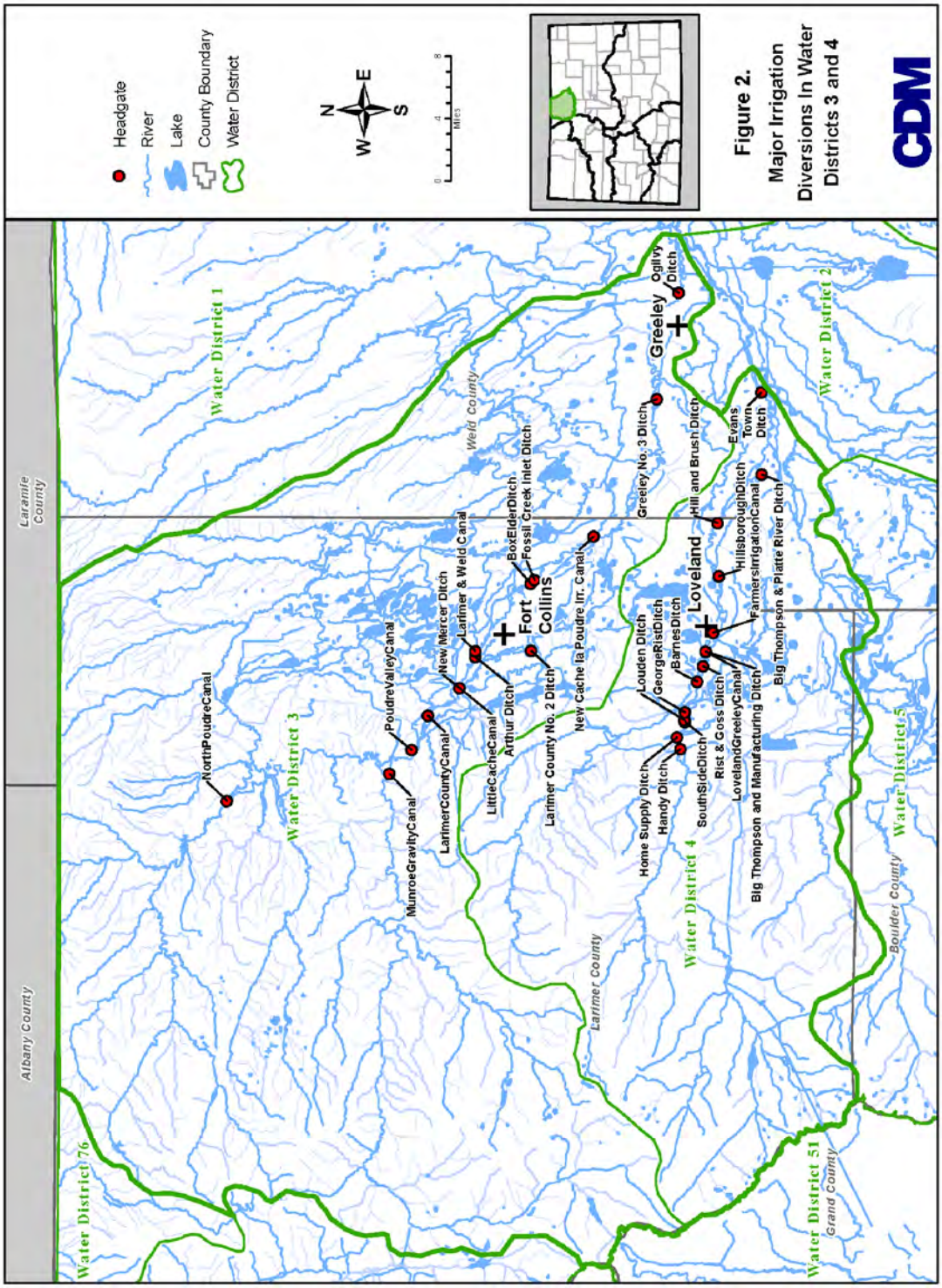
3.1.2 Cache la Poudre River Basin (Water District 3) and Big Thompson River Basin (Water District 4)

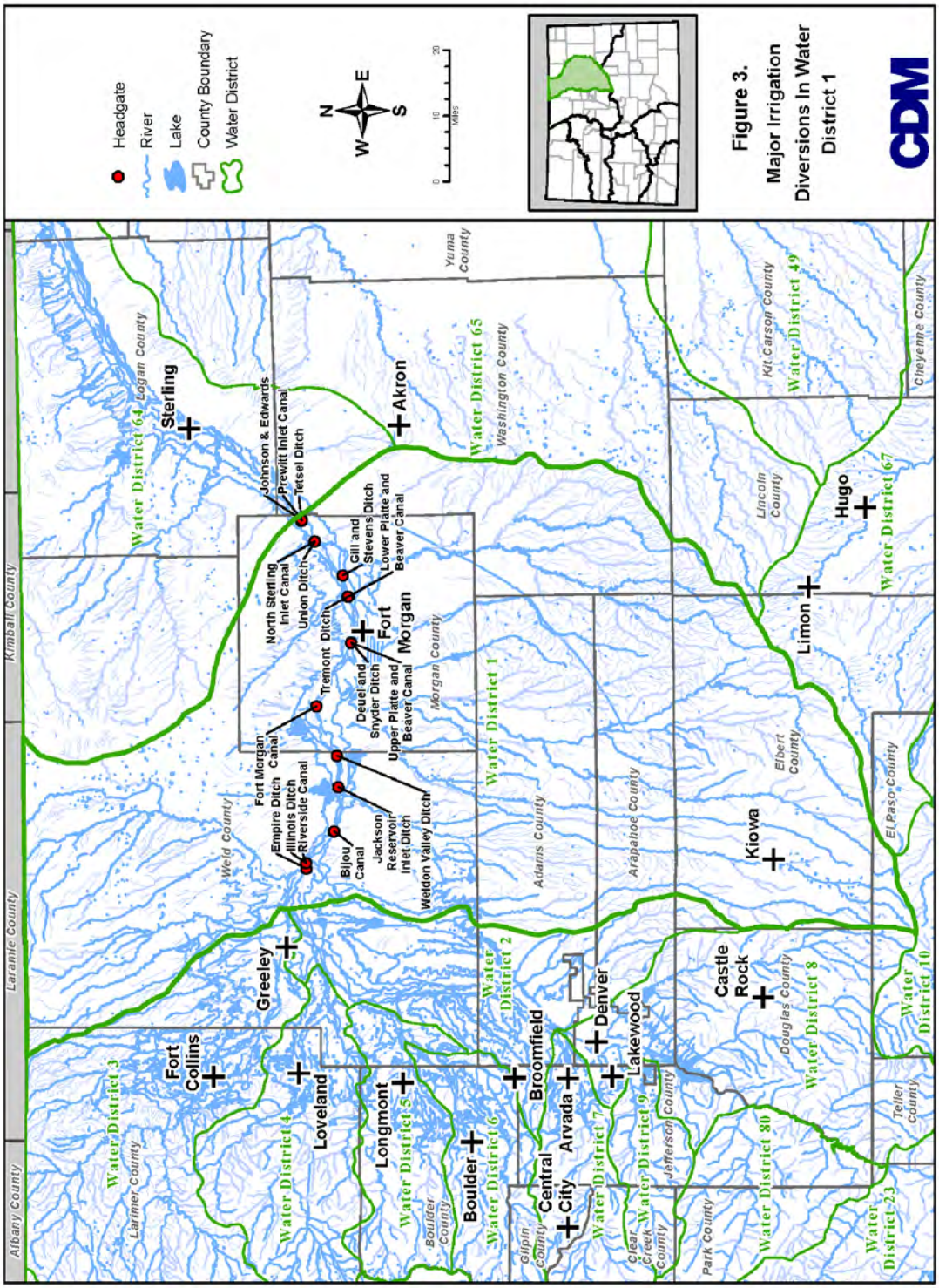
In the Cache la Poudre (Poudre) and Big Thompson River Basins (see **Figure 2** and Appendix C) there are considerable water rights acquisition activities that have been completed by Greeley, Thornton, Fort Collins, and Loveland as well as some smaller rural water districts. In some acquisitions, the water is being leased back to the farmers until the municipal providers grow to the point where water needs require the land to be removed from irrigation. Some of the water rights have been changed to municipal use already—such as the Thornton purchase of the WSSC shares—and the land was irrigated for several decades (or is still being irrigated) under leases to farmers before permanent dry-up and revegetation with native plant species. Some previous change-in-use cases were able to use ditch-wide change procedures and this has encouraged the sale of remaining shares in these canals since the historical CU has been established. As long as the farmer has been using the owned shares efficiently and as historically identified in the initial change case, the sale of remaining shares is more attractive and will require less transaction costs. Examples of previous ditch-wide analyses include the Greeley Irrigation Company (Greeley No. 3 Canal) in the Poudre Basin and the Consolidated Home Supply Ditch and Reservoir Company (Home Supply Ditch) in the Big Thompson Basin (Andrew Jones, personal communication, December 9, 2010). Again, this area is thought to be more amenable to traditional agricultural change in use cases resulting in permanent dry-up rather than ATM. The value of the irrigated land for subdivision development is also quite attractive due to the location in the growth area in the Loveland, Greeley, and Fort Collins area.

3.1.3 South Platte River, Water District 1, Kersey to Hillrose

This reach has 12 canals and ditches that divert water to irrigation use and 5 canals that divert water to off-channel storage for irrigation use. Some of these structures are shown in **Figure 3**, which also illustrates the boundaries of Water District 1. The earliest priority is one small right from 1868; the majority of the larger rights have priorities in the early- to mid-1880s. On the straight-line diagram prepared for Water District 1 (included in Appendix C), the DWR has identified three administered dry-up points in this reach:

- Below the Bijou Canal,
- Below the Upper Platte and Beaver Canal, and
- Below the Lower Platte and Beaver Canal.


Headgate
River
Lake
County Boundary
Water District
N
W
E
S
Figure 2.
Major Irrigation
Diversions In Water
Districts 3 and 4
CDM
Albany County
Laramie County
Weld County
Larimer County
Boulder County
Grand County
Water District 1
Water District 2
Water District 3
Water District 4
Water District 5
Water District 51
Water District 76
Fort Collins
Loveland
Greeley
NorthPoudreCanal
PoudreValleyCanal
MunroeGravityCanal
LarimerCountyCanal
New Mercer Ditch
Larimer & Weld Canal
LittleCacheCanal
Arthur Ditch
Larimer County No. 2 Ditch
New Cache la Poudre Irr. Canal
BoxElderDitch
Fossil Creek Inlet Ditch
Louden Ditch
GeorgeRistDitch
BarnesDitch
Home Supply Ditch
Handy Ditch
SouthSideDitch
Rist & Goss Ditch
LovelandGreeleyCanal
Big Thompson and Manufacturing Ditch
FarmersIrrigationCanal
HillsboroughDitch
Big Thompson & Platte River Ditch
Hill and Brush Ditch
Greeley No. 3 Ditch
Evans Town Ditch
Ogilvy Ditch


Headgate
River
Lake
County Boundary
Water District
N
E
S
W
Figure 3.
Major Irrigation
Diversions In Water
District 1
CDM
Sterling
Akron
Fort Collins
Greeley
Loveland
Longmont
Boulder
Broomfield
Central City
Arvada
Denver
Lakewood
Castle Rock
Kiowa
Limon
Hugo
Fort Morgan
Johnson & Edwards
Prewitt Inlet Canal
Tetsel Ditch
Gill and Stevens Ditch
Lower Platte and Beaver Canal
North Sterling Inlet Canal
Union Ditch
Tremont Ditch
Deuel and Snyder Ditch
Upper Platte and Beaver Canal
Fort Morgan Canal
Empire Ditch
Illinois Ditch
Riverside Canal
Bijou Canal
Jackson Reservoir Inlet Ditch
Weldon Valley Ditch
Water District 64
Water District 65
Water District 1
Water District 2
Water District 3
Water District 4
Water District 5
Water District 6
Water District 7
Water District 9
Water District 80
Water District 8
Water District 10
Water District 23
Water District 67
Water District 49
Logan County
Washington County
Yuma County
Kit Carson County
Cheyenne County
Lincoln County
Elbert County
El Paso County
Kimball County
Laramie County
Albany County
Larimer County
Weld County
Morgan County
Adams County
Arapahoe County
Douglas County
Jefferson County
Clear Creek County
Gilpin County
Boulder County
Park County
Teller County

The acquisition of irrigation water rights for municipal use is occurring at a slower pace in Water District 1 than in the areas previously described, according to available information. This is likely related to several factors, including water rights more junior than those in upstream water districts; diminished water quality (i.e., higher total dissolved solids [TDS] concentrations) relative to upstream reaches; and the lack of existing infrastructure to deliver water from the Lower South Platte River to centers of demand. Nonetheless, UWSD has purchased land and water rights on the 70 Ranch near Hardin and has filed a change in use for some of the water rights. UWSD, ECCV, and ACWWA have also filed for conditional water rights for municipal use, recharge, and irrigation on the South Platte River near the 70 Ranch. Water would be exchanged upstream to diversions on the South Platte River near Brighton; conditional exchange rights have been filed by these entities and many others in this reach. The water would be pumped from the South Platte River to Barr Lake for use by UWSD, ECCV, and ACWWA in the ECCV Northern Project.

This reach of the South Platte is more likely to be included in ATMs such as rotational fallowing since the land is not as desirable for subdivision and due to the rural character of the area. SWSI 2 reached a similar conclusion previously, stating the following:

> [T]he areas that may have a high probability for implementing a successful rotational fallowing program would be areas that are not facing urbanization or other development pressures or acquisition by other water providers. [The required] amount of acreage in the South Platte…is located in the lower reaches of [the] basin…The most likely geographic areas for a rotational fallowing program in the South Platte appear to be in Water Districts 1 and 64.

Water District 1 also has several large reservoirs that may be feasible to use for the storage of water from rotational fallowing under the canal systems served by the reservoirs. These include Riverside Reservoir that serves the Riverside Canal, Jackson Reservoir that serves the Ft. Morgan Canal, and possibly Empire Reservoir that serves the Bijou Canal. There are also recharge projects under all three canal systems that are used to augment well depletions from wells under the canals. If they can be used to store the CU from rotational fallowing or other ATM projects, these reservoirs would greatly improve the exchange efficiency and the prospects for successful ATM implementation.

Water from the ATM projects and water stored in the reservoirs identified above could be exchanged upstream when conditions permit to storage in gravel pit reservoirs owned by several municipal entities along the South Platte River in Water District 1. These gravel pit reservoirs are lined and are not in hydraulic connection with the river. Water from these gravel pit reservoirs is either pumped or exchanged by the municipalities to points of diversion, treatment, and use.

3.1.4 South Platte River, Water District 64, Hillrose to Stateline

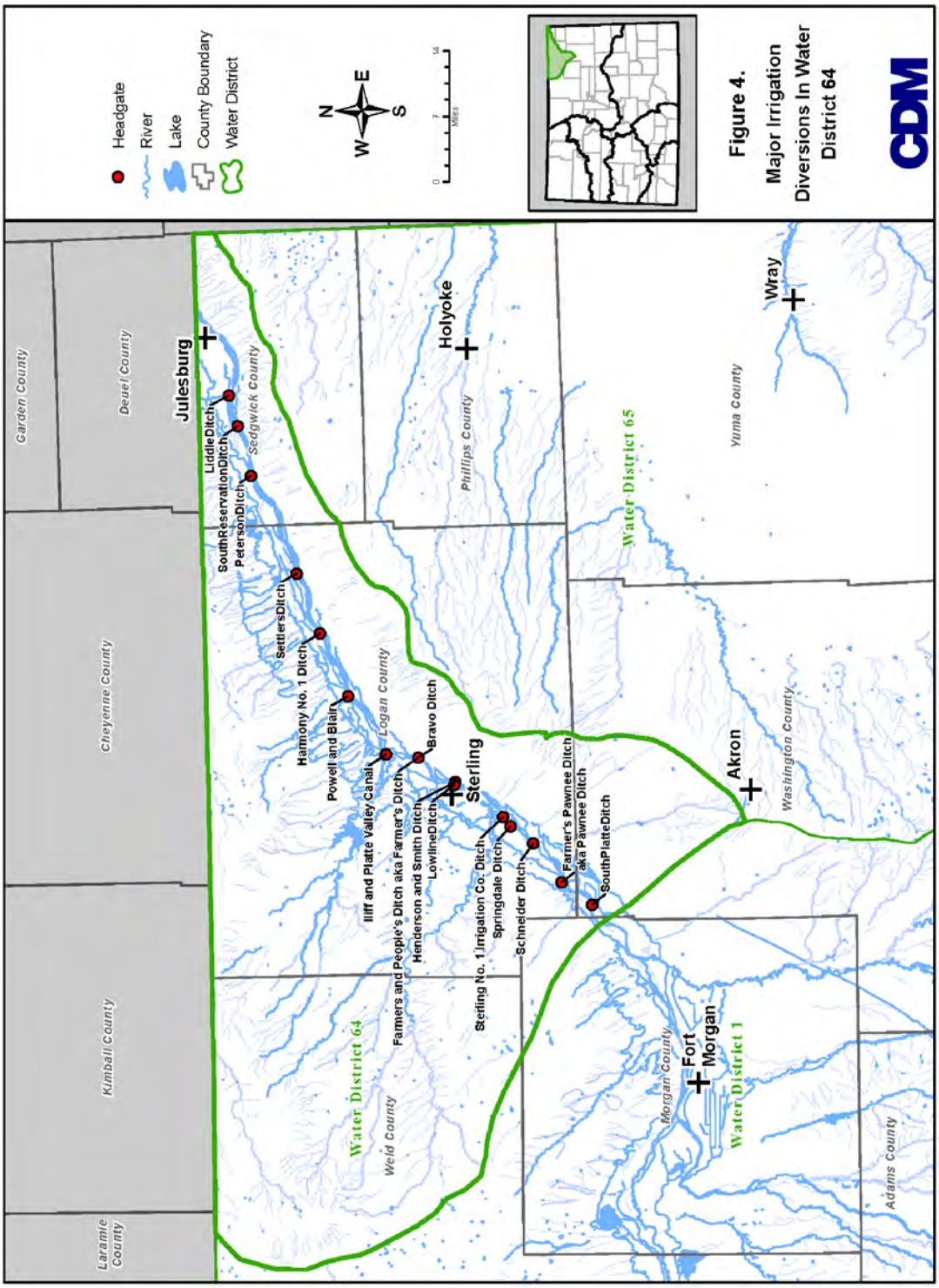
This reach has 16 canals and ditches, most of which are not as large as those in Water District 1, that divert water for irrigation use; many of these structures are shown in **Figure 4**. The priorities are mostly in the mid to late 1880s with the exception of the Sterling No. 1 Canal, which has a right for 114 cfs with a priority of July 15, 1873 and often places a call on the river. There are nine dry-up points shown on the Water District 64 straight-line diagram prepared for the SPDSS program (Appendix C). These dry-up points would make exchanges upstream from changed irrigation rights difficult and would require reservoir storage to improve the yield of a rotational fallowing program or a traditional "buy-and-dry" transfer.

There are two ATM grant-funded projects in this reach that provide useful information on various ATM concepts and include the PWSD and CSU LSPIRDP (see Section 2.2.1) and the CCGA, Ducks Unlimited, and City of Aurora Project (see Section 2.2.2).

The inability to exchange water from this reach to municipal growth areas upstream have been identified by project proponents and discussions are under way to see if there may be ways to overcome some of the dry-up point limitations. One example is the Lower South Platte Co-op concept being studied by CCGA. There also has been the recognition that pump back infrastructure may be required to increase the effectiveness of ATMs or traditional changes in use of irrigation water rights. These conclusions are again consistent with the SWSI 2 report, which states:

> Significant infrastructure would be required to deliver agricultural water from the lower South Platte…to the gap areas of the south metro area or northern El Paso County. As identified in the SWSI Report, there is very limited new exchange potential that would allow this water to be diverted upstream using existing infrastructure. This infrastructure would be needed even if a traditional agricultural transfer were to be implemented from the same geographic areas…[A]pproximately 60 to 100 miles of pipeline would be required to convey water from the agricultural areas to a centralized location near two major gap areas. Pumping facilities would also need to be constructed to lift the water 1,500 to 3,500 feet.

There are three off-channel reservoirs in Water District 64: North Sterling, Prewitt, and Julesburg Reservoirs. North Sterling Reservoir is too far away from the South Platte River to be of much value in storing water to assist an exchange. Prewitt Reservoir is located near the South Platte River at the upper end of Water District 64 and would therefore be a potential facility to store changed water rights for exchange or pump back to the metro area. New storage could be built if a site can be found for storing changed direct flow irrigation rights.


Headgate
River
Lake
County Boundary
Water District
N
W
E
S
Figure 4.
Major Irrigation
Diversions In Water
District 64
CDM
Julesburg
Holyoke
Wray
Sterling
Akron
Fort
Morgan
LiddleDitch
SouthReservationDitch
PetersonDitch
SettlersDitch
Harmony No. 1 Ditch
Powell and Blain
Iliff and Platte Valley Canal
Farmers and People's Ditch aka Farmer's Ditch
Henderson and Smith Ditch
LowlineDitch
Bravo Ditch
Sterling No. 1 Irrigation Co. Ditch
Springdale Ditch
Schneider Ditch
Farmer's Pawnee Ditch
aka Pawnee Ditch
SouthPlatteDitch
Garden County
Deuel County
Cheyenne County
Kimball County
Laramie County
Sedgwick County
Logan County
Phillips County
Yuma County
Washington County
Weld County
Morgan County
Adams County
Water District 64
Water District 65
Water District 1

3.2 Overview of Agricultural Transfers in the Arkansas River Basin

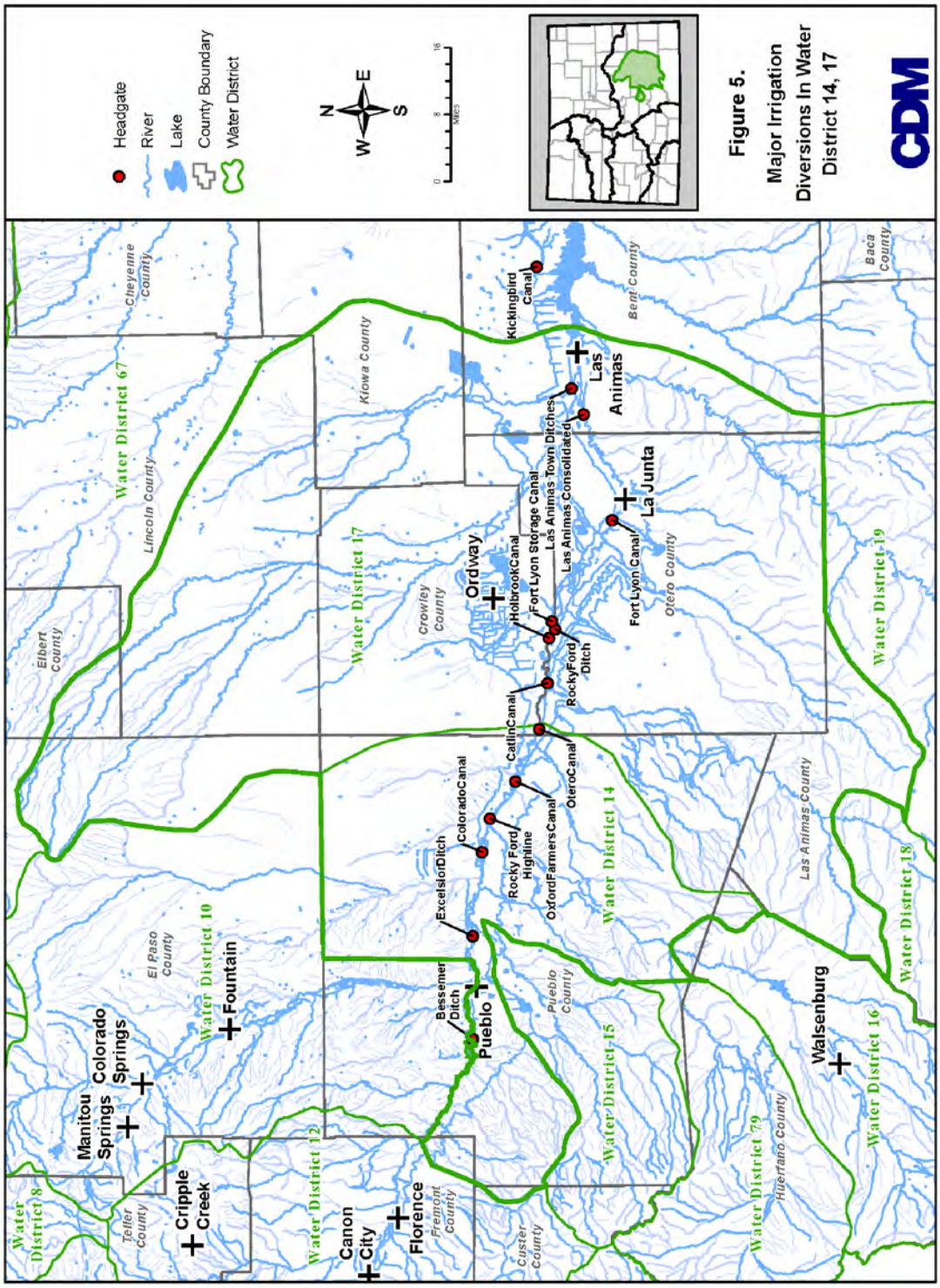
The following sections discuss the present state of agricultural transfers throughout the lower Arkansas River Basin and identify water districts in which ATMs have a greater likelihood of success.

3.2.1 Arkansas River, Water District 14 and 17, Pueblo to Las Animas

Water Districts 14 and 17 encompass the area from Pueblo Reservoir downstream to John Martin Reservoir near Las Animas. For this report, they will be discussed jointly as the geographic and agricultural characteristics are similar. Two canal companies, Rocky Ford Highline and the Colorado Canal, have diversion dams in Water District 14 but have most of their service areas in Water District 17. Total irrigated acreage as of 2010 is approximately 90,500 acres in Water District 14 and 143,500 acres in Water District 17 (CWCB 2011c).

Within this reach of the Arkansas River, there are 12 major irrigation canals and 7 off-channel reservoir systems that divert water from the river. The locations of many of these structures are identified in **Figure 5** as well as the straight-line diagram of Water Districts 14 and 17 that is included in Appendix C. Note that while the straight-line diagrams for the South Platte Basin water districts were prepared as part of state-led SPDSS efforts, the straight-line diagram for Water Districts 14 and 17 was prepared in conjunction with modeling efforts for the Super Ditch. The uppermost canal is the Bessemer Ditch that diverts water from an outlet in Pueblo Dam and lowest canal is the Las Animas Consolidated and Las Animas Town Ditches that share a headgate near Las Animas. The priorities of the water rights in this reach vary from April 1861 for a right in the Bessemer Ditch to May 1909 for Lake Henry.

This area has several large canal systems with significant irrigated areas and includes the Ft. Lyon Canal with 90,000 acres, the Rocky Ford Highline with 24,000 acres, the Bessemer Ditch with 20,000 acres, the Catlin Canal with 20,000 acres, and the Holbrook Canal with 16,000 acres. Other major canal systems in this area include the Excelsior, Collier, Colorado, Oxford, Otero, Rocky Ford, and Las Animas.


Headgate
River
Lake
County Boundary
Water District
N
W
E
S
Figure 5.
Major Irrigation
Diversions In Water
District 14, 17
CDM
Water District 67
Water District 17
Water District 10
Water District 12
Water District 14
Water District 15
Water District 19
Water District 18
Water District 16
Water District 79
Water District 8
Cheyenne County
Lincoln County
Kiowa County
Bent County
Baca County
Elbert County
Crowley County
Otero County
El Paso County
Teller County
Fremont County
Pueblo County
Custer County
Las Animas County
Huerfano County
Kickingbird Canal
Las Animas
La Junta
Ordway
Holbrook Canal
Fort Lyon Storage Canal
Las Animas Town Ditches
Las Animas Consolidated
Rocky Ford Ditch
Fort Lyon Canal
Catlin Canal
Oxford Farmers Canal
Otero Canal
Rocky Ford Highline
Colorado Canal
Excelsior Ditch
Bessemer Ditch
Pueblo
Fountain
Colorado Springs
Manitou Springs
Cripple Creek
Canon City
Florence
Walsenburg

This reach of the Arkansas River, as well as the reach below John Martin Reservoir to the Colorado-Kansas state line, has been extensively studied as a result of litigation between Kansas and Colorado over interpretation of the Arkansas River Compact signed in 1948. This litigation began in 1985 and was concluded in 2008. The two states jointly developed the Hydrologic-Institutional (HI) Model, which is a computer model that attempts to model the hydrologic and institutional components of the Arkansas River Basin. This model and related data are being used to determine compact compliance by Colorado under terms of the various agreements between the two states as approved by the U.S. Supreme Court. Information from the HI Model databases includes estimates of irrigated acres at 5-year intervals using satellite imagery. The latest estimate of the irrigated areas in Water Districts 14 and 17 is approximately 234,000 acres.

This reach of the river has had several traditional conversions of irrigation water rights to municipal use. For example, Bessemer Ditch shares have been acquired by the PBWW, St. Charles Mesa Water District, and Avondale Water and Sanitation District; some land has been removed from irrigation. The most recent acquisition by the PBWW includes a lease back provision to share owners for a period of 20 years. About 38 percent of the shares under the 20,000 acres initially irrigated by the Bessemer Ditch have been acquired for municipal use.

This reach of the Arkansas has been evaluated in significant detail for ATM possibilities, with two entities receiving ATM grant funding to begin or continue ongoing studies. As described in Section 2.2.3, the Super Ditch Company being proposed by the LAVWCD is a large rotational fallowing and leasing program being developed to provide water for municipal use under contracts with 40-year leases. The Super Ditch Company includes possible rotational fallowing and leasing under the Bessemer Ditch, Rocky Ford Highline Canal, Oxford Farmers Ditch, Otero Canal, Catlin Canal, Holbrook Canal, and the Fort Lyon Canal. The Super Ditch Company has conducted several studies to support the eventual water right filings that will be necessary to allow the change in use and transfer of water upstream to potential lessees.

The Rocky Ford Highline Canal is also considering some form of leasing and rotational fallowing and received a grant from the CWCB to help evaluate these options. However, the canal company has not yet entered into a contract to begin the study (see Section 2.2.6). These investigations of the potential for ATM development in the Lower Arkansas Valley are consistent with findings in the SWSI 2 report, which, along with the water districts in the lower reaches of the South Platte River, identified Water Districts 14 and 17 as viable locations for the implementation of a rotational fallowing program.

The ability to use the changed water rights from Water Districts 14 and 17 for primarily municipal uses upstream at Pueblo Reservoir or at points further upstream of Pueblo Reservoir will be most easily accomplished by exchange to these higher locations. However, a number of water providers have already obtained decreed rights of exchange from various downstream locations in Districts 14 and 17 to Pueblo Reservoir and points upstream and the City of Pueblo holds a recreational in-channel diversion (RICD) water right within this reach. The number of

exchanges that have been decreed or are pending totals 15, with priority dates ranging from February 10, 1939 to December 31, 2000. The total amount of the exchanges is difficult to quantify because of decree limitations but it is on the order of 800 cfs. These exchanges are shown in Table 5-6 of the State and Tribal Assistance Grant (STAG) Final Report for the Arkansas Valley Conduit (SECWCD 2010), included with this report as **Appendix D**.

In addition, there are locations at senior canals where calls result in a dry-up of the Arkansas River during the irrigation season. The dry-up locations are below the Catlin Canal and the Ft. Lyon Canal. In addition to the version included in Appendix C, there are straight-line diagrams available at the Division 2 Engineer's office and in various publications that show where the various canal systems are located along with the water rights decreed to them. A Decision Support System (DSS) program for the Arkansas River has not been completed at this time, but development is underway; it is anticipated that a DSS for the Arkansas Basin will be available within a few years if funding remains available.

The Pueblo RICD when combined with the senior exchanges will significantly impact the ability to exchange water from canals in the Super Ditch Company or from the Rocky Ford Highline Canal and limit exchange conditions to times of higher flows below Pueblo Reservoir. At other times, yield from the dry-up of lands irrigated by water from participant canals will have to be stored in local reservoirs where water can be held until flow conditions permit exchange to Pueblo Reservoir. It is possible that exchange potential has been nearly consumed and that pump back infrastructure will have to be constructed to move water to those whom have contracted for water. The Super Ditch Company has contracted with Leonard Rice Engineers to evaluate exchange potential remaining and to determine what infrastructure may be needed to facilitate the movement of water to water providers leasing the water. Estimates of historical CU available and exchanged to Pueblo Reservoir are included in **Table 3** below, which is reproduced from a version presented by the LAVWCD to the Arkansas Basin Roundtable in April 2010.

Table 3. Super Ditch Estimates of Water Available for Transfer[1,2]

Water Year	Historical CU Available (AFY)[3]	Exchanged to Pueblo Reservoir (AFY)[4]
Wet (1985)	78,000	53,000
Median (1996)	66,000	22,500
Dry (2002)	14,500	3,600

1 Assumes 65 percent participation (25 percent for Bessemer)
2 Assumes 1-in-4-year rotation
3 H-I model assumptions used to estimate CU of participating parcels
4 Used 2009 daily point flow exchange model with 1979-2008 simulation period of record

Local existing reservoirs such as Holbrook and Dye Reservoirs, Lake Meredith, and Lake Henry may be able to store water from rotational fallowing projects to allow yield from dry up of lands to be used by exchange or for pump back projects. Another possibility is to construct new

storage such as that associated with lined gravel pits located along the Arkansas River near the canals participating in the rotational fallowing program. Water could be released or pumped from the lined gravel pits to the river for exchange or for a pump back project.

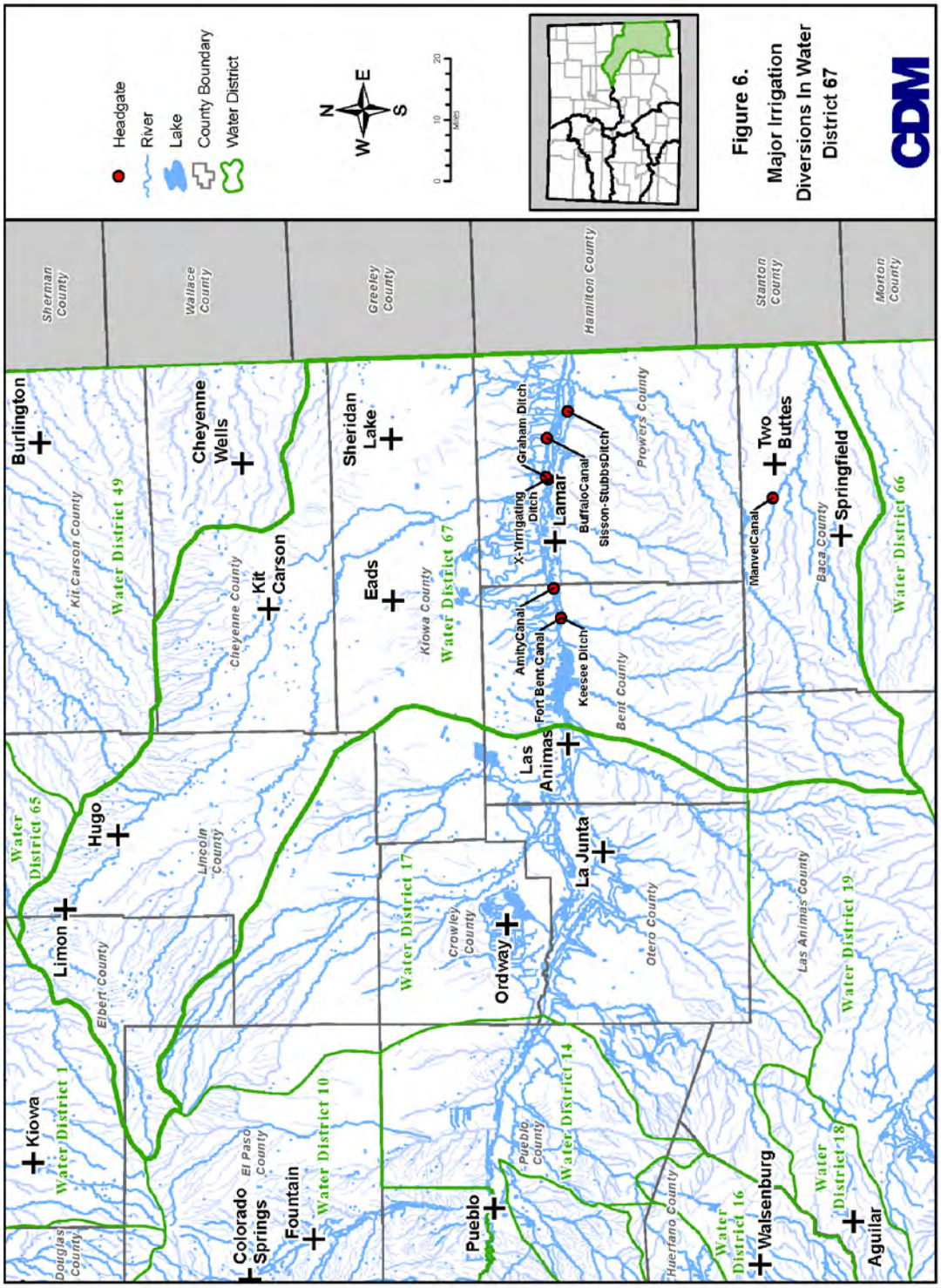
The water quality of water in Districts 14 and 17 is reduced as return flows from irrigation reach the Arkansas River and the TDS concentration increases. It is probable that a pump back project located in the Rocky Ford area or downstream will need to provide desalination treatment to reduce TDS to levels acceptable to the water providers. Water quality concerns are discussed in greater detail in Section 4.4 in the context of barriers to ATM project implementation.

3.2.2 Arkansas River, Water District 67, Las Animas to the Stateline

This area, shown in **Figure 6**, includes the Arkansas River from the Las Animas stream gage above John Martin Reservoir to the Stateline and has an estimated 105,000 irrigated acres (CWCB 2011c). It includes John Martin Reservoir, which was constructed in the 1940s to provide storage of winter flows and spring runoff for use by Colorado water users and by Kansas water users near Garden City, Kansas and to provide flood control protection. It has a capacity of about 600,000 AF. The Arkansas River Compact and the various agreements between the states allocate the benefits of John Martin Reservoir, with 60 percent to Colorado and 40 percent to Kansas. The U. S. Army Corps of Engineers operates the reservoir and has an office at the reservoir for making daily releases based on coordination with the Water Division 2 Engineer.

The area has six active irrigation canals with the Keesee Ditch, located just below John Martin Reservoir, having the most senior water right of March 3, 1871 and the Buffalo Canal at the east end of the area with a January 29, 1885 priority. The largest canal is the Amity with about 34,000 acres irrigated from direct flow water rights totaling 784 cfs and storage rights in the Great Plains Reservoirs (266,000 AF). The Great Plains Reservoirs have a priority date of August 1, 1896 and store from the Kicking Bird Canal, which uses the Fort Lyon Storage Canal and diversion dam to carry water to a bifurcation into the Kicking Bird Canal. This water right is only exercised in above average flow years and has not delivered any water via the canal since the late 1990s.

Over 50 percent of the Amity Canal was purchased by the Tri-State Generation and Transmission Association, and the use was changed to industrial and other uses in a change case completed in 2009. The shares are leased back to farmers for irrigation until a need for the changed water rights arises.


Headgate
River
Lake
County Boundary
Water District
N
W
E
S
Figure 6.
Major Irrigation
Diversions In Water
District 67
CDM
Sherman County
Wallace County
Greeley County
Hamilton County
Stanton County
Morton County
Burlington
Cheyenne Wells
Sheridan Lake
Kit Carson
Eads
Lamar
Two Buttes
Springfield
Hugo
Limon
Ordway
Las Animas
La Junta
Kiowa
Colorado Springs
Fountain
Pueblo
Walsenburg
Aguilar
Graham Ditch
X-Virrigating Ditch
BuffaloCanal
Sisson-StubbsDitch
AmityCanal
Fort Bent Canal
Keesee Ditch
ManvelCanal
Water District 65
Water District 49
Water District 67
Water District 66
Water District 17
Water District 10
Water District 14
Water District 19
Water District 1
Water District 16
Water District 18
Kit Carson County
Cheyenne County
Kiowa County
Prowers County
Bent County
Baca County
Lincoln County
Elbert County
Crowley County
Otero County
Las Animas County
El Paso County
Pueblo County
Huerfano County
Douglas County

The Lower Arkansas Water Management Association, which provides augmentation water for high capacity wells in the area, has acquired water rights from several canals and has an approved plan for augmentation to allow the wells to pump in accordance with the State Engineer's 1996 Rules concerning the use of tributary groundwater. The Sisson-Stubbs Ditch and X-Y and Graham Ditches were purchased and the lands under these canals removed from irrigation. In addition, shares in the Manvel and Ft. Bent Canals were purchased and the uses changed to include augmentation.

The likelihood of an ATM project to provide water for municipal use for the Front Range area seems fairly remote due to the inability to exchange water above John Martin Reservoir because of a requirement in the Arkansas River Compact that Kansas must approve such an exchange, and the difficulty of exchanging water above the Fort Lyon Canal under most flow conditions. The infrastructure needed to move water to the Front Range would not only involve pumps, a pipeline, and reservoirs for storing the yield of an ATM project, it would also require a reverse osmosis (RO) treatment plant to lower the TDS to acceptable levels. The TDS of the Arkansas River in this area exceeds 2,000 parts per million (ppm) throughout the year. The infrastructure costs would appear to make an ATM project infeasible in Water District 67. This conclusion is in contrast to SWSI 2, which previously identified Water District 67 as a region of the state where a rotational fallowing program appeared to be feasible.

Section 4 – Barriers to ATM Implementation

The SWSI 2 report (CWCB 2007) included a detailed list of issues and concerns associated with each of the five ATM concepts that were evaluated in the study. These obstacles are not limited to ATM concepts, as the SWSI 2 report states, "It should be noted that many of the issues…relating to water court and infrastructure needs would be similar to those faced with an agricultural transfer involving the permanent dry-up of lands." As shown in the project descriptions in Section 2, each of the grant recipient projects is focusing on one or more of the ATM concepts presented in the SWSI 2 report, and is seeking to find solutions to the various barriers to implementation.

Through the CWCB's ATM Program, additional hurdles have been identified that must be overcome for these alternative water transfer methods to be successful in Colorado. The major hurdles facing the implementation of ATM programs in Colorado include:

1. Potentially high transaction costs associated with water rights transfers.

2. Water rights administration uncertainties and water rights accounting questions.

3. Certainty of long-term supply and desire for water providers to have permanence of long-term supply.

4. Infrastructure needs and water quality issues.

Each of these barriers will be addressed in the following sections, with a description of the problem and potential solutions identified by the grant recipient projects. An expanded matrix of issues associated with the development of ATMs and the results from each ATM grant-funded study related to those issues are presented in Appendix B. Most of the content of this appendix was previously released as a Draft Technical Memorandum dated July 16, 2010, with the subject "Alternative Agricultural Transfer Methods Grant Program Summary of Key Issues Evaluation." For its incorporation here as Appendix B, the content of the memo has been revised to reflect recent findings and updated schedules for the grant-funded projects.

4.1 Potentially High Transaction Costs

Currently, there are few incentives for water providers to seek alternatives to permanent water transfers. Establishing a viable marketplace without an expensive water court process has been raised by some as a needed incentive to encourage participation in ATM programs. A potential barrier to a more active water market is that water rights change cases can entail high engineering and legal expenses. For example, regarding the ATM concept of reduced crop CU (see Section 2.1.4), the SWSI 2 report (CWCB 2007) specifically says that "Legal and engineering costs will be incurred and likely be higher than other alternatives." Reducing transaction costs and providing for administrative approval by DWR staff could be incentives for alternative agricultural transfer programs to succeed. The Super Ditch Company project team (Nichols 2010) elaborates on the factors that create the potentially high transaction costs, as follows:

> It appears that the costs and time required for legal, engineering, and accounting under a "business as usual" approach to a rotational fallowing change case may become cost prohibitive to the irrigator-lessors. There are several reasons for this: 1) water court change cases to implement leases would require engineering of each participating farm; 2)the number of acres required to be "engineered" to create a given transferable yield through a one-in-four rotational fallowing program is four times the number of acres that would be required under a traditional buy-and-dry scenario; 3) the accounting requirements (for decree compliance) under a one-on-four rotational fallowing program will be more complicated than a traditional buy-and-dry scenario; 4) engineering solutions to canal operations are more complicated under a rotational fallowing program than under a traditional buy-and-dry scenario; and 5) irrigator-lessors have little or no ability to finance the up-front engineering and legal costs of a water rights change case.

The ultimate conclusion reached by the Super Ditch team is that the water court costs associated with a large-scale rotational land fallowing-water leasing program will delay and possibly kill fallowing-leasing.

Potential solutions to these problems include a simplification of the water rights engineering required for temporary transfers, which would help the irrigator-lessors to pursue a change

case. Developing a "presumptive depletion" or "rebuttable presumption" type of change of water right process for temporary transfers that would "keep the river whole" could be an alternative to the very expensive "business-as-usual" engineering for a change of water right case that requires individual farm analyses. This would have to be accomplished at the legislative level. Another solution to the time and cost of a water court change case would be legislative enactment of a process for administrative approval of alternative agricultural transfers, in essence, and extension of the interruptible supply contracts statute to allow long-term leases.

The IBCC has looked to the ongoing efforts made through the CWCB's ATM Program and is recommending some strategies that can make such alternative transfers easier to achieve than traditional transfers resulting in permanent dry-up. One recommendation is to consider legislation that would allow the State Engineer to approve longer-term temporary transfers of irrigation water rights to another user via fallowing-leasing agreements. This could include allowing the State Engineer to approve these transfers (using a process similar to existing authority to approve substitute water supply plans) without requiring the potentially high transactional costs associated with a water court change case, while still providing that other vested water rights and decreed conditional water rights are not injured. The IBCC did recognize that any proposed legislation should take into consideration the differences between basins, and may need to be basin-specific.

Care should be taken when considering ways to make such alternative transfers easier to achieve. One of the reasons for the expense of the "business-as-usual" approach is that the primary goal is to avoid injury to other water rights and the burden of proof of no injury falls on the party wishing to transfer water. A shift from the "business-as-usual" approach, if not carefully thought out and implemented, may result in injury to other water rights and a shift of engineering and legal costs to parties not participating in the transfer.

4.2 Water Rights Administration Issues

While alternative agricultural transfer methods may be permissible under Colorado water law, there is some uncertainty as to what is allowed and how these alternative methods would be administered by the Division Engineers. With regard to the administration of various ATM concepts, the SWSI 2 report stated the following issues and concerns:

- Long-term rotational fallowing: "Administration by the SEO must be clear and achievable and adequately funded."

- Reducing consumptive use through cropping: "Administration issues would be more complicated and difficult to monitor."

In other words, ATMs may require significant work by the Division Engineers' Offices and the water commissioners to properly administer an alternative program as compared to a permanent dry-up of irrigated agricultural lands. Other water users expect that the DWR will

provide the impartial oversight needed to verify an irrigator is not expanding his water right or that other water right holders are not injured. It may be that a third-party could provide the verification and report to the Division Engineer paid for by the city and/or farmers. Preliminary findings from several of the ATM grant-funded projects suggest that this idea of third-party administration and/or administration by project proponents has merit and could help to ease the workload of the DWR:

- **CCGA:** Administration of the proposed alternative transfers would be a cooperative effort between the supplying agricultural users, the purchasing/leasing M&I users, and other involved parties. In the context of the Private Water Market, the details of program administration would be developed in the contract between the parties establishing the market and the water court decree approving operation of the market. The project team discussed the potential for a "Private Market Administrator"—a person or entity agreed upon and funded by the parties and approved in the water court decree that would oversee all aspects of operation, coordinate deliveries, and perform accounting functions.

- **Super Ditch:** The Super Ditch team also offers, as a general recommendation to improve program administration for all types of alternative transfer programs, the development of standardized, professionally-accepted, and relatively inexpensive monitoring programs for verification. It appears that all agriculture-related activities will require a higher degree of measurement and monitoring than we currently have available. Verification of deficit irrigation measures and other options to reduce consumptive are examples where additional tools are needed. Thus, some standardization and consistency with measurement devices and methodologies appears essential for moving transfers through the administrative process.

- **FRICO:** The shared water bank concept would involve cooperation between FRICO Barr and Milton shareholders and participating M&I water providers. As envisioned, the bank would be managed and administered by FRICO with participation by M&I water providers and FRICO shareholders.

According to a project summary handout provided at an October 2010 ATM workshop, Phase 4 (Administration and Basin Level Hydrology) of the LSPIRDP will "...address administration and hydrologic consideration necessary for the successful implementation of rotational fallowing and limited irrigation cropping practices as water saving approaches in Colorado" (PWSD and CSU 2010). This phase of the project is underway, but results of the analysis are not available at the time of this writing.

In summary, although some studies have been initiated and may be partially completed, there is not yet a consensus about how to measure, calculate, and monitor the amounts of water that can be made available as the result of implementing many of the ATM options discussed above without injury to other water rights. Fallowing-leasing seems to be ahead of many of the other ATM concepts in this regard, as it would likely use the same methodologies that have been used

in conventional agricultural transfers. However, the other options need more basic scientific research before such methodologies will be known and potentially gain acceptance in the water community, the SEO, and the water courts.

4.3 Certainty of Long-Term Supply and Permanence Issues

Another issue often raised is the need to reduce the uncertainty for municipal water providers so they are willing to participate in an alternative agricultural transfer program. Reducing the transactional costs as discussed above could provide some encouragement for those programs that rely on individual farmer's participation. An additional area of discussion should be on how an alternative agricultural transfer program would work within a municipal provider's overall water strategy for firm yield by combining this concept with dry-year leases or interruptible water supply agreements allowed by statute (CRS 37-92-309) to provide for future dry-year water needs. It would have to be economically viable for a municipality to pursue this alternative to more traditional water acquisitions resulting in permanent dry-up. Findings of the ATM grant projects regarding certainty of long-term supply are as follows:

- **CCGA:** The Private Water Market Concept addresses the permanence issue by calling for a permanent sale of a small percentage of the agricultural producers' CU (the project team suggested 10 percent) to the M&I user as a condition of participation in the leasing aspects of the program, which would provide for shorter term arrangements for an amount up to the remaining 90 percent. This was viewed as an "entry fee" for both parties, ensuring the M&I user that regardless of the outcome of the leasing arrangement, it would have a firm CU yield, and the agricultural producer that M&I user is committed to the process and willing to invest the resources necessary to achieve success. In addition, the study team proposed that the agricultural producer provide the M&I participant a right of first refusal by contract, so that should the agricultural producer decide to sell the water right, the M&I user would have the opportunity to purchase it. This would allow the M&I user to retain the advantage of its initial investment in changing the use of the water to allow for M&I uses under the lease arrangement.

- **Super Ditch:** A willingness for municipalities to accept long-term leases as a secure form of water supply, similar to municipal acceptance of U.S. Bureau of Reclamation (BOR) water service contracts would improve chances of success for ATMs.

- **FRICO:** Interviews with northern Denver metro area municipal water providers indicated that there is little interest in alternative transfers that are not permanent or result in the potential for future payments by M&I users to secure permanent supplies. The preference by municipal providers is for traditional water transfers that result in a one-time upfront payment for water rights acquisitions and ownership of the rights by the municipal provider. Most providers indicated that they had or will acquire supplies sufficient to meet future demands.

As discussed in Section 2.2.3, two entities—the City of Aurora and the Pikes Peak Regional Water Authority—have agreed upon terms as a basis for negotiations for long-term lease contracts with the Super Ditch Company. At least in the case of Aurora, this leasing is only periodic and subject to certain criteria that determine when the water will be available.

However, the willingness on the part of water providers to explore and utilize ATMs is clearly indicated by existing lease back activities, current rotational-fallowing and ISA negotiations, water bank studies, and ongoing interest and analysis of reduced crop CU that are occurring throughout the state.

4.4 Infrastructure and Water Quality

Various parts of Section 3 of this report identified Water Districts 1 and 64 in the South Platte Basin and Water Districts 14 and 17 in the Arkansas Basin as prime locations for the development of ATM projects. These findings were consistent with conclusions presented in the SWSI 2 report, which also identified Water District 67 in the Arkansas Basin. However, Water District 67 was determined herein to have too many obstacles for ATMs to be successful below John Martin Reservoir. Geography plays a role in each of the ATM grant projects, as follows:

- **PWSD and CSU:** This issue of project geography is not specifically addressed in the recent progress report. However, the project includes controlled research by CSU on a farm near Illiff in Logan County, Colorado that is owned by PWSD. Logan County is a significant distance from PWSD's service area in northeastern Douglas County, in the southern region of the Denver metropolitan area. Substantial investments in conveyance infrastructure would be required to directly deliver transferred agricultural water from the research farms to PWSD.

- **CCGA:** Geography has a significant influence on the ability to market water from alternative transfers (and permanent transfers as well). However, in the research on the programs associated with the demonstration projects, it was not apparent that geography would impact transfer methods differently. For example, it was not apparent that a rotational fallowing program would have a greater chance of success compared to a deficit irrigation program based on geography. However, as discussed in greater detail in the CCGA findings presented in Appendix D, alternative transfer methods can be extremely beneficial to overcoming geographic barriers to water transfers.

- **Super Ditch:** The sources of supply for this proposed rotational land fallowing-water leasing program are irrigation ditches diverting water from Pueblo Reservoir (Bessemer Ditch) or the Lower Arkansas River east of Pueblo (all other sources). Identified potential customers are located in Northern El Paso County, thus requiring pipeline conveyance of up to 125 miles and vertical lift of 3,000 feet or higher. Each alignment will traverse major roadways,

railroads, public lands, waterways, and private property. Significant efforts are required to obtain the permits and easements to build a water conveyance system through or around these types of existing infrastructure, land uses, and land ownership.

- **FRICO:** FRICO is the largest irrigation company near the Denver metropolitan area. A list of potential water providers that have infrastructure and/or water rights that could interface with FRICO's system was developed. Geographic information system (GIS) mapping was developed of key water provider storage and delivery facilities that could interface with the FRICO system. This list of M&I providers in the Denver metro area was narrowed to those providers that represent the most likely customers of water from the alternative agricultural transfer methods identified in the FRICO Barr and Milton shareholder surveys. North metro providers that could directly receive ATM supplies without additional infrastructure include South Adams Water and Sanitation District, the cities of Thornton and Brighton, and the towns of Lochbuie and Hudson. ECCV, UWSD, and ACWWA have developed infrastructure and treatment facilities within the FRICO system that could convey water developed from FRICO ATM methods to water providers in Adams, Arapahoe, and Douglas Counties. In addition, many Denver metro water providers could receive FRICO ATM supplies via substitutions, exchanges, or augmentation plans.

- **CSU Extension:** By selecting demonstration sites under two ditch systems more than 20 miles apart, the CSU Extension will be able to provide a comparative assessment of whether location in the Lower Arkansas Valley affects the parameters being studied in the context of rebound from fallowing.

It is clear from these findings that geography directly impacts infrastructure requirements for delivering water made available by ATM projects to centers of demand. Infrastructure needs were emphasized in the SWSI 2 report:

> Significant infrastructure would be required to deliver agricultural water from the lower South Platte or lower Arkansas to the gap areas of the south metro area or northern El Paso County. As identified in the SWSI Report, there is very limited new exchange potential that would allow this water to be diverted upstream using existing infrastructure. This infrastructure would be needed even if a traditional agricultural transfer were to be implemented from the same geographic areas…[A]pproximately 60 to 100 miles of pipeline would be required to convey water from the agricultural areas to a centralized location near two major gap areas [South Metro and El Paso County]. Pumping facilities would also need to be constructed to lift the water the 1,500 to 3,500 feet.

The evaluation of infrastructure needs for agricultural transfers was continued in a June 2010 report titled *Reconnaissance Level Cost Estimates for Agricultural and New Supply Strategy Concepts* (CWCB 2011d). This report includes pipeline alignments and costs from Lower South

Platte and Lower Arkansas to centers of M&I gap. Observations by the ATM grant recipients regarding infrastructure needs are stated below:

- **PWSD and CSU:** This issue does not appear to be addressed directly in the current progress report (Hansen et al. 2010). However, Phase 5 will provide a final report at the completion of all work related to this project, including the research results, conclusions related to the on-farm demonstrations, local and regional economic analyses, preliminary planning studies related to delivery of water, and the proposed administrative and hydrologic procedures that are proposed to support change of use proceedings in Water Court.

- **CCGA:** New infrastructure may be required for the DT Ranch and Private Market projects, but requirements are not anticipated to vary significantly from the requirements of a traditional transfer. The Lower South Platte Co-op concept could benefit from the construction of new storage, pipelines, pump stations, and recharge facilities.

- **Super Ditch:** In summarizing the infrastructure question generally, the Super Ditch team finds that infrastructure to move water from agricultural areas to areas of municipal need is limited and/or lacking, a problem that will have to be resolved before alternative transfers can realize their potential. Municipalities are reluctant to fund infrastructure for water they lease rather than own, and infrastructure is cost-prohibitive for the irrigators. More specifically, according to the documentation supplied by the Super Ditch project team, river diversion and storage is needed near the Arkansas River to provide for cost-effective design of the conveyance facilities. Without storage, the pump stations and pipeline(s) would have to be designed for more widely varying flow rates requiring larger diameter pipe and either (1) more pumps, (2) combinations of smaller and larger capacity pumps, or (3) more variable frequency drives for the pumps. Storage is also needed near the water users systems to provide water to their treatment plants as their production rates vary seasonally and day-to-day. At least nine storage options were identified that could be readily incorporated into the Super Ditch system infrastructure.

- **FRICO:** The project concept is designed to take advantage of opportunities that exist within FRICO's existing infrastructure and recharge capabilities. A key finding is that FRICO has significant capacity in its diversion and surface storage facilities. Furthermore, FRICO has significant potential to develop recharge facilities in the Beebe Draw alluvial aquifer with different unit response functions. The associated groundwater accounting is relatively straightforward, but involves the development of accounting programs to simplify the reporting of the monthly recharge volumes and accretions for multiple recharge ponds. As noted, given FRICO's unique geography, there is the potential to deliver water to many providers in Adams, Arapahoe, Boulder, Broomfield, Douglas, and Jefferson Counties.

One potential solution for water providers pursuing ATMs and needing options for delivery of leased or transferred agricultural water at a regional level is the contractual use of existing

infrastructure owned and operated by another water provider. Colorado Springs Utilities contributed the following information for this report, outlining the possibilities for contractual use of their facilities:

> In May 2010, the Colorado Springs Utilities Board approved policy changes that modify EL-10 and EL-13 to allow Colorado Springs Utilities to offer water-related services to regional water providers on a contract basis, provided such contract service does not jeopardize Colorado Springs' water rights or supply, benefits Colorado Springs Utilities' ratepayers, and is in the best interests of the citizens of Colorado Springs. City Council then modified the City Code to reflect these changes and to be consistent with Colorado Springs Utilities policy. These changes set the stage for Colorado Springs Utilities Staff to have substantive discussions with prospective regional water providers, concerning water-related services and/or water project partnerships. Such agreements require City Council approval.
>
> Colorado Springs Utilities staff and legal counsel have met with local providers to discuss and advise them on the regulatory and contracting provisions that will be required for long-term water-related services agreements that will benefit from Southern Delivery System (SDS) operation. Specific issues include how regional water providers obtain BOR's approval for conveyance of their water through Colorado Springs Utilities' SDS, how they obtain the same from Pueblo County under Colorado Springs Utilities' 1041 permit for SDS conveyance, and how they participate in regional stormwater management efforts in El Paso County. Also, water providers have initiated research and discussions with BOR concerning contracts for storage and conveyance in federal facilities.
>
> Colorado Springs Utilities recognizes the impact and risk of regional growth and demands for water. Regional water planning is needed to ensure a beneficial and comprehensive approach to management of all water resources. Historically regional water planning and cooperation has proved beneficial for all parties, for example the various arrangements between Colorado Springs Utilities, members of the Fountain Valley Authority, Aurora Water, PBWW, Southeastern Colorado Water Conservancy District, LAVWCD, Upper Arkansas Water Conservancy District, and others. More locally, many water providers are often reliant on increasingly uncertain deep groundwater supply. Regional water planning and cooperation will create greater flexibility in developing necessary solutions, such as renewable water supplies, water quality, stormwater, and reducing the risk of nearby water providers failing.

In addition to the required physical transport of water from one region of the South Platte or Arkansas Basin to another, source water from the lower reaches of the South Platte and Arkansas Rivers has significant water quality concerns. From the SWSI 2 report:

> TDS are an indicator of the level of water treatment that would be required to produce an acceptable quality water. There is not a primary drinking water standard for TDS, but the secondary maximum contaminant level for TDS under the Safe Drinking Water Act is 500 milligrams per liter (mg/L). Recent customer surveys by the City of Aurora and ECCV suggest that customer acceptability of TDS is in the 300 to 450 mg/L range…The water quality in the lower reaches of the South Platte and Arkansas are impacted by the successive use of water in the basin as shown by the TDS of 530 mg/L to 1,300 mg/L. There is a secondary drinking water standard of 500 mg/L of TDS and the water supplies currently used by South Metro and El Paso County water providers have TDS significantly below this level. Advanced water treatment such as RO would be required to lower the TDS and treat other pollutants present in the river to acceptable and regulated levels.

Table 4 provides a summary of TDS data collected by the U.S. Geological Survey (USGS) and CSU at four locations in the Lower Arkansas Valley. Data collection was completed in the months of April, May, and June, in calendar years 2001 through 2008. This table is reproduced from documentation prepared by AECOM in support of the Super Ditch Program.

Table 4. Spring (April-June) TDS Concentrations (mg/L) in the Lower Arkansas Valley, 2001-2008 (AECOM 2010)

Statistical Summary	Arkansas River near Avondale	Rocky Ford	Fort Lyon Canal Headgate	Arkansas River at La Junta
85th Percentile	749	1,281	1,267	1,077
Minimum	518	585	135	754
Maximum	810	1,479	1,467	1,134
Average	639	957	881	944
Number of Values	32	19	16	2

The sampling locations are arranged from upstream to downstream in Table 4, and overall, the results are consistent with the range of TDS levels previously reported in the SWSI 2 report. In general, the data suggest increasing TDS concentrations as the river moves in the downstream direction. However, the results are somewhat inconsistent, likely as a consequence of fewer sample data points at each successive downstream location.

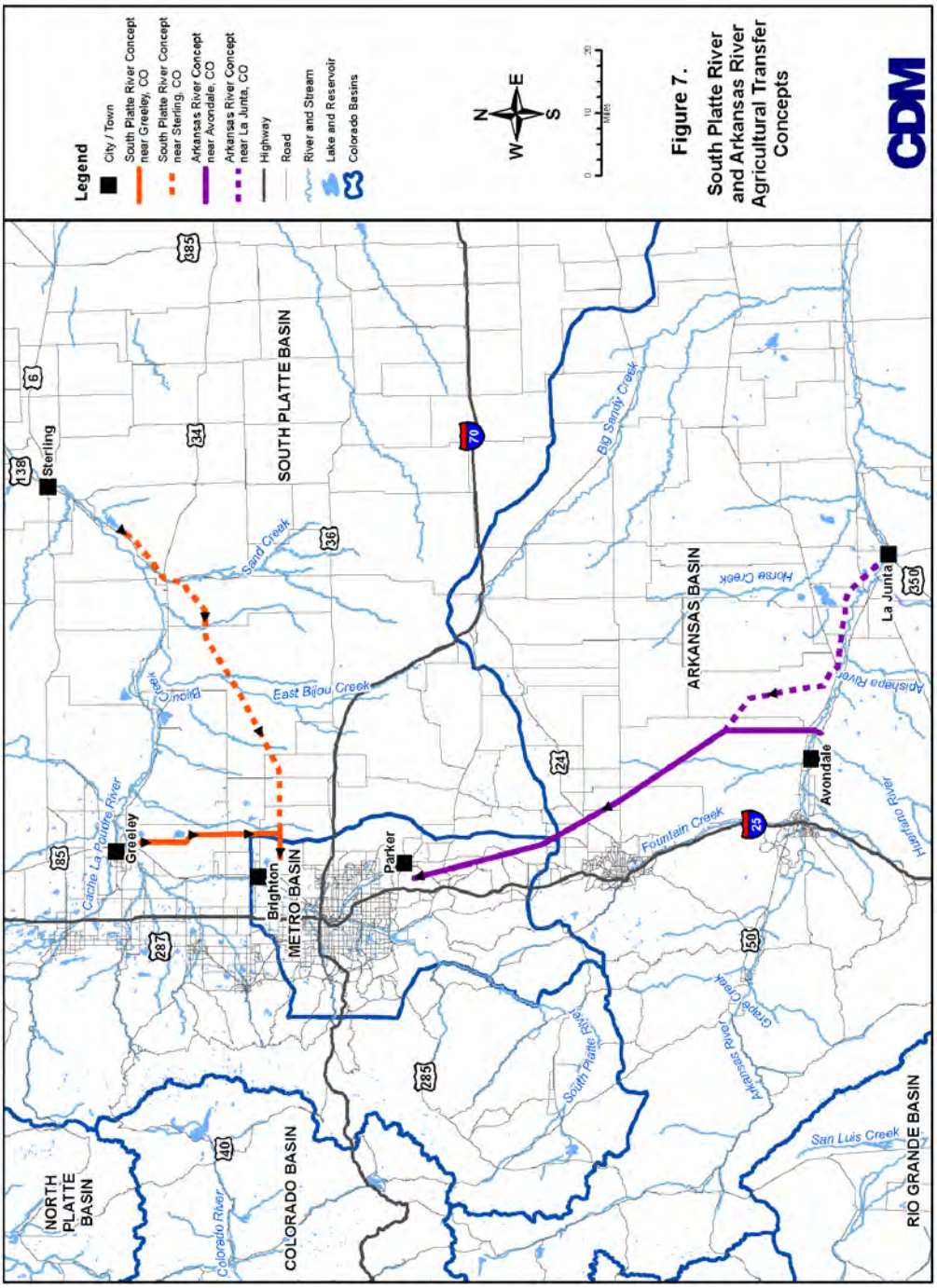
Increased infrastructure and water treatment requirements result in increased costs for facilitating agricultural transfers; either ATMs or traditional transfers. CWCB (2011d) developed reconnaissance level cost estimates for pipelines to deliver transferred agricultural water from various locations in the lower Arkansas and South Platte Basins, as described in **Table 5** and illustrated in **Figure 7**.

Table 5. Pipeline Alternatives for Delivery of Agricultural Water (CWCB 2011d)

Basin	Alignment	Diversion Location	Delivery Location
Arkansas River	1	Near Avondale, CO	Rueter-Hess Reservoir, Parker, CO
	2	Near La Junta, CO	
South Platte River	1	Near Greeley, CO	Near Brighton, CO
	2	Near Sterling, CO	

Capital costs were estimated for the delivery of 100,000 AFY (Option 1) or 250,000 AFY (Option 2), and are inclusive of conveyance, treatment, water rights, storage, and reuse. For the Arkansas Basin alternatives, capital costs range from $3.1 billion to about $8.5 billion (in 2009 dollars), depending on annual delivery volume and alignment selection. In the South Platte Basin, the range of capital cost estimates is $3.3 billion to $9.2 billion. Annual operations and maintenance costs would add millions of dollars in additional costs.

The infrastructure and treatment costs associated with any ATM project that derives its source water far from the demand center suggests an opening for shared water banking concepts such as that proposed by FRICO and described in Section 2.2.4. As reported at the October 2010 ATM workshop, there is a reluctance on the part of FRICO shareholders—as a result of the pending Colorado Supreme Court ruling on the appeal of Case No. 02CW403—to pursue ATM concepts such as leasing, rotational fallowing, or ISAs that would expose the irrigators' water rights to further risk. However, there appears to be a strong potential for the implementation of the "shared" water bank concept. Under such a program, existing FRICO infrastructure could be used to store surplus supplies held by Metro area water providers, and that water would be available in certain years for use by either M&I or agricultural users.


Legend
City / Town
South Platte River Concept near Greeley, CO
South Platte River Concept near Sterling, CO
Arkansas River Concept near Avondale, CO
Arkansas River Concept near La Junta, CO
Highway
Road
River and Stream
Lake and Reservoir
Colorado Basins
N
W
E
S
Figure 7.
South Platte River and Arkansas River Agricultural Transfer Concepts
CDM
SOUTH PLATTE BASIN
ARKANSAS BASIN
METRO BASIN
COLORADO BASIN
NORTH PLATTE BASIN
RIO GRANDE BASIN
Sterling
Greeley
Brighton
Parker
Avondale
La Junta
Big Sandy Creek
Sand Creek
East Bijou Creek
Bijou Creek
Horse Creek
Fountain Creek
Cache La Poudre River
Arkansas River
Huerfano River
South Platte River
Colorado River
San Luis Creek
Purgatoire River
Apishapa River

Section 5 – Summary and Conclusions

Planning documents prepared by the State of Colorado clearly indicate that, as population and demands for water continue to grow in the coming decades, it is increasingly likely that M&I water providers will turn to the acquisition of agricultural water rights as a source of supply for their customers. This is by no means a new phenomenon in Colorado; agricultural transfers have been occurring for decades as municipal boundaries expand further and further into once-rural territory. Agricultural water rights are an attractive source of water supply for M&I providers because they are typically very senior, with priority dates established in the latter half of the 19th century, and are likely to yield reliable supplies in all but the very driest years.

Unfortunately for farming communities, Colorado water law dictates that once agricultural water rights are sold to cities and towns and the allowable uses changed to include municipal use, the historical CU on the formerly irrigated land must permanently cease. This is normally accomplished via dry-up covenants whereby the historically irrigated lands are permanently dried up and restored to native vegetation or fallowed until development occurs. In most cases, this loss of agricultural production leads to adverse socioeconomic impacts for the source region. In response to these observation, the state recognizes the value in pursuing the development of alternative agricultural water transfer methods as a means to both (a) provide water supplies for Colorado's growing municipalities and (b) maintain agricultural production at only somewhat reduced levels in order to prevent the decimation of rural communities and economies.

Under the ATM Grant Program established in 2007, the CWCB has awarded $1.5 million to six groups—including cities, water districts, irrigation companies, university groups, and farm organizations—for the purpose of studying and further developing ATM concepts that might be implementable in Colorado. The recipients of the grant funding and the projects they are sponsoring are described in Section 2 and Appendix A.

As indicated in the project descriptions, there are some common elements between the various ATM projects. For example, both the PWSD and CSU study and the FRICO study seek to identify means to modify irrigation practices such that "saved" CU water could be transferred from agricultural to municipal use. Synergies exist in the Arkansas Valley as well, with collaborative studies involving the Super Ditch Company, the CSU Extension Office, and the High Line Canal Company. Moreover, most, if not all, of the projects involve some level of analysis to assess the economic viability of selected alternative transfer methods. Through evaluations of production costs and estimation of acceptable prices to be paid for leased and/or transferred water, these analyses aim to assure farmers that the profitability of their operations can be maintained.

Key project findings are documented in Section 4 in the context of finding solutions to major hurdles to ATM implementation; further details of project findings are provided in Appendix B.

The findings suggest that combinations of ISAs, shared water banking, and/or purchase and leaseback are likely to find success in Colorado. ISAs and rotational fallowing appear particularly suited to areas in the lower South Platte and Arkansas Basins, areas where there is extensive irrigated land and little pressure from urbanized development. Shared water banking may be viable at the interfaces of urban and rural areas. For example, Sections 3.1.1 (Water District 2) and Section 3.1.2 (Water Districts 3 and 4) suggest that traditional agricultural transfers resulting in permanent dry-up are more likely in these areas due to the likelihood of subdivision of these lands for future growth of the Front Range urban corridor. However, at some scale, shared water banking or other practices may allow some irrigated lands to remain in agricultural production in these areas and to provide valuable open space buffer areas between developments.

For the purpose of this report, emphasis was placed on finding solutions to overcome barriers that complicate or preclude the development of ATM projects. One major impediment to ATM success is the potentially high transaction costs associated with water court processes, including engineering and legal fees. Current law in Colorado allows certain types of ATM projects such as ISAs, but limits leasing to no more than 3 out of 10 years. Municipalities are generally reluctant to make significant expenditures for water supplies that are not guaranteed in the long term. Infrastructure and treatment of poor-quality source water dramatically increase the costs of agricultural transfers. As identified by CWCB and the sponsors of the grant-funded projects, some specific areas where water court processes could be streamlined and transaction costs could be lowered are as follows:

- **Development of special review procedures to facilitate ATM agreements.** This would provide for administrative approval for the use of long-term temporary transfers to avoid the high transactional costs associated with a change in water right yet ensuring that other vested water rights and decreed conditional water rights are not injured.

- **Adoption of presumptive CU procedures.** In some areas, the adoption of presumptive historical crop CU procedures might help to streamline the process of using a water right through fallowing-leasing agreements. It is suggested that any presumptive CU amounts would need to be conservative in nature to minimize concern and opposition by other water right holders. For example, the State and Division Engineers are using the factors and assumptions from the HI Model developed in Kansas v. Colorado to implement new rules on irrigation efficiency which use the model output as the basis for presumptive consumptive use at a farm level.

- **Determination of historical CU for a canal or ditch system.** A ditchwide assessment of CU could also streamline the process for some ATMs. For example, this could provide both the irrigators and cities some additional certainty before negotiating fallowing-leasing agreements. This might significantly reduce the engineering and other transaction costs for a rotational fallowing program or other ATM. Additional work is needed to discuss how and

where these could work to incentivize alternative transfers rather than to facilitate permanent water transfers.

- **Develop specific methodologies for measuring, calculating, and monitoring CU water transferred through ATM projects.** Studies are needed to develop specific methodologies for measuring, calculating, and monitoring the amounts of water that can be made available through ATMs without injury to other water rights. It appears likely that some of the grant applications in the upcoming round of the ATM Grant Program (discussed below) and the Water Supply Reserve Account may seek to address one or more components of this methodological question. If not, it is recommended that funding and support for encouraging such research be continued through the basin roundtables, CWCB, or other funding sources.

- **State funding of infrastructure cost.** Another incentive is for the state to help fund infrastructure (i.e., pipelines, supervisory control and data acquisition systems, storage, etc.) necessary to help ATMs work. Additional work is needed to define how this could work to encourage the use of ATMs.

- **Pursue transfer of a portion of a water right.** Many of the ATM programs being pursued in Colorado are examining the potential of transferring for M&I purpose a portion of the CU of a water right through deficit irrigation, different crop types, and/or irrigation scheduling. This type of transfer could be permanent or temporary. While the transfer of this water is possible under Colorado water law, it has not yet been tested in water court or codified by the General Assembly. This increases the uncertainty associated with these types of transfers. Additional discussion is needed to evaluate whether changes are needed to encourage the use of these ATMs.

Colorado's ATM Program is unique in the Western U.S. and to our knowledge no other Western state has implemented a similar program. Due to Colorado's unique geography and water law, alternative water transfers are oftentimes complicated and not yet proven as to the legality or practicality. State funding of water sharing projects have allowed proponents to explore the issues and obstacles associated with these methods and identify means to overcome the barriers and provide ideas for streamlining the process, providing incentives for their use and/or supporting pilot programs.

A second round of grants, to be awarded in January 2011 and totaling another $1.5 million, will fund activities that build on the first set of projects to explore further the identified obstacles and hopefully proposed solutions to these. The CWCB expects to fund projects which investigate:

- Barriers to acceptance of alternative transfer methods by cities and farmers

- Further technical analysis of transferable CU
- Administrative and legal barriers
- Institutional framework and water supply delivery options necessary to implement an alternative transfer method
- Potential third party concerns

The ATM Program can help serve as a clearing-house for information related to water sharing opportunities and help those entities interested in pursuing alternative transfer methods in their efforts. A future role of the ATM Program may be to provide funds for infrastructure for alternative methods, operating of water bank(s), and/or facilitating an alternative transfer.

Section 6 – References

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Appendix A
Colorado Water Conservation Board
Alternative Agricultural Water Transfer
Current Status of Projects (October 2010)

Appendix A - Current Status of Projects (October 2010)

The sections that follow include brief status reports for each of the grant recipients' projects that are currently underway. Note that while a grant was awarded to the High Line Canal Company in 2008, their project is not yet under contract as of late 2010.

Parker Water & Sanitation District/Colorado State University

The Lower South Platte Irrigation Research and Demonstration Project is an ongoing project that has received funding from several different sources. Current findings submitted to CWCB in June 2010 are described by Hansen et al. (2010) as follows:

> This report presents the results of work completed under Parker Water and Sanitation District's Water Supply Reserve Account (WSRA) grant (Contract Routing No. 08 PDA 00071). While this report presents the results from work conducted under the WSRA grant, the Lower South Platte Irrigation Research and Demonstration Project is ongoing under the CWCB's Alternative Agricultural Transfer Methods Grant Program (Contract No. C-150426). Therefore, this report can be considered a final report for the WSRA grant funds and a progress report for the overall project.

Specifically, the progress report includes findings for Phases 1 through 3 of the study. The remaining phases of the study are assumed to be ongoing, with the original schedule in the grant application anticipating delivery of a final project report to CWCB at the end of 2010.

Colorado Corn Growers Association

Documentation of current project findings and conclusions were provided to CWCB in a report titled "*Summary of Selected Findings for Development of Practical Alternative Agricultural Water Transfers Methods*" (CCGA et al. 2010).

The report summarizes the project status as of May 2010 as follows:

- Technical analyses referenced in the application are complete.
- The demonstration project for Lower South Platte Co-op is complete.
- Legal analyses of various alternative methods are complete.
- Barriers to alternative transfers and solutions to those barriers have been considered.
- The economic evaluation tool is complete. The project team is currently in the process of providing training on the economic evaluation tool.
- The guidance manual is under development.
- The remaining demonstration projects are underway.

It is anticipated that the project will be complete by the end of April 2011.

Three demonstration projects have been established to assess the viability of several alternative transfer methods, as follows:

- **DT Ranch (Interruptible Water Supply Agreement) –** As described by CCGA et al. (2010), DT Ranch is an entity owning shares of the Fort Morgan Reservoir and Irrigation Company (FMRIC) that is willing to lease to a municipal or industrial user on an interruptible supply basis. The demonstration project will evaluate the viability of interruptible supply agreements with end users outside of the FMRIC system.

- **Private Water Market (rotational fallowing; reduced consumptive use; purchase and leaseback; interruptible supply) –** The "private market" as conceived for this project incorporates a variety of alternative transfer approaches and would be a "water court approved contractual relationship between one or more municipal and industrial (M&I) users and one or more agricultural suppliers" (CCGA et al. 2010). The demonstration project will explore the application of the water market concept to the Platte Valley Irrigation Company (PVIC) and the City of Aurora. In such an arrangement, the agricultural user (PVIC) permanently sells a small percentage of shares (e.g., 10 percent, known as Base CU) to the M&I user(s) (Aurora). The remaining volume is referred to as Flex CU and is made available to the M&I users through variable leases (e.g., short-term, long-term, or interruptible). The agricultural user manages his or her land through rotational fallowing or reduced CU to produce the Base and Flex CU for the M&I user each year. Recharge sites, installed in cooperation with Ducks Unlimited, meet conservation goals and serve as vehicles for the delivery of CU and return flows. The Flex CU can be sold by the agricultural user at any time, whether to the M&I partner or to another water user, subject to a right of first refusal for the M&I user partner

- **Lower South Platte Co-op –** Augmentation plans on the Lower South Platte River often generate excess recharge credits that accrue to the river and leave the state. This alternative transfer proposal would facilitate the exchange of these excess credits, alternative transfer, senior rights, etc. to upstream agricultural and M&I users who are in need of augmentation supplies.

Lower Arkansas Valley Water Conservancy District/Super Ditch

The establishment of the Lower Arkansas Valley Super Ditch Company has been an ongoing pursuit since at least mid-2006, when pre-feasibility engineering studies were initiated. The Alternative Agricultural Water Transfer Methods Grant Program funded a portion of the ongoing project work in 2009-2010.

Current findings of Task E were documented in two places:

- Memorandum titled "Key study results" from George Oamek of Honey Creek Resources to Peter Nichols, Super Ditch legal counsel. Dated June 2, 2010.

- Draft Report *Rotational Land Fallowing Water Leasing Program Lower Arkansas Valley Super Ditch Company*. Aqua Engineering, Inc., July 2, 2010.

Current findings of Tasks F and G were documented in a memorandum titled "Alternative Water Transfer Methods – Interim Summary of Findings," from Rachel Pittinger and Steve Price of AECOM to Peter Nichols, dated June 1, 2010.

In addition, a personal e-mail communication from Peter Nichols to Todd Doherty of CWCB, dated June 1, 2010, offers the Super Ditch project team's thoughts on the question "What would it take to make an alternative agricultural transfer program work in Colorado."

Finally, a memo on *Draft Legislation To Incentivize Temporary Agricultural Water Transfers* from Peter Nichols to Todd Doherty of CWCB dated October 11, 2010 provides additional findings regarding facilitation of alternative agricultural transfers. These documents were reviewed to determine how the Super Ditch program has addressed the key issues identified in SWSI Phase 2.

Farmers Reservoir & Irrigation Company

The alternative transfers program proposed by FRICO uniquely integrates both agricultural and M&I water supplies. Water would be made available by irrigators through the implementation of various alternative transfer methods. Simultaneously, M&I providers may have surplus water supplies, particularly in wet years. Both sources of water could be deposited in a "shared" water bank, with all deposited water then being made available to project participants on a negotiated basis.

A memorandum submitted by FRICO to CWCB in June 2010 summarizes the current findings of several project tasks:

- Task 1 – Survey of FRICO Barr and Milton shareholders
- Task 2 – Survey of M&I providers
- Task 3 – Shared water bank structure
- Task 4 – Engineering analysis of alternative transfer mechanics

Water market experiments were conducted and the analysis of the impacts of an active water leasing market on water rights prices and transfers from agricultural to municipal use is near completion. Additional analysis is still underway for these and other tasks outlined in the project grant application. It is anticipated that ongoing work will be completed by early 2011, with a final report delivered to CWCB in May 2011.

Colorado State University Extension

Project activities being conducted by the CSU Extension office are focused on quantifying changes in yield, nutrient needs, and profitability that result on irrigated fields when they are brought back into production after various periods of fallowing. The project was designed to represent both interruptible supply and rotational fallowing arrangements. The demonstration sites are managed using practices typical to the region, including residue management for reduction of soil erosion and chemical applications for weed suppression.

The first of 4 years of this study has been completed, and findings to date are summarized in the report "2010 Annual Report to Colorado Water Conservation Board Alternative Agricultural

Water Transfer Methods" (Cabot et al. 2010a). A Fall 2010 update on year 2 of the study was submitted to CWCB in November 2010 (Cabot et al. 2010b).

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Appendix B
ATM Issues Matrix and Project Findings

Appendix B – ATM Issues Matrix and Project Findings

Alternative Transfers Issues Matrix

A specific objective of these projects is to evaluate alternative agricultural water transfer options in the context of a series of technical, legal/institutional, and financial/economic issues that were identified in the course of the SWSI 2 study (CWCB 2007). Table 1 below identifies each issue and the perceived applicability of each project to that issue.

Table 1. Alternative Agricultural Water Transfers Issues Matrix

	Parker Water & Sanitation District/Colorado State University	Colorado Corn Growers Association/Ducks Unlimited/City of Aurora	Lower Arkansas Valley Water Conservancy District/Super Ditch	Farmers Reservoir & Irrigation Company	Colorado State University Extension Office	High Line Canal Company
Technical Issues						
Suitable irrigated lands (i.e., having adequate water yield, water quality/soil suitability)	X	X	X	X	X	X
Infrastructure requirements compared to traditional agricultural transfers	X	X	X	X		X
Impact of geography on alternative transfer viability (e.g., stateline vs. upstream water right)	X	X	X	X	X	X
Water quality impacts (e.g., effects of reduced river flows due to agricultural transfers on TMDLs, salinity, etc.)	X	X	X		X	X
Legal and Institutional Issues						
Administrative/Verification	X	X	X	X		X
Legislative or regulatory changes necessary to facilitate implementation of alternative agricultural transfer program	X	X	X	X		
Water court process related to program approach and implementation (i.e., water court test case)	X		X	X		X
Program administration (i.e., by end user, governmental agency, agricultural water rights owners, or ditch and reservoir companies)	X	X	X	X	X	X
Likelihood of success if agricultural user is not required to bind the land and water to irrigation (short term protection of agriculture)	X	X	X	X		
Program conditions necessary to ensure that private property rights are not impaired (how will a leasing program effect value of other water rights)	X	X	X	X		

Table 1. Alternative Agricultural Water Transfers Issues Matrix (cont.)						
	Parker Water & Sanitation District/Colorado State University	Colorado Corn Growers Association/Ducks Unlimited/City of Aurora	Lower Arkansas Valley Water Conservancy District/Super Ditch	Farmers Reservoir & Irrigation Company	Colorado State University Extension Office	High Line Canal Company
Financial Issues/Economic Considerations						
Estimate costs to organize and administer a program	X	X	X	X	X	X
Identify parties that could contribute to costs (governmental entity)	X	X	X	X		X
Estimate portion of the total land and water rights value that will need to be paid to an agricultural user as compensation for enrollment in a program	X	X	X		X	
Streamline/equalize water court transaction costs		X	X			
Cost vs. supply certainty for municipalities purchasing water via alternative agricultural transfers	X	X	X	X		
Compare annual local impacts of a rotational fallowing program with a permanent dry-up that includes voluntary payment in lieu of taxes	X		X			

In addition, the CWCB has requested that the grant recipients provide insight gained from the experience of these projects in order to address the question "What would it take to make an alternative agricultural transfers program work in Colorado?"

Key findings to date for each of the ongoing alternative agricultural water transfer projects are summarized below in the context of the critical issues identified in the matrix. Source documents submitted by the grant recipients are listed in the references section, including AECOM (2010), Cabot et al. (2010), Colorado Corn Growers Association et al. (2010), Farmers Reservoir and Irrigation Company (2010), Hansen et al. (2010), Honey Creek Resources (2010), and Nichols (2010). Not every project is designed to provide responses or insight to every issue; many projects will provide additional valuable information once all project phases or tasks are complete and final documentation has been provided to CWCB.

Technical Issues

Suitable Irrigated Lands (i.e., having adequate water yield and water quality)

Parker Water & Sanitation District/Colorado State University

The objective of the first study phase was to identify and evaluate a feasible set of cropping systems that have potential to meet M&I water demands while sustaining agricultural production. The approach used was to evaluate existing research and published information, to seek input and suggestions from a focus group, and to conduct personal interviews with irrigators in the South Platte River Basin. Cropping systems with potential to reduce

consumptive use by at least 20 percent compared to continuous corn with full irrigation were sought.

The discovery phase identified rotational cropping, limited irrigation, and partial season irrigation cropping systems as potential water conserving practices. Rotational cropping refers to sequences of full irrigation crops with fallow or dryland crops in subsequent years. Potential dryland crops for rotational cropping include winter wheat, annual forage crops, corn, sunflower, and proso millet. Limited irrigation cropping is the application of less water than required to meet the full water demand of the crop, with an emphasis on applying the limited water during critical crop growth stages to optimize the beneficial effects of the water. All crops in a limited irrigation system receive irrigation but at lower levels than fully irrigated crops. Potential limited irrigation crops identified are corn, winter wheat, annual forages, sugarbeet, sunflower, soybean, and canola. Partial season irrigation is a combination of full irrigation during part of the growing season with no irrigation during other parts of the same growing season. Partial season irrigation has relevance to perennial crops with documented success especially for alfalfa. A set of proposed cropping systems was identified for further evaluation in Phase 2.

Phase 2 of the study is a controlled small plot and an on-farm field-scale evaluation of water conserving cropping systems. The objectives of the controlled research are to document irrigation water application, consumptive water use, crop productivity, and profitability of representative water conserving cropping systems. A controlled research site was established in Iliff, Colorado with a linear-move sprinkler irrigation system customized for research and with an onsite weather station. The site facilitates research on approximately 250 small plots where a water balance approach is used to determine evapotranspiration (ET) and drainage, crop yield, and water use efficiency. The objective of the on-farm demonstrations is to evaluate the practicality and feasibility of the cropping systems when practiced on full sized fields with farmers managing the system.

In summary—rotational cropping systems that alternate irrigated crops with fallow or dryland crops were effective at reducing ET, with average ET reductions of 30 to 40 percent compared to continuous corn. Rotating irrigated crops with dryland crops was a much more water efficient approach than rotating with a non-cropped fallow because of high evaporation and drainage during fallow. Annual forage crops such as triticale are good choices for the dryland phase of these rotations because they use residual water and nutrients from irrigated crops and have lower production risk than dryland grain crops. Corn produced after a fallow period or a dryland crop had a higher yield and water use efficiency than continuous corn, illustrating the benefits of crop rotation to maximize water use efficiency.

Limited irrigation cropping systems reduced ET by an average of 30 percent. Both rotational cropping and limited irrigation of sugarbeet and an annual forage crop saved 40 percent of the reference crop ET. Sugarbeet is drought tolerant and shows good adaptability to limited irrigation. Soybean had moderate yield but is a lower water use crop than corn even under full irrigation. Its growth and performance suggested it may be a good alternative crop for water conserving cropping systems in the South Platte River Basin. While rotational cropping and limited irrigation systems both reduced ET relative to full irrigation and continuous corn, the

rotational cropping systems have an economic advantage over limited irrigation systems because they maximize yields of profitable cash crops in the irrigated phase of the rotation and use lower input crops in the dryland phase.

An on-farm evaluation of limited irrigation corn established that practices can be successfully implemented into production scale, farmer-managed systems and can maintain viable levels of production. An on-farm evaluation of partial season irrigation of alfalfa showed that irrigation management alone cannot be used to control ET from a deep rooted crop in high water table environments. Partial season irrigation did effectively reduce ET for the more shallow rooted grass meadow hay. While water savings would be greatest by complete dry-up of irrigated land, the crop production in dryland is so low that it severely limits economic sustainability. Limited irrigation and rotational cropping systems should be considered as viable approaches to meeting changing water needs while maintaining irrigated agricultural systems.

Colorado Corn Growers Association

In the context of the Private Market demonstration project, the team found that many agricultural producers have a small percentage of lands under irrigation on one or more farms that are not optimal for crop production. In most cases, this is because the quality of the land is not as good as other areas on the farm, irrigation delivery systems are more labor intensive and difficult than other areas, or the lands themselves are difficult to access or cultivate. These "marginal" lands are not critical to the economic output of the farms, but the agricultural producers nevertheless continue to irrigate them as a means of gaining some value that contributes to their overall financial outlook. Many of these irrigators confirmed that they would lease the water supplies serving these lands if the opportunity presented itself and there was a potential to make more profit by leasing than irrigating. An infusion of income through leasing could help support continuation of farming on the more productive lands.

Based upon this factual finding, the project team hypothesized that it may be possible to foster alternative transfers that specifically target the consumptive use associated with these economically marginal lands under one or more ditch systems, thereby freeing water for M&I uses and providing economic support encouraging the continuation of irrigation on highly productive lands. The Private Market model, which calls for a permanent sale of a small percentage of the consumptive use to M&I users coupled with the ability to lease larger amounts, is a mechanism designed to facilitate the "freeing up" of marginal CU.

The project team did not conduct a comprehensive study to address this question specifically. However, it is noted that the adequacy of water yield and water quality depends on the needs of the end user. For example, a small community along the South Platte River with supplies consisting of alluvial wells will have a much different perception of adequate quantity and quality than a large municipality with treated surface water supplies.

Lower Arkansas Valley Water Conservancy District/Super Ditch

In order to have a greater pool of water to draw from and to minimize the impacts of fallowing in any particular ditch system, the Super Ditch incorporates shareholders from seven ditch companies in the Lower Arkansas Valley, between Pueblo Reservoir (Bessemer Ditch) and the La Junta area (Fort Lyon Irrigation Company). Estimates of yield available for leasing are conservatively based on the assumption of 65 percent participation by irrigators (25 percent for

Bessemer) and a 25 percent fallowing rate (1-in-4 year rotation). These numbers are viewed as minimum anticipated participation levels. The number of acres required to create a given transferable yield through a one-in-four year rotation is four times the number of acres that would be required under a traditional buy-and-dry scenario.

Farmers Reservoir & Irrigation Company
Using data from FRICO and various state and federal agencies, assessments were made to compare farm and irrigation practices in the FRICO counties (Adams and Weld) to practices in the overall South Platte and Arkansas Basins.

Compared to the rest of the South Platte River Basin, FRICO irrigated operations are similar in average size of irrigated operations, but irrigate a much larger percentage of total cropland. Partly due to this, FRICO county farm operations are close to twice as profitable on a per-acre basis. On average, South Platte operations are more profitable per acre and hold more assets per acre than the average Arkansas Basin farmland acre. Relative to the Arkansas Basin, the South Platte as a whole has a slightly more varied crop coverage, with a smaller percentage of acreage in corn and alfalfa, and a larger percentage in small grains. FRICO county operators tend to have a much higher percentage of acreage alfalfa (52 percent) compared with the 29 percent representative of the South Platte Basin. However, despite the difference in alfalfa and corn acreage in FRICO counties, crop trends over the last 50 years within FRICO counties are quite similar to the rest of the South Platte.

Colorado State University Extension
Two 8-acre demonstration sites were selected in the Lower Arkansas Valley—one under the Holbrook Canal and the other under the Rocky Ford High Line Canal. Each demonstration site is arrayed with 2-acre subplots that are either cropped (corn) or fallowed.

Infrastructure Requirements Compared to Traditional Agricultural Transfers

Parker Water & Sanitation District/Colorado State University
This issue does not appear to be addressed directly in the current progress report (Hansen et al. 2010). However, Phase 5 will provide a final report at the completion of all work related to this project, including the research results, conclusions related to the on-farm demonstrations, local and regional economic analyses, preliminary planning studies related to delivery of water, and the proposed administrative and hydrologic procedures that are proposed to support change of use proceedings in Water Court.

Colorado Corn Growers Association
New infrastructure may be required for the DT Ranch and Private Market projects, but requirements are not anticipated to vary significantly from the requirements of a traditional transfer. The Lower South Platte Co-op concept could benefit from the construction of new storage, pipelines, pumpstations, and recharge facilities.

Lower Arkansas Valley Water Conservancy District/Super Ditch
In summarizing the infrastructure question generally, the Super Ditch team finds that infrastructure to move water from agricultural areas to areas of municipal need is limited and/or lacking, a problem that will have to be resolved before alternative transfers can realize

their potential. Municipalities are reluctant to fund infrastructure for water they lease rather than own, and infrastructure is cost-prohibitive for the irrigators.

More specifically, according to the documentation supplied by the Super Ditch project team, river diversion and storage is needed near the Arkansas River to provide for cost-effective design of the conveyance facilities. Without storage, the pump stations and pipeline(s) would have to be designed for more widely varying flow rates requiring larger diameter pipe and either (1) more pumps, (2) combinations of smaller and larger capacity pumps, or (3) more variable frequency drives for the pumps. Storage is also needed near the water users systems to provide water to their treatment plants as their production rates vary seasonally and day-to-day. At least nine storage options were identified that could be readily incorporated into the Super Ditch system infrastructure.

Additional findings include:

- The available storage in Pueblo Reservoir alone can be used to meet the modeled demands.
- Additional initial storage vessels are available either (1) directly owned or managed by the Super Ditch entities, or (2) to be purchased. Additional storage vessels will help to optimize storage and administer exchanges in the future.

Farmers Reservoir & Irrigation Company
The project concept is designed to take advantage of opportunities that exist within FRICO's existing infrastructure and recharge capabilities. A key finding is that FRICO has significant capacity in its diversion and surface storage facilities. Furthermore, FRICO has significant potential to develop recharge facilities in the Beebe Draw alluvial aquifer with different unit response functions. The associated groundwater accounting is relatively straightforward, but involves the development of large spreadsheets to handle the monthly unit response functions for multiple recharge ponds.

Impact of Geography on Alternative Transfer Viability

Parker Water & Sanitation District/Colorado State University
This issue is not specifically addressed in the recent progress report. However, the project includes controlled research by CSU on a farm in Logan County, Colorado that is owned by PWSD. In order to ensure that the project proposals are implementable by agricultural producers on a farm-scale basis, there are also three on-farm demonstrations at PWSD's other farms in Logan County, which will have the farmers continue to work their farms with guidance from CSU.

Logan County is a significant distance from PWSD's service area in northeastern Douglas County, in the southern region of the Denver metropolitan area. Substantial investments in conveyance infrastructure would be required to directly deliver transferred agricultural water from the research farms to PWSD.

Colorado Corn Growers Association
Geography has a significant influence on the ability to market water from alternative transfers (and permanent transfers as well). However, in the research on the programs associated with

the demonstration projects, it was not apparent that geography would impact transfer methods differently. For example, it was not apparent that a rotational fallowing program would have a greater chance of success compared to a deficit irrigation program based on geography. More significantly, as discussed below, alternative transfer methods can be extremely beneficial to overcoming geographic barriers to water transfers.

- **DT Ranch –** The location of DT Ranch (just upstream of Fort Morgan) and the relatively small amount of water involved with the potential transfer limits the geographic area in which the water could be potentially marketed.

- **Private Water Market –** The Private Water Market demonstration project will explore the application of the water market concept to the Platte Valley Irrigation Company (PVIC) and the City of Aurora. The location of the PVIC (just downstream of the Denver metropolitan area) makes it an ideal candidate for the private water market or other form of alternative transfer. This location makes it feasible to involve water users on both the South Platte River and Beebe Draw.

- **Lower South Platte Co-op –** The water users involved in the Lower South Platte Co-op to date are located in Districts 1 and 64. Thus, without the pooling of resources and investment in infrastructure, marketing water to Denver-area water providers would be difficult. However, the demonstration project showed significant potential to exchange water from the downstream end of District 1 to the mouth of the Poudre River, where it could be potentially marketed to several water providers.

Lower Arkansas Valley Water Conservancy District/Super Ditch

The sources of supply for this proposed rotational land fallowing-water leasing program are irrigation ditches diverting water from Pueblo Reservoir (Bessemer Ditch) or the Lower Arkansas River east of Pueblo (all other sources). Identified potential customers are located in Northern El Paso County, thus requiring pipeline conveyance of up to 125 miles and vertical lift of 3,000 feet or higher. As indicated by AECOM, each alignment will traverse major roadways, railroads, public lands, waterways, and private property. Significant efforts are required to obtain the permits and easements to build a water conveyance system through or around these types of existing infrastructure, land uses, and land ownership.

Farmers Reservoir & Irrigation Company

FRICO is the largest irrigation company near the Denver metropolitan area. A list of potential water providers that have infrastructure and/or water rights that could interface with FRICO's system was developed. Geographic information system (GIS) mapping was developed of key water provider storage and delivery facilities that could interface with the FRICO system. This list of M&I providers in the Denver metro area was narrowed to those providers that represent the most likely customers of water from the alternative agricultural transfer methods identified in the FRICO Barr and Milton shareholder surveys. These providers included South Adams Water and Sanitation District, the cities of Thornton and Brighton and the Towns of Lochbuie and Hudson.

Colorado State University Extension
By selecting demonstration sites under two ditch systems more than 20 miles apart, the CSU Extension will be able to provide a comparative assessment of whether location in the Lower Arkansas Valley affects the parameters being studied in the context of rebound from fallowing.

Water Quality Impacts

Parker Water & Sanitation District/Colorado State University
This issue does not appear to be addressed directly in the current progress report (Hansen et al. 2010). However, Phase 5 will provide a final report at the completion of all work related to this project, including the research results, conclusions related to the on-farm demonstrations, local and regional economic analyses, preliminary planning studies related to delivery of water, and the proposed administrative and hydrologic procedures that are proposed to support change of use proceedings in Water Court.

Colorado Corn Growers Association
For each of the demonstration projects, water quality would be impacted positively by the use of wetlands for recharge and/or the provision of return flows. In terms of the individual demonstration projects, water quality would not be a major concern for transfers by DT Ranch that are used for recharge purposes. The private water market could deliver water to the Aurora Prairie Waters wellfield having the same quality as other sources diverted by the wellfield.

Lower Arkansas Valley Water Conservancy District/Super Ditch
The water quality along the Arkansas River degrades as the river moves downstream from Pueblo Reservoir, primarily due to the physical characteristics of this reach and the influence of irrigation return flows. Specifically, the river has high levels of total dissolved solids (TDS) that increase as water travels downstream in the Arkansas River. High TDS, even though not necessarily a public health concern, is commonly used to characterize the quality and public acceptability of drinking water. High TDS affects the taste of the water, causing a salty taste that is not palatable to customers and can be damaging to irrigated landscapes and household appliances such as water heaters. Available treatment processes that remove TDS are relatively expensive to build and operate.

Water quality of the proposed source water is not fully defined at this time. Publicly available water quality data is limited and is monitored on an annual basis. As the water source may be canal water (rather than water taken directly from the river) and because irrigation canals operate on a seasonal basis, actual water quality may vary significantly from that used for the Task G evaluations. However, the need for advanced treatment will likely remain due to the multiple wastewater discharges upstream of any canal headgate that would be a potential source for this project.

Colorado State University Extension
The CSU Extension study involves the monitoring of soil water quality, which indirectly relates to water quality due to the fact that Arkansas River water quality degrades downstream due to the influx of agricultural irrigation return flows, which leach nutrients and other constituents from the soil.

Specifically, the study is monitoring soils for nitrate-nitrogen, phosphorus, organic matter, sulfate-sulfur, cations (K, Ca, Mg, Na), micronutrients (Zn, Fe, Mn, Cu), soluble salts, soil pH, and selenium.

One interesting trend that the researchers have noted is the relatively high retention of nitrogen on fallowed fields. They note that because nitrogen is a fairly mobile nutrient with soil water movement, the retention of nitrogen is most likely due to the low precipitation levels in the Arkansas Valley that do not afford a pathway to movement.

Legal and Institutional Issues

Legislative or Regulatory Changes Necessary to Facilitate Implementation of Alternative Agricultural Transfer Program

Parker Water & Sanitation District/Colorado State University

This issue does not appear to be addressed directly in the current progress report (Hansen et al. 2010), which focused on Phases 1 through 3 of the study. Phase 4 will address administration and hydrologic considerations necessary for the successful implementation of rotational fallowing and limited irrigation cropping practices as water saving approaches in Colorado.

Colorado Corn Growers Association

Certain changes described below may encourage various transfer programs.

- **DT Ranch –** The study group is exploring the potential for an interruptible water supply agreement with a water user outside the FMRIC system pursuant to §37-92-309, CRS The §37-92-309 IWSA is an existing tool that has not been used very frequently, if at all. The study group considers this second DT ranch project approach to be an important opportunity to "get inside" the IWSA process and gain an understanding of its strengths and weaknesses in the hope that it can make some recommendations for improving the process and encouraging greater use of this tool.

- **Private Water Market –** The core elements of the Private Market concept do not require any additional legislative approval. Parties are already free to enter into contractual arrangements regarding the purchase, sale, and lease of water rights. The 1969 Water Rights Determination and Administration Act provides for changes in use, and expressly recognizes the concept of rotational fallowing, one of the key implementation strategies. Reduced consumptive use strategies, though not expressly authorized by the Act, are probably within the definition of a "change in use," and could be approved so long as there is no injury to other water users. Recharge activities have been recognized by the Water Courts in Divisions 1 and 2 as a viable means of delivering water to the aquifer as return flow replacement or later diversion from the river. The fact that the Water Court approves each "Private Market," including the operational details related to the delivery of water changed to new uses, provides protection to vested water rights.

  Several legislative changes could support the Private Market concept. The completion of ditch-wide change in use cases for major ditches would greatly improve the potential for the development of Private Markets, because of the certainty they provide regarding the amount of consumptive use available for alternative transfers. Recent decisions in Division One,

including the FRICO 403 case, have made ditch companies wary of water court proceedings and reluctant to proceed with changes in use. Legislation providing protections and incentives to ditch companies who apply for ditch wide changes in use could serve to open up markets.

In addition, a change to the statute recognizing reduced consumptive use as a viable change in use could bolster parties considering this approach and encourage implementation. Though the current statutes do not prohibit reduced consumptive use, neither do they expressly allow it. As a result, there are mixed opinions among legal counsel and other professionals as to whether this strategy is authorized by the Act. This uncertainty should be removed.

- **Lower South Platte Co-op –** No legislative or regulatory changes are needed to implement the Lower South Platte Co-op. The Lower South Platte Co-op proposal is based upon contractual relationships and a series of administrative exchanges to facilitate delivery of water. Though the organizational structure of the Co-op has not been determined yet, there are a number of viable options open to it, and Colorado law would allow an entity of this sort to enter into contracts with end users for the delivery of water via exchange. Exchanges are recognized by the 1969 Water Rights Determination and Administration Act. They may be operated administratively, without water court approval, or they may be adjudicated to achieve a priority date.

Lower Arkansas Valley Water Conservancy District/Super Ditch
According to Peter Nichols, reporting on behalf of the Super Ditch project team,

> It appears that the costs and time required for legal, engineering and accounting under a "business as usual" approach to a rotational fallowing change case may become cost prohibitive to the irrigator-lessors. There are several reasons for this: 1) water court change cases to implement leases would require engineering of each participating farm; 2)the number of acres required to be "engineered" to create a given transferable yield through a one-in-four rotational fallowing program is four times the number of acres that would be required under a traditional buy-and-dry scenario; 3) the accounting requirements (for decree compliance) under a one-on-four rotational fallowing program will be more complicated than a traditional buy- and-dry scenario; 5) engineering solutions to canal operations are more complicated under a rotational fallowing program than under a traditional buy-and-dry scenario; and 5) irrigator-lessors have little or no ability to finance the up-front engineering and legal costs of a water rights change case.

The ultimate conclusion is that "the cost required to put together a program, negotiate leases, and resolve contingencies will delay and possibly kill fallowing-leasing."

Potential solutions to these problems include a simplification of the water rights engineering required for temporary transfers, which would help the irrigator-lessors to pursue a change case. Developing a "presumptive depletion" or "rebuttable presumption" type of change of water right process for temporary transfers that would "keep the river whole" could be an alternative to the very expensive "business-as-usual" engineering for a change of water right case that requires individual farm analyses. This would have to be accomplished at the

legislative level. Another solution to the time and cost of a water court change case would be legislative enactment of a process for administrative approval of alternative agricultural transfers, in essence, and extension of the interruptible supply contracts statute to allow long-term leases.

Farmers Reservoir & Irrigation Company
It is anticipated that this issue will be addressed through the ongoing project work and documented in the final report.

Colorado State University Extension
This project observes that a significant portion of fallowed land management is related to weed suppression, which does not add value to the field or soil, but simply maintains a condition for future farming. It would be more desirable, however, to utilize fallowed fields for productive purposes in line with SWSI Phase 2 Section 3 (page 3-15), which states that challenges with fallowed land management may be "may be minimized by dryland cropping on the fallowed lands so long as adequate safeguards to prevent expanded use by sub-irrigation." Therefore, in response to the question, "What would it take to make an alternative agricultural transfer program work in Colorado?" one obvious and immediate suggestion is to make viable the use of fallowed land for continued crop production on a dryland basis. This project is being expanded in 2010 to evaluate this possibility by further subdividing the sites to include a farmed portion of sorghum-sudan, which is a warm season grass that has grown fairly well in drier climates.

Water Court Processes Related to Program Approach and Implementation

Parker Water & Sanitation District/Colorado State University
This issue does not appear to be addressed directly in the current progress report (Hansen et al. 2010), which focused on Phases 1 through 3 of the study. Phase 4 will address administration and hydrologic considerations necessary for the successful implementation of rotational fallowing and limited irrigation cropping practices as water saving approaches in Colorado.

Colorado Corn Growers Association
Water court requirements vary depending on the type of transfers involved, as described below.

- **DT Ranch –**No water court process is necessary. However, an administrative approval process would be necessary in order to operate the interruptible supply program.

- **Private Water Market –** Water court approval would be necessary to change the use of agricultural water rights to municipal use and to adjudicate any exchanges that are necessary. Once the private water market is decreed, additional M&I users or agricultural suppliers could join, subject to the water court's approval under retained jurisdiction.

- **Lower South Platte Co-op –** Water court approval should be obtained to adjudicate an exchange and secure a priority date for administration.

Lower Arkansas Valley Water Conservancy District/Super Ditch
Included in discussion of legislative and regulatory changes.

Farmers Reservoir & Irrigation Company
Although not directly related to water court processes, there is a pending ruling from the Colorado Supreme Court that could significantly affect alternative transfer proposals for FRICO. Specifically, there is an appeal underway regarding the Water Court ruling in Case No. 02CW403. If that ruling stands, it will have the following impacts:

- The potential for alternative agricultural transfers from FRICO shareholders to M&I users will be limited.

- There will be a greater shortage for FRICO shareholders—another key finding was that FRICO shareholders in the Barr and Milton systems are water short—which will in turn increase the availability of FRICO infrastructure to divert, store, and regulate other supplies.

Program Administration

Parker Water & Sanitation District/Colorado State University
This issue does not appear to be addressed directly in the current progress report (Hansen et al. 2010), which focused on Phases 1 through 3 of the study. Phase 4 will address administration and hydrologic considerations necessary for the successful implementation of rotational fallowing and limited irrigation cropping practices as water saving approaches in Colorado.

Colorado Corn Growers Association
Administration of the proposed alternative transfers would be a cooperative effort between the supplying agricultural users, the purchasing/leasing M&I users, and other involved parties In the context of the Private Water Market, the details of program administration would be developed in the contract between the parties establishing the market and the water court decree approving operation of the market. The project team discussed the potential for a "Private Market Administrator"—a person or entity agreed upon and funded by the parties and approved in the water court decree that would oversee all aspects of operation, coordinate deliveries, and perform accounting functions.

Lower Arkansas Valley Water Conservancy District/Super Ditch
Program administration would be conducted by the Lower Arkansas Valley Super Ditch Company, acting as representative for the participating ditch company shareholders.

A general recommendation to improve program administration for all types of alternative transfer programs is the development of standardized, professionally-accepted, and relatively inexpensive monitoring programs for verification. It appears that all ag-related activities will require a higher degree of measurement and monitoring than we currently have available. Verification of deficit irrigation measures and other options to reduce consumptive are examples where additional tools are needed. Some standardization and consistency with measurement devices and methodologies appears essential for moving transfers through the administrative process.

Farmers Reservoir & Irrigation Company
The shared water bank concept would involve cooperation between FRICO Barr and Milton shareholders and participating M&I water providers. As envisioned, the bank would be managed and administered by FRICO.

Colorado State University Extension
Although not directly aimed at addressing issues of program administration, the CSU Extension demonstration project seeks to provide answers to typical questions heard from farmers, which the researchers paraphrase as "How will fallowing my ground for a period of years affect the yields, nutrient needs and profitability of my land when I decide to farm it again?"

Likelihood of Success if Agricultural User is Not Required to Bind the Land and Water to Irrigation

Parker Water & Sanitation District/Colorado State University
This issue does not appear to be addressed directly in the current progress report (Hansen et al. 2010), which focused on Phases 1 through 3 of the study. Phase 4 will address administration and hydrologic considerations necessary for the successful implementation of rotational fallowing and limited irrigation cropping practices as water saving approaches in Colorado.

Colorado Corn Growers Association
M&I water users are generally reluctant to invest capital resources in water supply sources and infrastructure that do not provide guaranteed supplies. In addition, the CCGA study group has found little support for the concept of a "spot market" with M&I users. However, each demonstration project has certain benefits in this regard.

- **DT Ranch –** Ready access, short distance between DT Ranch and the Town of Wiggins, and low transaction costs may make these sorts of locally based alternative transfers attractive to smaller M&I users on an interruptible supply basis.

- **Private Water Market –** The Private Water Market Concept addresses the permanence issue by calling for a permanent sale of a small percentage of the agricultural producers' consumptive use (the project team suggested 10%) to the M&I user as a condition of participation in the leasing aspects of the program, which would provide for shorter term arrangements for an amount up to the remaining 90%. This was viewed as an "entry fee" for both parties, ensuring the M&I user that regardless of the outcome of the leasing arrangement, it would have a firm CU yield, and the agricultural producer that M&I user is committed to the process and willing to invest the resources necessary to achieve success. In addition, the study team proposed that the agricultural producer provide the M&I participant a right of first refusal by contract, so that should the agricultural producer decide to sell the water right, the M&I user would have the opportunity to purchase it. This would allow the M&I User to retain the advantage of its initial investment in changing the use of the water to allow for M&I uses under the lease arrangement. .

- **Lower South Platte Co-op –** The availability of excess recharge credits is highly variable and dependent on hydrologic conditions. However, there is a greater potential for more reliable supply if the program were to incorporate storage and re-timing of excess flows.

Lower Arkansas Valley Water Conservancy District/Super Ditch
The Super Ditch project team offers a number of recommended program characteristics related to this issue that would help to improve the chances of success for alternative agricultural transfers:

- A willingness for municipalities to accept long-term leases as a secure form of water supply, similar to municipal acceptance of Bureau of Reclamation water service contracts.

- A willingness for municipalities to work with irrigators to minimize their future water supply risks, such as the use of dry-year options, interruptible supply contracts, and water banks.

- A more regional outlook from Front Range water providers in the context of providing delivery and exchange opportunities for agricultural water.

Farmers Reservoir & Irrigation Company
Interviews with northern Denver metro area municipal water providers indicated that there is little interest in alternative transfers that are not permanent or result in the potential for future payments by M&I users to secure permanent supplies. The strong preference by municipal providers is for traditional water transfers that result in a one-time upfront payment for water rights acquisitions and ownership of the rights by the municipal provider.

Water market experiments were conducted to evaluate the impacts on water rights transfers and the value of water rights if a permanent water leasing market was available. Results of these water market experiments will be included in the final report.

Program Conditions Necessary to Ensure that Private Property Rights are Not Impaired

Parker Water & Sanitation District/Colorado State University
This issue does not appear to be addressed directly in the current progress report (Hansen et al. 2010), which focused on Phases 1 through 3 of the study. Phase 4 will address administration and hydrologic considerations necessary for the successful implementation of rotational fallowing and limited irrigation cropping practices as water saving approaches in Colorado.

Colorado Corn Growers Association
Water court processes would ensure that the concerns of other water users are addressed and that vested senior water rights are protected from injury.

Lower Arkansas Valley Water Conservancy District/Super Ditch
The water court process required for changing the use of irrigation water rights to allow for municipal uses under the proposed rotational land fallowing-water leasing program would allow for the concerns of interested parties to be addressed and would ensure no injury to vested senior water rights on the Arkansas River and its tributaries.

From the perspective of the irrigators, the Super Ditch team suggests benefits could be gained from collective negotiations by an entity on behalf of the irrigators, possibly basin or region-specific, that could counterbalance the "divide-and-conquer" and “prey on the weak” approaches municipalities used historically to acquire agricultural water rights.

Farmers Reservoir & Irrigation Company
FRICO irrigators were surveyed to collect types of demographic, farm, and irrigation data, as well as to gage interest in the various alternative transfer methods and the "shared" water bank

concept. Participants were concerned that their voices were not heard nor represented at the state level. In addition, surveyed FRICO irrigators were concerned that the information they provided would be used against them by cities during lease or transfer negotiations.

Financial Issues

Estimate Costs to Organize and Administer a Program

Parker Water & Sanitation District/Colorado State University

This issue does not appear to be addressed directly in the current progress report (Hansen et al. 2010). However, Phase 5 will provide a final report at the completion of all work related to this project, including the research results, conclusions related to the on-farm demonstrations, local and regional economic analyses, preliminary planning studies related to delivery of water, and the proposed administrative and hydrologic procedures that are proposed to support change of use proceedings in Water Court.

Colorado Corn Growers Association

The project team did not make dollar estimates of the costs of organizing or administering the three selected demonstration projects. Conceptually, the administrative requirements and costs associated with these programs will vary. Administrative costs for DT Ranch to execute and obtain administrative approval for an interruptible supply agreement are anticipated to be less than a water court proceeding. On the other hand, the legal, engineering, infrastructure construction, and administrative costs for the private water market and co-op would likely be substantial. However, the pooling of resources by several agricultural providers and M&I end users could bring down costs to a reasonable level for interested parties.

Funding for implementation of the Private Market concept would come from the parties involved in the market. Initial costs would include legal and administrative fees related to the drafting and negotiation of the Private Market Agreement between the parties, water court costs to change the use of the water rights involved and achieve interim substitute water supply plan approvals, and costs for installation of infrastructure in the Evans No. 2 ditch to facilitate operation, including recharge sites, and one or more augmentation stations to return water to the South Platte River. Additional grant funding could help offset these costs and help establish the project as a functional pilot that could serve as a template for other similar projects.

Lower Arkansas Valley Water Conservancy District/Super Ditch

The Super Ditch team summarized several factors affecting program costs:

- Storage near the source and closer to the users significantly reduces conveyance costs and provides for more continuous operating of the pipeline.
- Storage that provides for reduced size of the advanced WTP allows for cost reductions as well as continuous operation of the treatment plant.
- Conveyance configurations indicate that the west (diversion from Pueblo Reservoir) or middle (diversion from Stonewall Springs gravel pit) alignments are more favorable from a capital and operations and maintenance (O&M) cost perspective.

- Total estimated capital costs for conveyance facilities range from $20,000 per acre-foot to $36,000 per acre-foot.

- O&M costs for all the conveyance configurations are high. Annual O&M costs range from $8 to $10 per 1,000 gallons. This is significantly above current consumption costs in the Front Range, which typically do not exceed $7 per 1,000 gallons at the top tier of an increasing block rate. Primary components of the annual O&M costs are leasing the water, pumping the water, and advanced treatment.

- The cost associated with improving water quality is directly related to the degradation in water quality: treatment costs increase as water quality declines.

In terms of potential customers for Super Ditch water, that translates to about $7,240 per acre-foot for capital and O&M costs for entities in Northern El Paso County, such as the Pikes Peak Regional Water Authority (PPWRA). This cost estimate is based on the following assumptions:

- Relatively poor water quality is diverted in the Lower Arkansas Basin, between La Junta and Las Animas, treated on-site, and delivered to the PPWRA in a dedicated pipeline.

- Treatment is by reverse osmosis, few economies of scale are achieved with the pumps and pipeline, and the vertical elevation change is substantial.

Potential mitigating factors to this high cost are (1) potential exchanges to Pueblo Reservoir that both improve the quality of the water and shorten the distance to the PPRWA service area, and (2) the potential use of the Southern Delivery System (SDS) pipeline allowing PPRWA to share in economies of scale in treatment and transmission. The combination of exchanges and the use of the SDS pipeline reduces estimated costs dramatically, from $7,240 per acre-foot to about $2,200 per acre-foot.

Farmers Reservoir & Irrigation Company

Discussions have been held between M&I providers, the project team and Farmers Reservoir and Irrigation Company staff and board members on the sharing of costs and benefits of operating a shared water bank program. An operations model was developed and will be used to evaluate water supply yields and benefits to participating entities conduct additional investigations and documented in the final report.

Colorado State University Extension

The project has also completed enterprise budgeting for Year 1 (2009) of the demonstration sites. The purpose of this exercise was to evaluate typical costs that will be associated with fallowed land management, such as weed suppression and the cost of "not farming" (as evaluated by gross receipts on a continuous corn index crop. The enterprise budgets for both demonstration sites reflect the value of corn ($3.65 per bushel) and cost of various farm inputs (e.g., fertilizer, herbicide, insecticide) for 2009. These are static costs, and therefore do not incorporate the inherent long-term variability in the costs of farming as well as the price of corn, which are not known definitively at the time a lease arrangement is written.

For 2009, however, the break-even point for the sites was $480.14 and $541.37, for the Highline and Holbrook Canal sites, respectively. These values were calculated by adding the net value of corn production (return to land, operator's labor, management, and risk) and the cost of managing land in the fallowed condition. Fallowed land management largely involves chemical application of an herbicide such as Roundup or Gly Star to manage weeds common to the Lower Arkansas Valley area. These weeds include Kochia, Pigweed, Bindweed, Bull Nettle, and various grasses.

Identify Parties that Could Contribute to Costs

Parker Water & Sanitation District/Colorado State University
This issue does not appear to be addressed directly in the current progress report (Hansen et al. 2010). However, Phase 5 will provide a final report at the completion of all work related to this project, including the research results, conclusions related to the on-farm demonstrations, local and regional economic analyses, preliminary planning studies related to delivery of water, and the proposed administrative and hydrologic procedures that are proposed to support change of use proceedings in Water Court.

Colorado Corn Growers Association
Included in the discussion of estimated costs to organize and administer a program. In addition to these parties, federal grant funding under the EQIP, CREP or similar programs could provide payments to participating agricultural producers who have fallowed land.

Lower Arkansas Valley Water Conservancy District/Super Ditch
Included in the discussion of estimated costs to organize and administer a program.

Farmers Reservoir & Irrigation Company
Identified potential M&I partners in the shared water bank include South Adams Water and Sanitation District, the cities of Thornton and Brighton and the Towns of Lochbuie and Hudson. It was noted specifically that South Adams WSD has a need for consumable water sources to meet winter return flow obligations from transferred agricultural water and for well pumping depletions. In addition, there are many FRICO Barr and Milton shareholders who are also groundwater users in the Beebe Draw and in need of well augmentation.

South Adams WSD and Thornton were surveyed as part of ongoing project work. Both were willing to explore the concept of a shared water bank, but do not believe they will have significant volumes of surplus supplies to contribute in the long-term, due to planned gravel lake storage along the South Platte River and projections indicating that they will grow into their supplies.

Estimate the portion of the total land and water rights value that will need to be paid to an agricultural user as compensation for enrollment in a program

Parker Water & Sanitation District/Colorado State University
The project sought to understand the potential of South Platte farms to adopt limited irrigation, rotational cropping, partial season irrigation, and the barriers to adoption. A farmer survey was a key instrument to determine the potential water leasing rather than 'buy and dry' fallowing, as well as the adoption of limited irrigation strategies. Importantly, the limited irrigation

cropland remains in production and mitigates reduced economic effects of dry-up. The producer survey gauged the amount of water that might be made available in water leasing arrangements and the necessary compensation needed for farmers to participate in a lease arrangement. More than 60 percent of survey respondents are willing to lease water, with an aggregate of between 50,000 and 60,000 acre-feet of potential water supplies just among those who responded. Preferred compensation ranges from $300 - $500 per acre of irrigated cropland. Most farmers would prefer not to lease their entire water portfolio, thus these respondents are likely to remain in agriculture and generate positive economic activity.

In addition, a spreadsheet decision tool has been developed to help farmers determine the tradeoffs of various limited irrigation and water saving strategies. The spreadsheet allows farm managers to input their own business information and contrast alternative water saving cropping strategies.

Colorado Corn Growers Association
In each of the three case studies, the answer to this question would be the same: each farmer will need to determine these values based upon their individual circumstances. That is, the financial returns of each farmer's individual operations would need to be gained in compensation plus any fixed costs, such as debt service. Further, each farmer will need to determine what risk premium they must have as incentive to enter into such a program. Over and above operating and fixed costs, the amount of compensation necessary to make program participation worthwhile for each farmer would vary, depending upon their individual financial circumstances, family situation, and risk tolerance. The project team recognized that this question must be answered by each farmer individually and, therefore, we designed the AgLET evaluation program so that farmers could independently evaluate their required financial returns for participation.

Lower Arkansas Valley Water Conservancy District/Super Ditch
This issue does not appear to be within the scope of Tasks E, F, and G, which are funded by the Alternative Agricultural Water Transfer Methods Grant Program. However, a comprehensive report (Task H) on the water leasing concept and the Super Ditch Company is anticipated to be completed in mid 2011. This document may contain additional relevant information.

Farmers Reservoir & Irrigation Company
FRICO irrigators were surveyed to collect types of demographic, farm, and irrigation data, as well as to gage interest in the various alternative transfer methods and the "shared" water bank concept. When discussing prices at which they would be willing to lease, survey participants were uncertain (i.e., they hadn't seriously considered this issue) or anchored to prices of other water transactions that they had heard, even though the circumstances and types of those transactions were very different. For example, $500 per acre-foot was the most common price indicated. It was subsequently revealed that a number of participants indicated this price because they had heard others received this price for short-term leases with cities.

The FRICO investigators utilized additional data from the 2007 Thorvaldson/Pritchett survey of South Platte irrigators. Based on this data, nearly two-thirds of operators surveyed indicated they were willing to enter into a leasing agreement, and close to half were willing to enter into an agreement with municipalities. Minimum payment required per acre required to forgo

irrigation for one year as a part of a leasing agreement was approximately 30% higher among FRICO irrigators, which is consistent with the higher general productivity of irrigated land relative to the South Platte as indicated in the census data.

Colorado State University Extension
Included in the discussion of estimated costs to organize and administer a program.

Streamline/Equalize Water Court Transaction Costs

Lower Arkansas Valley Water Conservancy District/Super Ditch
See responses in Legal/Institutional issues section.

Cost vs. Supply Certainty for Municipalities Purchasing Water via Alternative Agricultural Transfers

Parker Water & Sanitation District/Colorado State University
This issue does not appear to be addressed directly in the current progress report (Hansen et al. 2010). However, Phase 5 will provide a final report at the completion of all work related to this project, including the research results, conclusions related to the on-farm demonstrations, local and regional economic analyses, preliminary planning studies related to delivery of water, and the proposed administrative and hydrologic procedures that are proposed to support change of use proceedings in Water Court.

Colorado Corn Growers Association
Aware of the tension between M&I user's desire for certainty and agricultural users' reluctance to commit to permanent transfers, the study team incorporated elements into each project that tried to strike a balance in a way that made the projects more attractive to agricultural suppliers and M&I users.

- **DT Ranch –** The DT Ranch Project has no element of permanence. However, if costs for establishing the interruptible supply agreement can be held sufficiently low, such an agreement could become a viable option for an M&I user who's water needs are compatible with the terms of an interruptible supply program. The study team postulates that M&I users' interest in less than permanent water supplies is inversely proportional to transaction cost. If an interruptible supply or short term lease can be achieved at a reasonable rate, M&I users may view an interruptible supply or short term lease as an acceptable component of a larger water supply plan.

- **Private Water Market –**The Private Market model addresses the permanence issue by including a portion of the agricultural user's water supply (10 percent) as a permanent transfer or sale to the M&I user, while the remaining 90 percent is subject to shorter term arrangements. M&I users are more interested in participating if there is some amount of water that they own permanently. Ideally, the amount of the permanent transfer is enough to justify the transactional cost in and of itself, and leasing opportunities are an added benefit. The Private Market also addresses the permanence issue by providing that agricultural users may sell the remaining 90 percent of their consumptive use to any party, subject to a right of first refusal to the M&I user partner.

- **Lower South Platte Co-op –** The study confirmed that there is water available to exchange via the Co-op and that exchange capacity is available. The Co-op is investigating the different types and the reliability of the supplies (i.e. excess recharge credits, water provided through alternative transfer methods, senior irrigation rights, etc.) that could be marketed via the Co-op. With the appropriate infrastructure and management, it is possible that the downstream surpluses could be stored or retimed and provided to upstream agricultural and M&I users on a relatively stable basis. Further study is needed to determine how reliable various water sources might be and whether the contemplated exchanges could be established and operated at a cost that is attractive to other water users.

Lower Arkansas Valley Water Conservancy District/Super Ditch
See responses in Legal/Institutional section, specifically recommendations for municipalities that could make alternative agricultural transfer programs more likely to succeed.

Farmers Reservoir & Irrigation Company
As noted, interviews with northern Denver metro area municipal water providers indicated that there is little interest in alternative transfers that are not permanent or result in the potential for future payments by M&I users to secure permanent supplies. The strong preference by municipal providers is for traditional water transfers that result in a one-time upfront payment for water rights acquisitions and ownership of the rights by the municipal provider. Most providers indicated that they had or will acquire supplies sufficient to meet future demands,

Compare Annual Local Impacts of a Rotational Fallowing Program with a Permanent Dry-up that Includes Voluntary Payment in Lieu of Taxes

Parker Water & Sanitation District/Colorado State University
An objective of the third project phase was to develop a regional economic impact model to quantify the direct and indirect economic effects of adopting alternative irrigation systems. The South Platte River basin expects to fallow as many as 266,000 (22 percent) of its irrigated acres in the next 25 years. Each irrigated acre is estimated to generate economic activity equivalent to $690 in the basin. Economic effects of drying up irrigated land will be substantial, especially in sparsely populated rural areas with few other alternatives.

Colorado Corn Growers Association
The annual local economic impacts of a rotating fallowing program will be less than a permanent dry up that includes voluntary payment in lieu of taxes for the following reasons:

- The economic contribution from the farm would be lost to the local area under a permanent dry up, whereas they would only be reduced under a rotational fallowing program. Beyond the tax payments, expenditures, employment, and income from that farm would be lost to the region.

- The indirect or induced economic effects of the farm operation would be lost to the region. That is, as the farmers regional expenditures circulate through the local farming communities, additional economic effects occur which would also be lost as a result of the permanent dry up.

- "Upstream" economic linkages or farm products, which are used by cattle or ethanol plants, would also be lost to the region. With less feed stock, higher prices, more constrained supply might occur.

In sum, rotational fallowing programs allow for a continuation of farming and the contributions that farming brings to a region and the State as a whole. Property tax payments, even held at an equivalent level, only represent a part of the economic contribution of irrigated agriculture.

Lower Arkansas Valley Water Conservancy District/Super Ditch
This issue does not appear to be within the scope of Tasks E, F, and G, which are funded by the Alternative Agricultural Water Transfer Methods Grant Program. However, a comprehensive report (Task H) on the water leasing concept and the Super Ditch Company is anticipated to be completed in June 2011. This document may contain additional relevant information.

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Appendix C
South Platte and Arkansas Basin Straight-Line Diagrams

Division 1, District 2

WATER DISTRICT NO. 6
WAMAN CREEK
LOWER BOULDER DITCH
CHURCH DITCH ID 0700540
FARMER'S HIGHLINE ID 0700569
CROKE CANAL ID 0700553
ID 3903
STANDLEY LAKE
AKA KINNEAR
RESERVOIR
09-01-1869 940.36 AF
COAL RIDGE DITCH
ID 552
ID 3890
COAL RIDGE WASTE
RESERVOIR
AKA SANDHILL LAKE
07-30-1916 199.04 AF
WATER DISTRICT NO. 7
WATER DISTRICT NO. 2
CLEAR CREEK
LITTLE DRY CREEK
BIG DRY CREEK
NORTHGLENN RETURN
ID 809
BRANTNER DITCH
04-01-1865 0.0 CFS
04-01-1865 29.17 0.0 CFS
05-01-1871 12.18 0.0 CFS
01-15-1874 63.30 0.0 CFS
ID 810
BRIGHTON DITCH
12-01-1861 22.22 0.0 CFS
11-01-1871 12.58 0.0 CFS
2006
2007
ID 812
LUPTON BOTTOM DITCH
05-15-1865 47.70 0.0 CFS
03-10-1871 1.00 0.0 CFS
09-15-1873 92.87 0.0 CFS
SLATE DITCH
Perry Sump
AKA Asphalt Raving Recharge Area
AKA Wattenburg Sump 1 & 2
09-08-1997 2 0.0 CFS
Sullivan Recharge Area
AKA Wheeler Lake Recharge
10-18-1994 22.15 77.85 CFS
12-31-1991 0.0 115 CFS
Central changed water rights 8.44 cfs
2005
ALSO USED FOR IRR.
MEADOW ISLAND #1 AKA SIDE HILL DITCH
04-28-1882 84.8 CFS
Ditch Recharge
12-31-1991
Trs 05-01-1866 22.0 CFS
RETAIN 09-20-2000 0.0 90.0 CFS
MEADOW ISLAND #2
AKA MEADOW ISLAND #2
05-31-1866 51.6 41.4 CFS
04-10-1876 0.0 0.0 CFS
12-19-1972 0.0 0.0 CFS
Limited to 40 cfs when
Consolidated ditches are
By 1925 agreement between
Meadow Island and
Consolidated
ID 821
FT. LUPTON GAUGE
ID 822
ID 826
JAY THOMAS
DITCH 1865
04-01-1865
18.0 0.0 CFS
CBT WATER
ST. VRAIN CREEK
BIG THOMPSON RIVER
CACHE LA POUDRE RIVER
WATER DISTRICT NO. 4
WATER DISTRICT NO. 2
GREELEY
EVANS
ID 836
PATTERSON DITCH
05-01-1871 19.92 CFS
12-31-1986 370.00 CFS
WATER DISTRICT NO. 3
WATER DISTRICT NO. 1
CROW CREEK
KERSEY GAGING STATION
KERSEY
DENVER GAGING STATION
ID 800
FARMER AND GARDENERS DITCH
ADMIN AS DIST 2
03-15-1865 13.72 0.0 CFS
04-01-1874 10.28 0.0 CFS
ID 806
GARDENERS OR KELLER DITCH
LAND NO LONGER IRRIGATED
BY PSC 1984
05-01-1871 4.9 0.0 CFS
PSC RCHN
64TH AVE GAUGE
CAT (SACWSD/DWB)
DENVER
CHERRY CREEK
WATER DISTRICT NO. 8
WATER DISTRICT NO. 2
SAND CREEK
1ST CREEK
SECOND CREEK
THIRD CREEK
METRO WWTP
MILLER (SACWSD/DWB)
ADAMS CITY
ID 3699
WEST GRAVEL LAKES
(THORNTON)
ID 3700 WEST SPRAT PLATTE (THORNTON)
ARAPAHOE
ID 3560 SOUTH DAHLIA (THORNTON)
ID 3705 NORTH DAHLIA (THORNTON)
ID 3707 SPRAT-PLATTE RANDT (THORNTON)
EAST GRAVEL LAKES
(THORNTON) ID 3706
COOLEY EAST
(THORNTON)
COOLEY WEST (THORNTON)
MANN LAKES
SOUTH
(THORNTON)
HAMMER
(THORNTON)
HENDERSON GAUGING STATION
HENDERSON
ROAD RUNNER'S REST II
MARSHALL
HAZELTINE
HOWE-HALLER
TANABE
(SACWSD/DWB)
BRANNAN
(FRICO)
BROMLEY LAKES
(BRIGHTON)
ID 3361
ID 808
UPPER McCANNE DITCH
02-26-1892 4.0 CFS
SEEP
07-06-1982 0.0 CFS
McCANNE DITCH ID 868
11-01-1865 40.0 CFS
BRIGHTON
FULTON DITCH ID 808
04-01-1865 79.74 0.0 CFS
04-01-1868 450.0 0.0 CFS
04-25-1900 450.00 0.0 CFS
124TH AVENUE
(BRIGHTON)
3302
ZIGEN PIT
FULTON DITCH
CHANGED WATER 0.9445 cfs
CITY OF BRIGHTON RETURN
CENTRAL RETURN
LUPTON SHORTLINE
DITCH DUMP
ABANDONED ID 811
FORT LUPTON
ID 817
EVANS #2
AKA ENGLISH
09-05-1871 177.07 0.0 CFS
06-09-1909 215.95 0.0 CFS
02-01-1984 510.00 0.0 CFS
PLATTEVILLE DITCH ID 813
07-01-1865 8.62 0.0 CFS
10-15-1873 94.23 0.0 CFS
CCWCD RETURN
PLATTE VALLEY CANAL
Ditch Recharge
02-01-1984 510 cfs
2006
ID 818
CCWCD RETURN
PLATTEVILLE
DRYUP
BUCKERS DITCH ID 823
07-08-1879 121.87 0.0 CFS
WATER RIGHT NOT ABANDONED
ID 824
FARMERS INDEPENDENT DITCH
11-20-1865 85.6 0.0 CFS
11-20-1876 85.4 0.0 CFS
ID 825
HEWES COOK AKA WESTERN DITCH
04-01-1865 27.45 0.0 CFS
08-01-1865 27.45 0.0 CFS
01-26-1884 84.42 0.0 CFS
CENTRAL AND MONFORT RETURN
BIG BEND DITCH NO LONGER EXISTS
4 CFS TRANSFERRED TO UNION AND
REST TO WELLS
ID 828
UNION DITCH 08-26-1873
11-01-1871 100.00 0.0 CFS
11-02-1881 84.03 0.0 CFS
ID 829
SECTION NO. 3 DITCH AKA GODFREY BOTTOM
03-15-1870 36.88 0.0 CFS
03-15-1870 36.8 0.0 CFS
ID 834
LOWER LATHAM DITCH
12-01-1871 15.00 0.0 CFS
12-24-1871 15.00 0.0 CFS
12-24-1871 15.00 0.0 CFS
LA SALLE
ID 837
HIGHLAND DR RUN DITCH
10-01-1871 24.4 CFS
AUG RETURN FROM
LOWER LATHAM
ID 3876
MILTON LAKE
05-29-1909 26,773 0 AF
200 CFS
05-29-1909 0 16,374 AF
ID 3858
LOWER LATHAM RESERVOIR
06-23-1898 4,325.07 0 AF 183 0.0 CFS
06-24-1900 1,430.21 0 AF 183 0.0 CFS
08-07-1915 2,180.89 0 AF 183 0.0 CFS
MORRISON SEEP DITCH
RETURN FLOWS & MOSTLY
RESERVOIR SEEPAGE
8 – 10 CFS
Ditch Recharge
03-17-1982 29.0 46.0 CFS
2002
Ditch Recharge
11-01-1985 Feed Off Pond
11-01-1985 80 cfs
2004
2003
ID 3837
BARR LAKE
11-20-1885 11,081.25 0 AF
01-13-1909 54,941.26 0 AF 900 0.0 CFS
FRICO
BEEBE DRAW
RETURN FLOWS TO MILTON RESERVOIR
GILMORE (FRICO)
ID 805
DENVER HUDSON CANAL
06-01-1965 550 0.0 CFS
SHARE STORAGE RIGHTS
WATER DISTRICT NO. 2
WATER DISTRICT NO. 1
BOX ELDER CREEK
BOX ELDER CREEK
2500
BOXELDER CREEK RECHARGE 2440 3560 AF
5-10-1979 FROM DENVER HUDSON CANAL
ID 3592
HORSE CREEK
RESERVOIR
03-17-1911 16,965.1 0 AF
Burlington ID 802 400 0.0 CFS
07-20-1922 0 2,550.0 AF
GAGE HT. FROM 48' TO 51'
Burlington ID 802 450 0.0 CFS
ID 3609
PROSPECT
RESERVOIR
11-21-1910 5,970.20 0 AF
Burlington ID 802 500 CFS
7-20-1922 0 1,690.03 AF
ID 3892
OLDS RESERVOIR
2501
NO DECREE
USED UNDER FREE
RIVER CONDITIONS
ID 3902
LORD RES. NO.4
04-12-1907
775 0 AF
DISCHARGE TO
LOST CREEK
HENRYLYN SYSTEM
DENVER HUDSON CANAL
LITTLE LAKES
WITH STORAGE
RIGHTS AT END
OF DITCH
BURLINGTON DITCH
06-02-1862 3.00 0.0 CFS (REITHMAN RIGHT) ID 803
04-01-1864 27.4 0.0 CFS (DUGAN RIGHT)
11-20-1885 350.0 0.0 CFS
11-28-1907 300.0 0.0 CFS (O'BRIAN)
03-09-1908 600.0 0.0 CFS
01-13-1909 900.0 0.0 CFS
05-29-1909 200.0 0.0 CFS
11-21-1910 500.0 0.0 CFS
03-17-1911 400.0 0.0 CFS
01-28-1918 150.0 0.0 CFS
06-01-1919 20.25 0.0 CFS
06-05-1921 20.25 0.0 CFS
06-15-1922 150.0 0.0 CFS
07-20-1922 450.0 0.0 CFS
02-01-1984 900.0 0.0 CFS (O'BRIAN)
O'BRIAN CANAL ID 802
LITTLE BURLINGTON CANAL ID 915
2003
FORD RECHARGE AREA
11-24-1984 400 0 AF 20 0.0 CFS
2512
SCIENTURFIC
RECHARGE AREA
BURLINGTON LEASE WATER
ID 3301
EMPIRE DITCH
04-01-1865
612.48 0.0 CFS

EXPLANATION:

ID XXXX Water District ID
DRY-UP POINTS ON THE RIVER
DITCH NO LONGER EXISTS, OR IS NOT USED
WATER RIGHT MAY OR MAY
NOT BE ABANDONED
CITY
RESERVOIR AND DITCH TURNOUTS TO RIVER
DWR GAGE STATION OR DCP
DITCH MEASUREMENT POINT
RECHARGE SITE(S)
USGS GAUGE
SPILLING OR MIXING POINT
GRAVEL PIT

GRAVEL PIT ID TABLE

1) TUCSON (AURORA)
2) ROGERS (THORNTON)
3) ID 3358 WALKER RESERVOIR (CCWCD)
4) ID 3359 WATTENBERG (WESTMINSTER
5) FORT LUPTON (THORNTON)
6) FORT LUPTON (THORNTON)
7) FORT LUPTON (THORNTON)

Colorado Division of Water Resources

Version as of 10-08-2008 by David Ellington & George Roark, DWR

Net amounts are shown (Absolute and Conditional).

Example: 03-15-1974 25.5 0.0 CFS; 06-15-1908 69,446 0 AF

Recharge areas are connected to ditches but are not necessarily geographically placed.

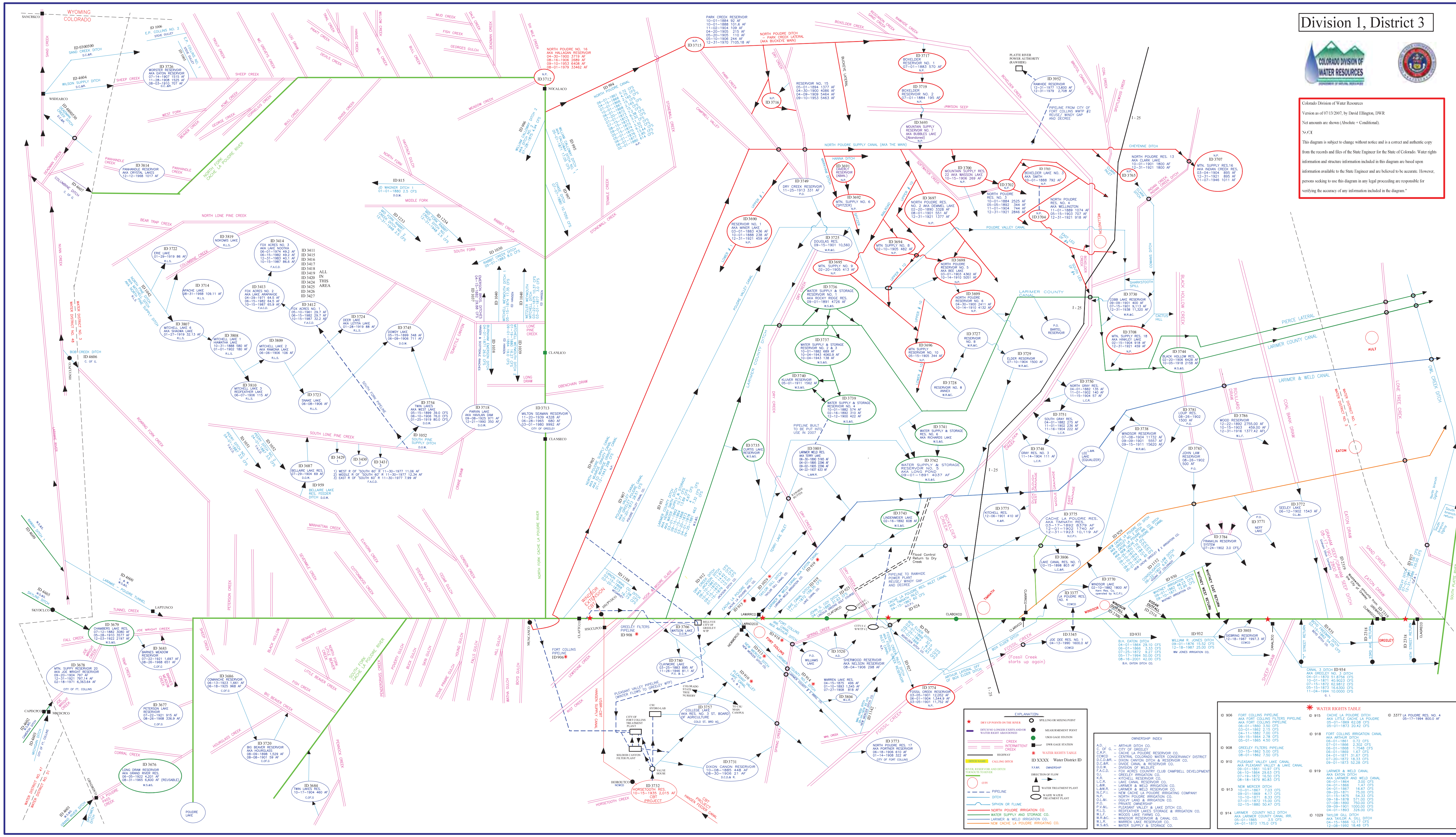
Direct flows shown on ditches, storage flows shown in reservoirs and recharge areas

NOTE:

This diagram is subject to change without notice and is a correct and authentic copy from the records and files of the State Engineer for the State of Colorado. Water rights information and structure information included in this diagram are based upon information available to the State Engineer and are believed to be accurate. However, persons seeking to use this diagram in any legal proceeding are responsible for verifying the accuracy of any information included in the diagram.

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES

COLORADO WATER CONSERVATION BOARD
STATE OF COLORADO
1876
1937


Division 1, District 3
Colorado Division of Water Resources
Version as of 07/13/2007, by David Ellington, DWR
Net amounts are shown (Absolute + Conditional).
N+C.T.
This diagram is subject to change without notice and is a correct and authentic copy from the records and files of the State Engineer for the State of Colorado. Water rights information and structure information included in this diagram are based upon information available to the State Engineer and are believed to be accurate. However, persons seeking to use this diagram in any legal proceeding are responsible for verifying the accuracy of any information included in the diagram."
WATER RIGHTS TABLE
ID 906 FORT COLLINS PIPELINE AKA FORT COLLINS FILTERS PIPELINE AKA FORT COLLINS PIPELINE 06-01-1860 3.50 CFS 03-01-1862 2.15 CFS 04-11-1862 7.00 CFS 09-15-1864 2.78 CFS 05-01-1865 4.50 CFS
ID 908 GREELEY FILTERS PIPELINE 03-15-1862 5.00 CFS 08-01-1862 7.50 CFS
ID 910 PLEASANT VALLEY LAKE CANAL AKA PLEASANT VALLEY & LAKE CANAL 09-01-1861 10.97 CFS 06-10-1864 29.63 CFS 07-19-1872 16.50 CFS 08-18-1879 80.83 CFS
ID 913 NEW MERCER DITCH 10-01-1867 7.03 CFS 09-01-1869 4.17 CFS 10-10-1871 8.33 CFS 07-01-1872 15.00 CFS 02-15-1880 50.47 CFS
ID 914 LARIMER COUNTY NO.2 DITCH AKA LARIMER COUNTY CANAL IRR. 05-01-1865 3.5 CFS 04-01-1873 175.0 CFS
ID 915 CACHE LA POUDRE DITCH AKA LITTLE CACHE LA POUDRE 05-01-1869 62.08 CFS 05-01-1873 20.42 CFS
ID 918 FORT COLLINS IRRIGATION CANAL AKA ARTHUR DITCH 06-01-1861 0.72 CFS 07-01-1866 2.302 CFS 06-01-1868 1.7548 CFS 06-01-1869 1.67 CFS 04-01-1871 31.67 CFS 07-20-1872 18.33 CFS 09-01-1873 52.28 CFS
ID 919 LARIMER & WELD CANAL AKA EATON DITCH AKA LARIMER AND WELD CANAL 06-01-1864 3.00 CFS 04-01-1866 1.47 CFS 04-01-1867 16.67 CFS 09-20-1871 75.00 CFS 01-15-1875 54.33 CFS 09-18-1878 571.00 CFS 07-08-1890 750.00 CFS 09-09-1901 1000.00 CFS 04-01-1893 326.00 CFS
ID 1029 TAYLOR GILL DITCH AKA TAYLOR & GILL DITCH 04-15-1866 12.17 CFS 12-08-1992 18.48 CFS
ID 3377 LA POUDRE RES. NO. 4 05-17-1994 800.0 AF
OWNERSHIP INDEX
A.D. - ARTHUR DITCH CO.
C. OF G. - CITY OF GREELEY
C.P.R. - CACHE LA POUDRE RESERVOIR CO.
CCWCD - CENTRAL COLORADO WATER CONSERVANCY DISTRICT
D.C.D.&R. - DIXON CANYON DITCH & RESERVOIR CO.
D.C.&R. - DIVIDE CANAL & RESERVOIR CO.
D.O.W. - DIVISION OF WILDLIFE
F.A.C.D. - FOX ACRES COUNTRY CLUB CAMPBELL DEVELOPMENT
G.I. - GREELEY IRRIGATION CO.
K.R. - KITCHELL RESERVOIR CO.
L.C.R. - LAKE CANAL RESERVOIR CO.
L.&W. - LARIMER & WELD IRRIGATION CO.
L.&W.R. - LARIMER & WELD RESERVOIR CO.
N.C.P.I. - NEW CACHE LA POUDRE IRRIGATION CO.
N.P. - NORTH POUDRE IRRIGATION CO.
O.L.&I. - OGILVY LAND & IRRIGATION CO.
P.O. - PRIVATE OWNERSHIP
P.V.&L. - PLEASANT VALLEY & LAKE DITCH CO.
R.L.S. - REDFEATHER LAKES STORAGE & IRRIGATION CO.
W.L.F. - WOODS LAKE FARMS CO.
W.R.&C. - WINDSOR RESERVOIR & CANAL CO.
W.L.R. - WARREN LAKE RESERVOIR CO.
W.S.&S. - WATER SUPPLY & STORAGE CO.
EXPLANATION:
DRY-UP POINTS ON THE RIVER
DITCH NO LONGER EXISTS AND/OR WATER RIGHT ABANDONED
CREEK
INTERMITTENT CREEK
HIGHWAY
CALLING DITCH
DITCH NAME
RIVER, RESERVOIR AND DITCH TURNOUTS TO RIVER
CITY
PIPELINE
DITCH
SIPHON OR FLUME
NORTH POUDRE IRRIGATION CO.
WATER SUPPLY AND STORAGE CO.
LARIMER & WELD IRRIGATION CO.
NEW CACHE LA POUDRE IRRIGATING CO.
SPILLING OR MIXING POINT
MEASUREMENT POINT
USGS GAGE STATION
DWR GAGE STATION
WATER RIGHTS TABLE
ID XXXX Water District ID
X.X.&X. OWNERSHIP
DIRECTION OF FLOW
WATER TREATMENT PLANT
WASTE WATER TREATMENT PLANT

Division 1, District 4

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES

COLORADO WATER CONSERVATION BOARD
STATE OF COLORADO
1876 1937

Colorado Division of Water Resources, Version as of 08/27/2007

By David Ellington

Net amounts are shown (Absolute + Conditional).

NOTE:

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OWNERSHIP INDEX

B.&L.I.&M. - BOULDER & LARIMER COUNTY IRRIGATING AND MANUFACTURING CO.
C.H.D. - CONSLIDATED HILLSBOROUGH DITCH CO.
C.H.S.D.&R. - CONSOLIDATED HOME SUPPLY DITCH AND RESERVOIR CO.
E.C. - EAGLE CONSTRUCTION CO.
H.D. - HANDY DITCH CO.
L.&G.I. - LOVELAND AND GREELEY IRRIGATING CO. (GREELEY AND LOVELAND)
L.L.R.C. - LOVELAND LAKE RESERVOIR CO.
L.I.C.&R. - LOUDEN IRRIGATING CANAL AND RESERVOIR CO.
P.O. - PRIVATE OWNERSHIP
R.G.R.C. - RYAN GULCH RESERVOIR CO.
S.L.R. - SEVEN LAKES RESERVOIR CO.
S.S.R.C. - SOUTH SIDE RESERVOIR CO.
S.S.D.C. - SOUTH SIDE DITCH CO.

WATER RIGHTS TABLE

ID 521 HANDY DITCH
04-01-1863 1.3855 CFS
05-01-1864 1.5150 CFS
02-25-1865 19.9334 CFS
03-01-1867 2.6729 CFS
05-01-1872 0.3987 CFS
02-28-1878 31.0960 CFS
01-15-1877 198.000 CFS

ID 524 HOME SUPPLY DITCH
11-10-1861 14.78 CFS
04-01-1863 2.33 CFS
05-01-1864 14.19 CFS
03-01-1867 25.06 CFS
05-01-1872 3.74 CFS
07-15-1881 278.84 CFS
03-15-1881 286.52 CFS
04-10-1896 3.500 CFS
07-15-1881 275.00 CFS

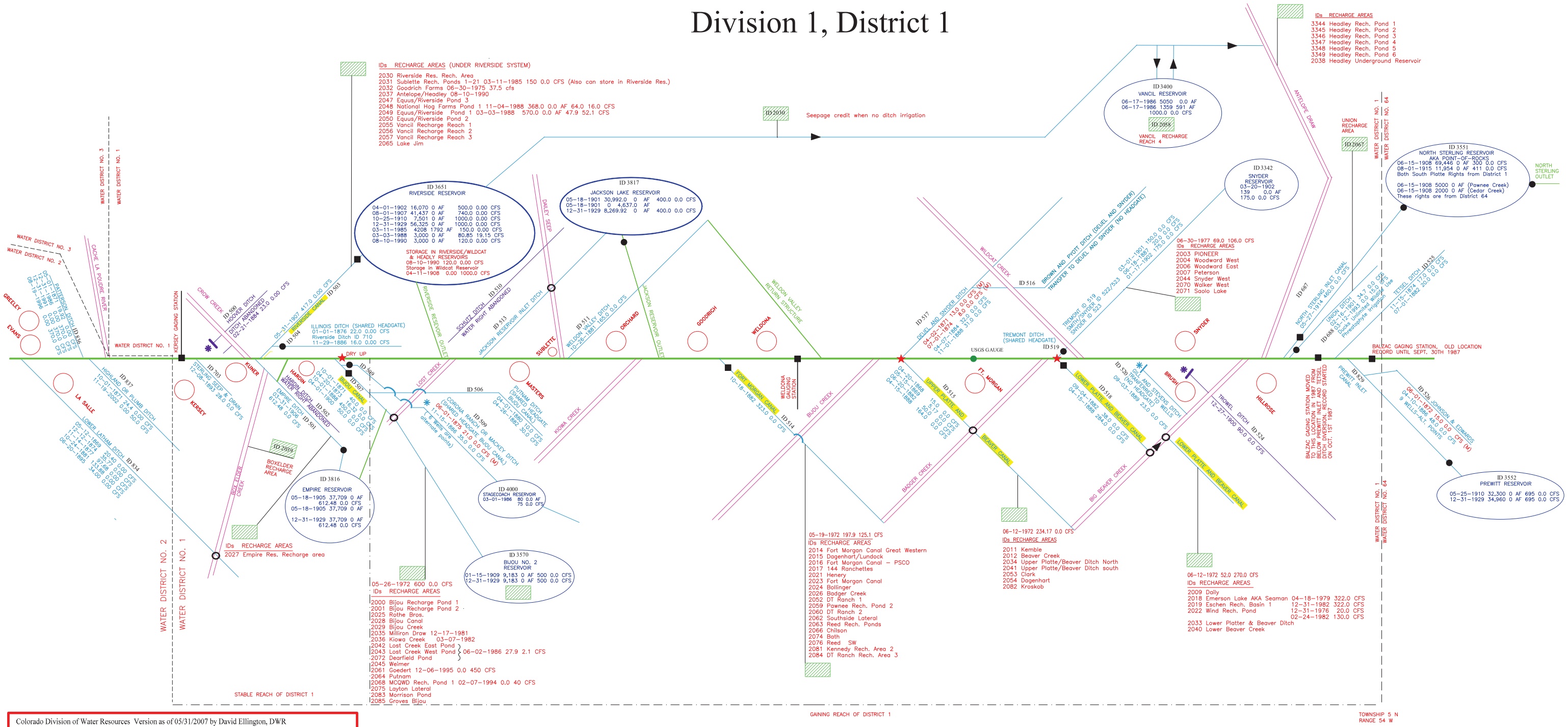
ID 527 IDYLWILD RESERVOIR AND PIPELINE
07-14-1913 74.0 CFS

EXPLANATION:

DIRECTION OF FLOW
CITY
DITCH NAME
CBT PROJECT CONVEYANCE STRUCTURE
RESERVOIR OR LAKE
CBT PROJECT RESERVOIR
CREEK NAME
RIVER
PIPELINE
SIPHON OR FLUME

X.X.&X. OWNERSHIP
DRY-UP POINTS ON THE RIVER
POWER PLANT
MEASUREMENT POINT
USGS GAGE STATION
DWR GAGE STATION
ID XXXX Water District ID
SPILLING OR MIXING POINT
WATER TREATMENT PLANT

Division 1, District 1



Colorado Division of Water Resources Version as of 05/31/2007 by David Ellington, DWR

Net amounts are shown (Absolute + Conditional). Example: 03-15-1974 25.5 0.0 CFS; 06-15-1908 69,446 0 AF

Recharge areas are connected to ditches but are not necessarily geographically placed.

Direct flows shown on ditches, storage flows shown in reservoirs and recharge areas

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EXPLANATION:

- ID XXXX — Water District ID
- DRY-UP POINTS ON THE RIVER
- ALTERNATE POINT DIVERSION USED, WATER RIGHT ACTIVE, TAKEN THROUGH ALTERNATE POINT, DITCH NO LONGER EXISTS
- ALTERNATE POINT DIVERSION USED, WATER RIGHT ACTIVE, DITCH STILL EXISTS
- DITCH NO LONGER EXISTS OR WATER RIGHT ABANDONED
- DITCH NAME — CALLING DITCH
- CITY
- RESERVOIR AND DITCH TURNOUTS, RETURNS TO RIVER
- (M) MEADOW RIGHT 4-10 TO 7-10
- SPILLING OR MIXING POINT
- DITCH CROSSES BUT DOES NOT MIX
- DIRECTION OF FLOW
- CFS = Cubic Feet Per Second
- AF = Acre-Feet
- DWR GAGE STATION OR DCP
- USGS GAUGE
- MEASUREMENT POINT
- RECHARGE SITE

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES

COLORADO WATER CONSERVATION BOARD
STATE OF COLORADO
1876
1937

Division 1, District 64

COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES

COLORADO WATER CONSERVATION BOARD
STATE OF COLORADO 1876 1937

ID 6400687
0100687
NORTH STERLING INLET CANAL
05-27-1914 460.0 0.0 CFS

IDs RECHARGE AREAS
2013 North Sterling

ID 3551
NORTH STERLING RESERVOIR
AKA POINT-OF-ROCKS
06-15-1908 5,000 0 AF (Pawnee Creek)
06-15-1908 2,000 0 AF (Cedar Creek)
District 64 Rights
06-15-1908 69,446 0 AF 300 0.0 CFS
08-01-1915 11,954 0 AF 411 0.0 CFS
Both South Platte rights from District 1

NORTH STERLING OUTLET

IDs RECHARGE AREAS
2031 North Sterling Outlet

12-23-2002 4.4 145.6 CFS
IDs RECHARGE AREAS
2088 Iliff & Platte Valley Area 2
2089 Iliff & Platte Valley Area 3
2097 Iliff & Platte Valley Area 4
2098 Iliff & Platte Valley Area 5
2101 Iliff & Platte Valley Area 6
2106 Iliff Ditch
2110 Iliff & Platte Valley Area 1
2184 Iliff & Platte Valley Ditch Rech. Area

12-24-2003 0.0 90.0 CFS
IDs RECHARGE AREAS
2146 Powell & Blair Area 1
2147 Powell & Blair Area 2
2148 Powell & Blair Area 3
2149 Powell & Blair Area 4
2150 Powell & Blair Area 5
2151 Powell & Blair Area 6
2152 Powell & Blair Area 7
2153 Powell & Blair Area 8
2154 Powell & Blair Area 9
2155 Powell & Blair Area 10
2156 Powell & Blair Area 11
2157 Powell & Blair Area 12
2158 Powell & Blair Area 13
2175 Powell & Blair Area 14
2176 Powell & Blair Area 15
2177 Powell & Blair Area 16
2178 Powell & Blair Area 17
2179 Powell & Blair Area 18
2180 Powell & Blair Area 19
2181 Powell & Blair Area 20
2182 Powell & Blair Area 21
2183 Powell & Blair Area 22
2186 Powell Ditch Area 1
2187 Powell Ditch Area 2

04-24-2003 0.0 90.0 CFS
IDs RECHARGE AREAS
2102 Upper Harmony D R Area 1
2137 Upper Harmony D R Area 2
2138 Upper Harmony D R Area 3
2139 Upper Harmony D R Area 4
2140 Upper Harmony D R Area 5
2141 Upper Harmony D R Area 6
2142 Upper Harmony D R Area 7
2143 Upper Harmony D R Area 8
2144 Upper Harmony D R Area 9
2145 Upper Harmony D R Area 10
2185 Upper Harmony D 2 R Area

12-31-2002 252 0.0 CFS
04-30-2003 0.0 60.0 CFS
IDs RECHARGE AREAS
2006 Julesburg Highline
2042 Lind Farms
2043 Jenick
2044 R Jenick
2045 Steve Nein
2061 Lechman
2066 HV & L & O
2067 D. Nein Area 3
2068 L Leachman
2069 McClary Farms Area 1
2073 Mowery
2074 Kobayashi
2118 Kuksie
2120 McClary Farms Area 2
2136 Rober
2202 Meier

05-02-1989 65.0 0.0 CFS
IDs RECHARGE AREAS
2005 Julesburg
2019 Julesburg City
2021 Peterson Ditch
2028 McKinstry/Thode
2029 Peterson Ditch A 2
2047 Sittner
2048 Sanger
2049 Peterson Ditch A 3
2050 HKA
2053 Gerk
2054 Farmers Grain
2055 Kontny
2056 Meier Brothers
2057 Walter
2058 LSR
2059 Schneider
2060 Engelker
2061 Lechman
2065 Kinnison
2075 Schneider Rchg Area 2
2111 Jld & Harms Gate 38
2121 Kinison Gate 45
2122 Irvin Hanson
2123 Don Spillman
2124 Thode Gate 56
2125 Rundall
2191 Meier 2/22
2192 Anderson
2200 Sowder
2201 Cottonwood

02-04-1997 7 19 CFS
IDs RECHARGE AREAS
2007 Liddle Ditch
2008 Thrasher

IDs RECHARGE AREAS
2040 D Nein Recharge Area 2
2041 Settlers Ditch
2119 D Nein Recharge Area 1

IDs RECHARGE AREAS
2000 Schuman Lake 03-01-1986
2011 Fritzler Recharge Lake Combined
2109 Wykoff
2205 Baney
2206 Samber
2505 Country Club Hills 03-29-1978

04-14-1994 0.0 75.0 CFS
12-22-1995 77.0 63.0 CFS
IDs RECHARGE AREAS
2010 Bostron
2012 Pawnee Ditch
2016 Miller Pond AKA 2353A
2018 Scalva Recharge Area 2
2023 Healy Pond
2024 Lebsock Recharge Area 1
2030 Bostron No. 2 Pond
2034 Bostron No. 3 Pond
2035 Schott 1
2036 Schott 2
2037 Hettinger
2046 Mori Pond 1
2051 Ills Pond
2052 Keller Pond
2064 Propst
2072 Mori Pond 2
2077 Pomeroy Pond
2078 Scalva Pond 2
2080 Wagner Pond
2081 Baseggio Pond
2082 Weber Pond
2083 Guenzi Farms
2084 Mc Endeffer
2085 Williamson
2086 Lousburg Partners
2207 Mc Endeffer Recharge Area 2
2208 Warner/Amen
2209 Fritzler Recharge Area 1
2210 Fritzler Recharge Area 4
2211 Fritzler Recharge Area 6
2212 Vandemoer
2501 Manahan 05-03-1979 25 0.0 CFS
2502 Pivonka
2515 Sterling

IDs RECHARGE AREAS
2100 Sterling No. 1 Ditch
2112 Gene Manuello

IDs RECHARGE AREAS
2099 Lawline Ditch
2113 Jerome Schell
2114 Adrian Kaiser
2115 Jim Corbin
2116 Steve Kaiser
2131 Tim Corbin

JULESBURG RESERVOIR
AKA
JUMBO RESERVOIR
2-12-1904 28,178 0 AF
450 0.0 CFS
ID 3906

ID 617
HILINE CANAL
AKA OUTLET 1

PETERSON DITCH
ALSO IRRIGATES
IN NEBRASKA

PIONEER DRAIN

WATER DISTRICT NO. 1
WATER DISTRICT NO. 64

ID 0100525
TETSEL DITCH
11-15-1874 17.0 0.0 CFS
07-01-1882 20.0 0.0 CFS

PAWNEE CREEK
DITCH CONCRETE/BOARD STRUCTURE & SAND DAM (CONTROL AT RIVER)
PAWNEE CREEK
ID 533
PAWNEE'S PAWNEE DITCH – AKA PAWNEE
09-17-1873 14.4 0.0 CFS
08-22-1882 1260.0 0.0 CFS

SPRINGDALE DITCH – SAND DAM
07-19-1886 62.275 0.0 CFS
STERLING NO. 1 IRRIGATION DITCH INTAKE – GATE & SAND DAM
CONTROL AT RIVER
07-01-1873 115.447 0.0 CFS

ID 530
ID 528
ID 526
STERLING NO. 2 DITCH
08-07-1894 43.56 0.0 CFS
LOW LINE DITCH
10-14-1882 38.76 0.0 CFS

COMMUNITY SPILLWAY
CEDAR CREEK
CORRAL CREEK
LEWIS CREEK
ID 520
BIJOU AND SOUTH VALLEY CANAL – SAND DAM
10-01-1883 150.0 0.0 CFS
ID 516
POWELL AND BLAIR DITCH – SAND DAM
05-01-1895 40.0 0.0 CFS
05-03-1897 40.0 0.0 CFS
ID 515
HARMONY NO. 2 DITCH 05-03-1897 50.0 CFS
ID 514 RAMEY DITCH – SAND DAM
08-23-1894 12.0 0.0 CFS
HARMONY NO. 1 DITCH
04-28-1895 252.0 0.0 CFS BLADDER/ROLLOVER
(CONTROL AT RIVER)
ID 510 HARMONY NO. 3 DITCH
05-13-1903 219.0 0.0 CFS
ID 511 & SAND DAM & 30' BLADDER/ROLLOVER
(CONTROL AT RIVER)

MOORE'S
SETTLERS DITCH ID 508
12-13-1897 51.67 0.0 CFS
12-13-1897 51.67 0.0 CFS
LONG ISLAND DITCH
02-20-1895 18.0 0.0 CFS
02-20-1895 20.0 0.0 CFS
RED LION
ID 507
SUPPLY DITCH
10-31-1895 52.0 0.0 CFS
ID 506
ID 504
PETERSON DITCH
03-01-1895 164.0 CFS
12-01-1926 50.0 CFS
COTTONWOOD CREEK
LODGE POLE CREEK
11-24 BAYS
(EACH BAY HAS
5 SECTIONS W/ BOARDS)
(CONTROL AT RIVER)
LODGE POLE CREEK
SAND DAM & 20' DROP GATE (CONTROL AT GATE)
ID 502
10-21-1891 10.0 0.0 CFS (Sub. to Decree 11-10-98)

SPRINGDALE DITCH – SAND DAM W/ 44' CONC. STRUCTURE (4-6' SECTIONS)
CONTROL AT RIVER W/ BOARDS
ID 503
SOUTH RESERVATION DITCH
09-14-1892 25.0 0.0 CFS
ID 501
CARLSON DITCH
12-01-1894 6.0 0.0 CFS

ID 0103526 JOHNSON & EDWARDS
06-01-1887 45.0 0.0 CFS
9 WELLS-SALT CREEK
ID 0103539 PREWITT INLET

ID 0103552, 6403522
PREWITT RESERVOIR
05-25-1910 32,300 0 AF 695 0.0 CFS
12-31-1929 34,960 0 AF 695 0.0 CFS

PREWITT OUTLET
PREWITT DRAW DITCH
ID 535 SOUTH PLATTE DITCH – ROLLOVER BLADDER, GATE & SAND DAM
(CONTROL AT RIVER)
DAVIS BROS. DITCH ID 532
04-10-1872 4.0 0.0 CFS
04-10-1872 4.0 0.0 CFS
10-20-1886 10.0 0.0 CFS
04-25-1887 30.0 0.0 CFS
04-25-1887 30.0 0.0 CFS
ID 531
SCHNEIDER DITCH – CONCRETE ROLLOVER & GATE (CONTROL AT RIVER)
04-10-1872 1700.0 0.0 CFS (From 4-10 to 7-10)
10-20-1886 17.8 0.0 CFS
ID 533 (From 4-10 to 7-10)
STERLING HEBRON CATTLE CO'S DITCH ID 527
11-30-1892 12.0 0.0 CFS
02-17-1902 24.0 0.0 CFS
ID 535 JOHNSON AND SMITH DITCH
ID 521 FARMERS AND PEOPLES DITCH, AKA FARMER'S DITCH
CONTROL AT RIVER – SAND DAM
07-01-1883 40.0 0.0 CFS
04-01-1956 20.0 0.0 CFS
ID 2515 Sterling Recharge Area
06-30-1998 35 0.0 CFS
IDs RECHARGE AREAS
2132 Sterling Recharge Area 2
2133 Sterling Recharge Area 3
2134 Sterling Recharge Area 4
2135 Sterling Recharge Area 5
3920 Sterling Res. 1
3921 Sterling Res. 2
ID 522
LAB DITCH AKA LUD BRUSH DITCH
07-17-1888 70.0 0.0 CFS
LONE TREE DITCH ID 518
07-15-1884 8.0 0.0 CFS
07-15-1884 70.0 0.0 CFS
ID 519
CHAMBERS DITCH ID 513
05-01-1888 300 0.0 CFS
ID 2514
ID 2015
ID 2062
ID 2063
ID 2027
OVERLAND TRAIL RANCH
RECHARGE AREA
AKA
ID 3027

IDs RECHARGE AREAS
2001 Lone Tree Recharge Pond
03-12-1981 1130 0 AF 27.0 0.0 CFS

03-15-1974 26.8 0.0 CFS
IDs RECHARGE AREAS
2004 Smart 07-23-1977 11.3 3.7 CFS
2014 S. Platte A 1
2020 Smart R Area 3
2025 Smart R Area 2
2026 Sandhills Area 2
2032 Sandhills Lake
2033 Kautz
2107 Marl
2108 Lingreen
2504 South Platte Ditch

08-20-1996 0.0 60 CFS
IDs RECHARGE AREAS
2022 Bravo D Recharge Area
2038 Manuello
2090 Fanning
2091 Sleb R Area 1
2092 Manuello R Area 2
2093 Karg
2094 Manuello R Area 3
2203 Veeman R Area 1
2204 Veeman R Area 2
2500 Home Ranch 11-29-1976

IDs RECHARGE AREAS
2193 Fender R Area 1
2194 Fender R Area 2
2195 Paker
2196 Berges
2197 Lanckriet
2198 McCormick R Area 2

TURNOUT (3-3' BAYS)
TURNOUT (3-4' GATES)
TURNOUT (3-5' BAYS)
6' TURNOUT
TURNOUT (9-4.5' BAYS)
TURNOUT (3-4.5' BAYS)
TURNOUT (6-6' BAYS)
TURNOUT (4-4.5' GATES)
TURNOUT (3-5' BAYS)
TURNOUT (2-20'BAYS W/ 4 GATES EA.)
TURNOUT (2-4' BAYS)

MESSEX
MERINO
ATWOOD
STERLING
ILIFF
PROCTOR
CROOK
SEDGWICK
OVID
JULESBURG

BALZAC GAGING STATION MOVED TO THIS LOCATION IN 1987 FROM BELOW PREWITT INLET AND TETSEL DITCH DIVERSION. RECORD STARTED ON OCT. 1ST 1987

BALZAC GAGING STATION, OLD LOCATION RECORD UNTIL SEPT. 30TH 1987

JULESBURG GAGING STATION

STATE LINE COLORADO

WESTERN CANAL
06-14-1897 120 CFS

From April 1 to Oct 15 flow at the interstate line not to be diminished to less than 120 CFS by Colorado Priorities junior to 06-14-1897 and east of the western Washington County boundary.

NORMAL CALLS:

6/82 PAWNEE BYPASS TO STERLING #1

7/86 SPRINGDALE BYPASS TO STERLING #1 OR ILIFF & PLATTE VALLEY CANAL

10/82 FT. MORGAN BYPASSTO LOWLINE

10/83 ILIFF & PLATTE VALLEY

04/95 HARMONY #1

FROM APRIL 1 TO OCT 15 FLOW AT INTERSTATE LINE NOT TO BE DIMINISHED TO LESS THAN 120 C.F.S. BY COLORADO PRIORITIES JUNIOR TO 06/14/1897

(NOTE: MANY TIMES TWO OR MORE CALLS WILL OCCUR AT THE SAME TIME)

EXPLANATION:

ID XXXX Water District ID
DRY-UP POINTS ON THE RIVER
ALTERNATE POINT DIVERSION USED, WATER RIGHT ACTIVE, TAKEN THROUGH ALTERNATE POINT, DITCH NO LONGER EXISTS
ALTERNATE POINT DIVERSION USED, WATER RIGHT ACTIVE, DITCH STILL EXISTS
DITCH NO LONGER EXISTS OR WATER RIGHT ABANDONED
DITCH NAME CALLING DITCH
CITY
RESERVOIR AND DITCH TURNOUTS, RETURNS TO RIVER
(M) MEADOW RIGHT 4-10 TO 7-10
SPILLING OR MIXING POINT
DITCH CROSSES BUT DOES NOT MIX
DIRECTION OF FLOW
CFS = Cubic Feet Per Second
AF = Acre-Feet
DWR GAGE STATION OR DCP
USGS GAUGE
MEASUREMENT POINT
RECHARGE SITE

Colorado Division of Water Resources Version as of 07-13-2007 by David Ellington, DWR

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Recharge areas are connected to ditches but are not necessarily geographically placed.

Direct flows shown on ditches, storage flows shown in reservoirs and recharge areas

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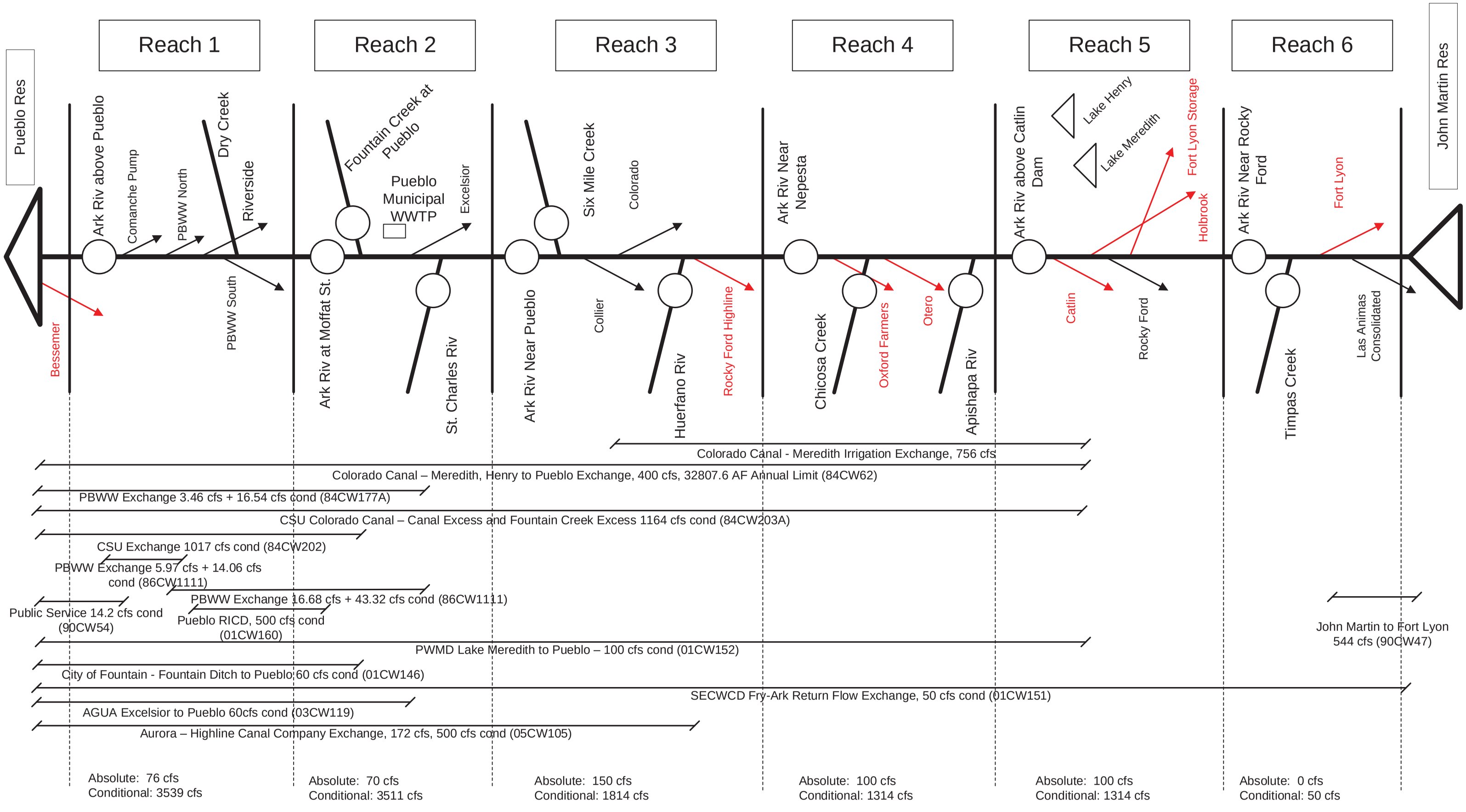
Arkansas River Exchange Model
Straight Line Diagram



Appendix D
Summary of Arkansas River Water Exchanges

significant impact upon current water management operations in Water Division 2 or those that may have a significant impact upon adjudication and implementation. The summary of primary water exchanges that pertain to existing and potential deliveries and exchange of water through the AVC are summarized in Table 5-6.

Table 5-6. Summary of Arkansas River Water Exchanges

Priority	Entity	Amount	Adjudication	Case	Priority Date
1	SECWCD	(1)	Decreed	B-42135	2/10/1939
2	BWWP	27cfs	Decreed	83CW18 84CW62-64 84CW35 84CW202-203 84CW177-178	6/5/1985
3	Colorado Canal	100cfs	Decreed		
4	BWWP	50 cfs	Decreed		
	Colorado Canal Companies	50 cfs	Decreed		
5	Colorado Canal Companies	50 cfs	Decreed		
6	City of Colorado Springs	77 cfs, less the rate of flow exchanged by BWWP under Priorities 2 and 4	Decreed		
7	Aurora	Applicable maximum diversion rates specified by the final decree in Case 83CW18	Decreed		
8	City of Colorado Springs	100 cfs, less any amount exchanged under Priority 6	Decreed		
9	Colorado Canal Companies	1/2 of remaining exchange potential, up to 756 cfs	Decreed		
	City of Aurora	Up to 40 cfs, not to exceed 500 acre-feet/year; thereafter 25% of remaining exchange opportunity to an additional 500 acre-feet/year	Decreed		
	City of Colorado Springs	The balance available or remaining	Decreed		
10	Public Service Company	14 cfs	Decreed	86CW111	7/1/1985
11	SECWCD	(2)	Pending	01CW151	1/12/1989
12	SECWCD	(3)	Pending	01CW151	6/4/1996
13	City of Aurora	Applicable maximum rate of flow allowed by decree in 99CW169	Decreed	99CW169	12/28/1999

Table 5-6. Summary of Arkansas River Water Exchanges					
Priority	**Entity**	**Amount**	**Adjudication**	**Case**	**Priority Date**
14	City of Fountain	60 cfs	Pending	01CW108, 01CW146	12/31/2000
15	SECWCD	(4)	Pending	06CW008	Pending

(1) Measured Fryingpan-Arkansas Project Water and Measured Municipal Return Flows

(2) Unmeasured Municipal Fryingpan-Arkansas Project Return Flows

(3) All other Fryingpan-Arkansas Project Return Flows

(4) From Dye Reservoir and Holbrook Reservoir No. 1.

Total exchanges shall not exceed 15,000 acre-feet per year.

Maximum Exchange Rates

Dye Reservoir. Rate not to exceed 594 cfs.

Holbrook Reservoir No. 1. Rate not to exceed 185 cfs.

Direct Flow Exchanges: will not exceed 50 cfs or 20,000 acre-feet per year.

The sources of information used in the composition of the Arkansas River Water Exchange Summary in Table 5-6 include the water rights tabulation maintained by the Division 2 Engineer's Office, adjudicated and pending water court decrees, and documented water exchange priorities in technical reports (Bethel 2002, MWH 2007).

5.3.7 Findings and Conclusions of Exchange Analysis

The AVC offers an effective and viable mechanism to facilitate water exchanges, which optimize water resources management and use in the lower Arkansas River Valley below Pueblo Reservoir. For illustrative purposes, the engineering report compiled in the earlier Rocky Ford Ditch change in water rights Case No. 99CW169 indicated the exchange potential from the Lake Meredith Outlet Canal to Twin Lakes Reservoir during the period of March 15 through November 14 averaged 79,028 acre-feet per year during the 14-year period of 1976 through 1989 that included dry and wet years (Bethel 2002).

The sources of exchange water presently available for use with the AVC include direct flow exchanges from non-Project water supplies and Fry-Ark Project return flows that include measured municipal return flows from Project participants. In Case No. 01CW151, the SECWCD has petitioned the Division 2 Water Court for Conditional Appropriative Rights of Exchange that will grant the right to store surplus Fry-Ark Project return flows in Pueblo Reservoir (including the enlargement) for use in the Arkansas River Valley downstream from Pueblo Reservoir. These return flows include Fry-Ark Project irrigation

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