Analysis and Technical Update to the Colorado Water Plan

Technical Memorandum

Prepared for:

Colorado Water Conservation Board

Subject:

Review of Successful Alternative Transfer Method Programs and Future Implementation

Date: July 16, 2019

Prepared by: Jacobs and BBC Research & Consulting

Reviewed by: Brown and Caldwell

Table of Contents

Section 1 : Introduction & Overview of ATMs 1
1.1 Mechanics of ATMs 1
1.2 ATM Attributes & Barriers 1
1.3 New Legal Structures 2
Section 2 : Case Studies 5
2.1 Little Thompson Farm 6
2.2 Catlin Canal (A.K.A. Super Ditch) 9
2.3 McKinley Ditch 12
2.4 Grand Valley Water Users Association Conserved Consumptive Use Pilot Program (CCUPP) 14
Section 3 : Hypothetical Agricultural to Municipal Transfer 17
3.1 Drivers of Water Transfer Frequencies for Municipal ATMs 17
3.2 Infrastructure Considerations for Municipal ATMs 19
3.3 Hypothetical Example of Large-Scale Agriculture to Municipal ATM Project 20
Section 4 : Lessons Learned, Data Needs, & General Recommendations 21
4.1 Monitoring of ATM Implementation and Effectiveness 21
4.2 Conclusions and Next Steps 22
References 23

List of Figures

Figure 1: Case Study Locations 5

List of Tables

Table 1: Hypothetical Example of Frequency That Municipal Water Providers May Exercise Their Option to Transfer 10,000 AFY of ATM Water 18
Table 2: Potential ATM Monitoring Data 21

Section 1: Introduction & Overview of ATMs

Colorado's Water Plan (Water Plan) describes how future population growth in Colorado will translate into higher municipal, industrial and other non-agricultural water demands, placing increased pressure on existing agricultural water rights to be transferred to new uses. The Water Plan further notes that permanent reductions in irrigated agricultural lands to transfer water (commonly referred to as "buy-and-dry") results in harmful impacts to rural agricultural communities and economies. Across the state, water stakeholders want to minimize buy-and-dry in ways that respect property rights, recognize the importance of agriculture in Colorado, and support a sustainable agriculture industry - while identifying diverse and flexible options to provide water for municipal, industrial, and non-consumptive needs.

These options, referred to as Alternative Transfer Methods (ATMs), offer voluntary tools that enable both farmers and other water users to share water in a sustainable and economically beneficial manner. In addition, ATMs can support the environment, as well as recreation, industry, groundwater sustainability, and compact compliance. Colorado's Water Plan sets a goal of achieving 50,000 acre-feet of water transfers through voluntary alternative transfer methods by 2030. This case study reviews select ATM projects that have been recently implemented while highlighting key characteristics of the ATM that provide insight into how future ATMs might also be successfully structured.

1.1 MECHANICS OF ATMS

ATMs broadly encompass a variety of voluntary methods to transfer agricultural water to other uses. Each ATM includes a unique set of supply and transfer methods to move water from one user to another on a temporary contract or intermittent supply basis. Recent ATM projects have also incorporated indefinite or perpetual interruptible water supply agreements to address end-user concerns regarding long-term water availability. Altogether, ATMs typically transfer water to a new use without permanently removing irrigation water use, maintain agricultural ownership of the water right, add flexibility and resilience to water systems, and minimize economic impacts associated with traditional transfers. ATMs consist of two components: (1) agricultural water conservation methods and (2) water transfer methods.

Agricultural water conservation methods are the types of changes made by agricultural water users to reduce their water consumption such that the right to use that increment of water supply can be transferred to other uses, or to reduce demand on water systems in furtherance of groundwater sustainability and compact compliance efforts. Example agricultural supply methods for ATMs include varying degrees of crop land fallowing (such as full season, rotational, and split season fallowing), regulated deficit irrigation, or, in some limited cases, agricultural infrastructure improvements and on-farm practices that reduce evaporative loss.

Water transfer methods are the contractual terms by which water is made available through the agricultural supply methods and is transferred to new users. Example water transfer methods include water banks, interruptible water supply agreements, short term leases, and long-term leases.

1.2 ATM ATTRIBUTES & BARRIERS

ATM projects provide several general benefits when compared to permanent, buy-and-dry water transfers. For municipalities, ATMs may provide a reliable source of dry-year water supplies and can be more cost effective than permanent transfers and other traditional new supply sources. By maintaining some farm operations as part of the ATM program, rural economies that depend on agricultural activities

can be sustained and agricultural users can have access to new income streams for purchasing new equipment, investing in infrastructure improvements, or other operational needs. ATMs can also be useful in preserving ecosystem services associated with working agricultural lands such as open space and wildlife habitat. Additionally, ATMs can be applied to address multiple water supply challenges including municipal and industrial needs, compact compliance, groundwater management, and non-consumptive needs. This flexibility allows implementation of ATM programs that maximize benefits to both the agricultural community and the end users of transferred water.

Barriers to implementation include both balancing the municipal and industrial user's desire for certainty and permanence of long-term supply with the supplier's desire to maintain agricultural and farming viability, and potentially high new infrastructure costs needed to implement a viable water transfer (it is worth noting that potentially high infrastructure costs are also a barrier to implementing a permanent transfer and are not necessarily unique to ATMs). Furthermore, high transaction, legal, engineering, and administration costs can discourage some parties from pursuing an ATM arrangement, particularly for temporary agreements. Additionally, socio-normative barriers exist where water managers either lack the capacity or incentives to try new approaches to water management. Water managers may not feel empowered or compelled to implement ATMs that may have broader economic, social and environmental benefits, but make their primary duties more difficult or do not align with their primary goals.

Several efforts have been made to address these challenges over recent years, including the continued financing of ATM projects through the CWCB's long-standing ATM Grant Program and development of more flexible, administrative ATM project approvals through the HB 13-1248 Fallowing-Leasing Pilot Program and Agricultural Water Protection Water Right (described further in Section 1.3).

1.3 NEW LEGAL STRUCTURES

Under Colorado water law, only the historical consumptive use (HCU) of the crops can be transferred to another water use, while the historical return flows to the river system must be replicated under the ATM operation to avoid injury to downstream water right holders who depend on these historical return flows to fulfill their water rights[1]. Traditionally, transferring a water use from a historical location of use to another location and for a different use requires approvals through the water court process. This approval process can require extensive amounts of time and substantial legal and engineering costs and, therefore, this system can be a barrier to transferring small amounts of water or transferring water on an intermittent basis.

In response to this challenge, the Agricultural Water Right Protection Act (House Bill 16-1228) was passed in May 2016. Currently, this Act only applies to Water Divisions 1 and 2. Specifically, the Act protects the agricultural use for which a water right was originally decreed while permitting renewable one-year transfers of up to 50 percent of the historical consumptive use to another water user. The law requires that the remaining water must continue to be used for agricultural production. The primary benefit is that after the water use change is approved by water court, the water can be easily used as irrigation water in some years and for the other approved use or uses in other years without the need for additional court approvals. An important and novel aspect of this law is that the new (non-agricultural) water use does not have to be explicitly defined at the time of water court approval.

[1] This is not unique to ATMs, and applies to buy and dry transfer operations as well.

Other recent Colorado legislative changes since 2010 related to ATM facilitation include:

- House Bill 13-1248: This bill authorizes the CWCB to approve pilot projects to test fallowing-leasing as an alternative to buy-and-dry. In 2015, under Senate Bill 15-198, the pilot program was expanded from municipal use to include other uses, including agricultural, environmental, industrial, or recreational uses. Each project can last up to 10 years and no more than 5 pilot projects may be located in any one of the major river basins. The legislation also led to the creation of the Lease Fallow Tool (LFT), which was developed to simplify and streamline the evaluation of historic depletions and return flows, thus reducing ATM transaction costs.
- House Bill 13-1130: Clarifies operation of interruptible water supply agreements and allows for a temporary change in location and type of use of a water right without water court approval. The original interruptible water supply agreement legislation allowed the State Engineer to approve a lease agreement that provides a changed use in 3 out of 10 years for a single period. This bill modifies the previous legislation to allow the State Engineer to approve of up to two additional 10-year periods for the agreement.
- Senate Bill 13-019: Offers protection to water rights holders when consumptive use of the water right is decreased due to participation in select conservation programs, including some ATMs. The bill provides that a determination of HCU may not consider years in which the water right, or the land appurtenant to the water, was enrolled in a government conservation program. More specifically, the bill says that HCU will not be decreased because of the following: (1) the land was enrolled in a Federal land conservation program, (2) reduced use of the water right for up to 5 out of 10 years because the water right was involved in a water conservation program, a land fallowing program, or a water banking program. This provision applies to all Water Divisions in Colorado, with the exception of Division 7.

This Page Intentionally Left Blank

Section 2: Case Studies

ATMs in Colorado are predominantly used to transfer water from agriculture to municipal, industrial, or environmental uses on a temporary basis. Recent efforts have also explored using ATMs to comply with interstate water compacts. Generally, ATMs reflect the values and competing demands for water within each basin. For example, ATMs have been implemented in basins with growing population pressures (e.g., the South Platte and Arkansas Basins), environmental pressures (e.g., the Colorado, Yampa, and Gunnison Basins), or facing other water administration challenges such as groundwater sustainability and compact compliance. The following sections summarize some of the key characteristics of the following ATM projects, shown in Figure 1 and categorized by type:

- Agricultural to Municipal/Industrial
    - Little Thompson Farm
    - Catlin Canal
- Agricultural to Environmental
    - McKinley Ditch
- Compact Compliance
    - Grand Valley Water Users Association Conserved Consumptive Use Pilot Program

Figure 1: Case Study Locations

2.1 LITTLE THOMPSON FARM

Project Description	
River Basin:	South Platte
Supplier:	Larimer County Open Lands Program
Buyer:	City and County of Broomfield
General Narrative Description:	The Larimer County Open Lands Program (OLP) works with willing landowners to conserve land throughout the County using various conservation tools, including acquiring fee title to the land. Through various planning efforts, the OLP heard from citizens urging the county to prioritize the acquisition of water rights to protect prime agricultural land and provide land for emerging farmers. In 2014, the OLP was approached by the owners of the Little Thompson Farm, a 211-acre agricultural property southwest of Berthoud, Colorado to learn about opportunities for conserving the farm as a working operation. In exploring options and potential tools for financing the project, OLP began exploring the possibility of an ATM.
How/Why Parties Came Together:	In 2016, the OLP acquired the farm using public open space resources with the goals of conserving a viable, irrigated farm in perpetuity, offsetting the purchase costs through piloting a water-sharing agreement, and providing a catalyst for a viable model for future ATMs. After acquiring the farm, Larimer County secured a CWCB ATM grant to hire a consultant team to compile the water, agricultural, and legal knowledge needed to design an agreement that would work for both the farm and a municipality, while meeting the above-stated goals. The project team met with multiple water providers with the City and County of Broomfield ultimately agreeing to pursue a water-sharing agreement. The City and County of Broomfield and OLP agreement is a combination sale of 115 Colorado Big Thompson (CBT) units and an interruptible water supply agreement for 80 CBT units. The parties determined that an interruptible water supply could be an effective way to meet dry-year municipal water demands while maintaining water supplies for the farm during normal/wetter years.
Project Facts	
Type of ATM Project:	Agriculture to Municipal Transfer
Supply Method:	Temporary fallow
Transfer Agreement Type:	Interruptible Water Supply Agreement (IWSA)
Agreement Length:	Perpetuity (indefinite IWSA, first perpetual agriculture to municipal ATM in Colorado)
Frequency of Transfer:	3 out of 10 years on a rolling basis for an indefinite period
Volume/Flow Transferred:	115 C-BT units sold outright, with OLP retaining a right of first refusal to lease back these units any time Broomfield is putting them up for lease. 80 Units of Colorado-Big Thompson (C-BT) water, or roughly 60 acre-feet annually, is subject to the IWSA.
Unit Price of Water Transferred:	115 units sold for the appraised value of $26,000/unit, with Broomfield paying $25,500/unit, and CWCB ATM Grant funding $450/unit. For the IWSA, a one-time cost of $832,000 or roughly $15,000 per acre-foot. Plus, a dry-year lease payment of $225/unit each year the ATM is exercised, or roughly $320/acre-foot. The rental payment is subject to a price escalator based on the lease price for CB-T shares beginning in 2028. Broomfield is responsible for reimbursement of crop-related costs if notice to use water is given between January 31st and June 1st.
Factors Determining Price:	Several factors contributed to determine the above costs. Since the City and County of Broomfield have rights to the water every 3 out of 10 years, it agreed to pay 30% of the appraised value for each C-BT share plus 10% extra to have access to water in dry years for a total of 40% of the appraised value. Annual costs were added to the agreement to

2.1 LITTLE THOMPSON FARM

	compensate Larimer County for transaction costs to fallow the farm and the opportunity cost of lost crop production.

Methods for Overcoming Typical ATM Barriers

Transaction Costs:	The transferred water came from the C-BT project. One of the unique aspects of C-BT water shares is that they do not require water court to add or change uses. CWCB ATM grant funds were used to cover a portion of the legal, engineering, and administrative costs.
Water Rights Administration and Accounting:	Prior to initiating the ATM project, Larimer County contacted Northern Water to make sure a perpetual agricultural-to-municipal interruptible water supply agreement involving C-BT was permitted in accordance with Northern Water's rules, regulations and policies. When the idea of a perpetual interruptible supply agreement was broached with Northern Water staff, they thought this was unique enough from their typical year-by-year lease arrangements that they would require more review and oversight. As a result, the team navigated an unexpected rulemaking process with Northern Water that delayed the ATM. The new rules required that all C-BT subcontracts must be approved by the Northern Water Board. Northern Water also agreed that non-irrigation use of CBT water is allowed for 3 out of 10 years. In the event of prolonged drought, this term can be extended on a case-by-case basis.
Reliability:	While the team initially thought the ATM deal would be a dry-year interruptible water supply agreement involving all or most of the 240 C-BT units, reluctance amongst municipal water providers to pay a premium of 60 to 80 percent of the total water value necessitated an alternative approach. The parties agreed to transfer 115 units of C-BT, less than half the 240 C-BT units. The financial return of selling those units enabled the County to keep 45 C-BT units out of the ATM and acquire additional Handy Shares. The 45 units plus the additional Handy shares contribute to the farm's viability by making the ATM less of an "all-or-nothing" arrangement and allowing for higher crop production in years when the ATM is utilized. The sale of the C-BT units also ultimately provided the "carrot" the water provider needed to commit the time and resources necessary to negotiate and execute this first-of-its-kind deal.
Infrastructure:	No new or additional infrastructure was required for this ATM. It is worth noting that the City and County of Broomfield currently receives C-BT water separately from this ATM and is able to utilize its existing raw water conveyance infrastructure from Carter Lake to take delivery of water supplied by the ATM.

Unique Issues Overcome

Seller Issues:	Even when an ATM appeared feasible, according to the experts, Larimer County needed to find the right water-sharing partner with compatible water portfolio needs, financial capacity, and decision-maker support for trying something new and innovative. The County pushed hard for a dry-year payment in addition to the up-front payment for the ATM to ensure the farm viability and preserve the financial health of the deal. The dry year payment adds to the farm's viability two-fold: providing a disincentive to the M&I partner using the water when the water is not truly needed and helping cover ATM-year costs/losses on the farm such as weed management and lower yields. The $225/unit ATM-year payment met the County's farm viability and financial needs while providing value to Broomfield in securing a below market rental price.
Buyer Issues:	Broomfield's current and future water demands were analyzed to make certain the C-BT units included in the ATM would have a positive impact on the City's water supply and would not hinder any type of development. The amount of water included in the ATM was a welcome and viable fit to support potential dry-year water demands in the city, especially in the period while Broomfield is developing storage and water firming capability in Chimney Hollow Reservoir.

2.1 LITTLE THOMPSON FARM

Benefits Derived from ATM	
Seller Benefits:	The ATM agreement allowed Larimer County to maintain a viable 211-acre farm in perpetuity as part of its open space program and provide opportunities for young/new farmers entering the industry. This ATM would not have been financially feasible without the consideration of public benefits and underlying motivation of Larimer County to preserve agricultural lands.
Buyer Benefits:	Overall, the addition of the ATM units to Broomfield's water supply portfolio was an excellent fit. The nature of the agreement allowed Broomfield to purchase C-BT units at a fraction of the full market value. The units will help aid Broomfield in times of drought and drought recovery.
Lessons Learned	
	Widespread use of ATMs will likely require additional tools that facilitate the transfer of water back and forth between municipal and agricultural uses. Legislation and other measures aimed at reducing the cost and uncertainty of changing water in water court for ATM purposes, while still, of course, protecting other water rights from injury, should be considered. It was critical to the success of this project that staff educate the decision makers continually and often and have a well thought out backup plan if the ATM could not be executed for any number of reasons. Strong political support was an important factor for the County to even attempt to implement this project given the large investment of staff time and resources and the complicated nature of negotiating a new and innovative conservation project. The team would advise other entities that pursue this sort of arrangement to begin as locally as possible to the farm and exhaust those opportunities before moving outward. The intrinsic value of keeping viable farmland close to the community involved in the water sharing deal may also add to the value of the arrangement, particularly in municipalities, which tend to have multiple objectives such as those with an open space initiative that also have unmet water needs, or a water district with board members that also farm in the same ditches as the farm being conserved.

2.2 CATLIN CANAL (A.K.A. SUPER DITCH)

Project Description	
River Basin:	Arkansas
Supplier:	Catlin Canal
Buyer:	Multiple municipalities (Town of Fowler, City of Fountain, and Security Water and Sanitation District)
General Narrative Description:	After years of permanent water transfers from agricultural producers to municipalities, irrigators in the Lower Arkansas basin came together to develop an alternative to the permanent sale of water rights to municipalities. The Super Ditch project was created in 2008 as a solution to this challenge. The Super Ditch was formed as a general working group to implement various types of ATMs in the Arkansas River Basin spanning from Pueblo Reservoir to John Martin Reservoir. The Super Ditch is comprised of shareholders from six ditches to utilize rotational fallowing to make water available for alternative uses. The overall objectives of the Super Ditch are to: • Conserve rural community values; • Increase market power through consolidation; • Increase marketability of water supplies; and • Reduce transaction costs. Under an agreement with Lower Arkansas Valley Water Conservancy District (LAVWCD) the first pilot project was developed and is formally known as the Catlin Pilot Project.
How/Why Parties Came Together:	Lower Arkansas Basin irrigators were motivated to make water available to the municipal providers in a way that reduced permanent transfers. The ATM terms were attractive to municipal water providers that were looking for a cost-effective near-term water supply, alternative water sources due to quality concerns, and augmentation supply.
Project Facts	
Type of ATM Project:	Agriculture to Municipal Transfer
Supply Method:	Rotational fallow (30% of participating land fallowed each year)
Transfer Agreement Type:	Lease
Agreement Length:	10 years (the Catlin pilot program is limited to ten years by statute)
Frequency of Transfer:	Annually; fallowing is rotated to adhere to HB13-1248 requirements prohibiting the fallowing of the same land for more than three years in a ten-year period or the fallowing of more than 30% of a single irrigated farm
Volume/Flow Transferred:	Up to 500 acre-feet per year
Unit Price of Water Transferred:	500 per acre-foot of water transferred and $150 per acre of land fallowed, or approximately $982 per acre fallowed (payment varies annually due to several climatic and operational factors)
Factors Determining Price:	A steering committee helped estimate the value of the irrigation water by comparing the profitability to an irrigator of selling a water right, using the right on a fallowing-leasing basis, or continuing to use the right to irrigate. The study estimated that the price for an outright purchase would need to be in the range of $5,000 per acre-foot to make the “sell” strategy competitive with the lease strategy. The study estimated that farm returns would need to be about $500 per acre to make the continue-to-irrigate decision preferable. This latter value was used to set the water price.

2.2 CATLIN CANAL (A.K.A. SUPER DITCH)

Methods for Overcoming Typical Barriers	
Transaction Costs:	The Catlin Pilot Project was the first application to be submitted and approved through the CWCB's HB13-1248 pilot program, which is designed to streamline the approval of fallowing-leasing projects outside of the typical water court change of use process, while still maintaining historic return flow conditions.
Water Right Administration and Accounting:	For the current project, historical consumptive use and return flows were quantified using the Lease Fallow Tool (LFT) per criteria and guidelines established by HB13-1248. Terms and conditions to prevent injury were developed through public meetings moderated by the SEO under the administrative processes defined in HB13-1248. The streamlined approach embodied in the LFT proved to be an efficient means to calculate water available for lease and to determine return flows owed to avoid injury to other water rights holders and to ensure compliance with the Arkansas River Compact. Just as significant, the LFT facilitated and expedited the application and approval process.
Reliability:	The Catlin Canal Pilot project is limited to ten years by statue, but has generated municipal interest in future lease arrangements. The Super Ditch and Fountain are currently in the process of seeking administrative approval for a separate interruptible water supply agreement that will provide up to 1,100 AF per year beginning in 2019. The Super Ditch is also in the process of developing a second fallowing-leasing project involving Colorado Springs Utilities.
Infrastructure:	An engineering study determined it is not financially feasible to construct a dedicated pipeline for this project. Therefore, this ATM uses a series of exchanges using existing and planned diversion & storage facilities to deliver water to municipal lessees. For the current project, measurement devices and recharge facilities were installed by the LAVWCD.
Unique Issues Overcome	
Seller Issues:	The Catlin Pilot Project application was the first to go through the process established in the CWCB's Criteria and Guidelines and was also the first to conduct an analysis using the LFT that was developed by the State Engineer. As a result, the process of putting together the Catlin Pilot Project application, working through the comments of nine parties, preparing a joint conference report with proposed terms and conditions, obtaining the CWCB approval and then complying with the "conditions precedent" to project operations that were set out in that approval, involved significant commitment of time and financial resources by the LAVWCD. Because of the costs incurred in developing the first pilot project application, the Lower Ark District requested and obtained grant funding from the CWCB's ATM Grant Program in May 2015. The grant money covered certain operational expenses incurred as a part of the 2015, 2016 and through February of 2017 Catlin Pilot Project operations, including accounting and reporting.
Buyer Issues:	Some potential lessees expressed initial concern that the newly formed Super Ditch Company may not have the administrative ability to sufficiently manage the ditch company members in a way that would guarantee that water would be available under the terms of the contract. Extensive work was required to ultimately gain the required trust.
Benefits Derived from ATM	
Seller Benefits:	This project allows the producer to have additional crop in their rotation with a fallowed piece of land tied to a revenue stream. The declining economy in the Arkansas Basin benefits from the producers staying in business and spending money locally. Ownership stays with the farm and the amount of land dried up on a year by year basis is determined by the producer. The project has resulted in several additional benefits such as improved water quality and enhanced soil health.
Buyer Benefits:	Lessees gain access to water supplies to address drought concerns and replace groundwater pumping, while participation in projects benefits the region's agricultural economy.

2.2 CATLIN CANAL (A.K.A. SUPER DITCH)

	Transactional costs associated with the water court process and long-term management of permanently fallowed lands are also avoided.
Lessons Learned	
	The continued experience gained during Catlin Pilot Project operations is identifying ways to streamline operations and administration for this and future rotational fallowing-leasing projects. For the current project, engineering costs to quantify historical consumptive use were minimized using the streamlined processes defined under HB 13-1248. Also, use of on-farm recharge facilities to maintain return flows reduced concerns of injury to other water rights. Operations continued to increase irrigators' interest in rotational fallowing-municipal leasing and further demonstrated to municipal users that temporary transfers for municipal use can be accomplished through the successful exchange and delivery of wet water. The continued success of the Catlin Pilot Project is significant in that it reflects the first "proof of concept" in Colorado for rotational land fallowing-municipal leasing as a viable alternative to the permanent buy-and-dry of agricultural lands. After the project began, the producers have learned how to strategically fallow land years in advance to allow the project to continue. Weed management becomes difficult on a dry parcel of land and puts more ownership on the producer. In the dry years the delivery of water and exchange potential are low and new mechanisms are required to deliver the full amount of HCU. Operations of the project are very comprehensive with daily, monthly, and yearly reporting to all interested parties. Being able to plant a dry land shallow rooted crop has allowed for additional cropping patterns as well as weed and erosion control.

2.3 MCKINLEY DITCH

Project Description	
River Basin:	Gunnison
Supplier:	Colorado Water Trust
Buyer:	Colorado Water Conservation Board
General Narrative Description:	The McKinley Ditch project is a pioneering opportunity to provide streamflow and ecological benefits for the Little Cimarron River while keeping agricultural lands in production. In 2014, the Colorado Water Trust purchased the water rights associated with a 200-acre irrigated ranch in the Gunnison River Basin that had been recently acquired by the Western River Conservancy. The water rights include 1.5 shares in the McKinley Ditch, which diverts water from the Little Cimarron River, approximately 5 miles above its confluence with the Cimarron River. Agricultural use is maintained using a split-season operation, where water is used for agriculture during the first part of the irrigation season, then left instream when flows reach critically low levels later in the season. This is the first decreed environmental ATM in the state.
How/Why Parties Came Together:	The goals of the Colorado Water Conservation Board, Colorado Water Trust and the Western River Conservancy are to preserve agricultural use of land by through split-season use, pilot and agricultural/environment multi-use projects, restore flows to a 9.2 mile reach of the Little Cimarron and Cimarron Rivers, and re-water a seasonally dry 3.3 mile reach of the Little Cimarron Ditch.
Project Facts	
Type of ATM Project:	Agriculture to Environmental Transfer
Supply Method:	Split season (typically July or August) fallow
Transfer Agreement Type:	Grant of Flow Restoration Use from the Colorado Water Trust to the CWCB
Agreement Length:	Perpetuity
Frequency of Transfer:	Varies based on per-determined conditions each year
Volume/Flow Transferred:	Varies - up to 5.8 cfs
Unit Price of Water Transferred:	CWCB paid $145,640 for instream flow use of the water rights to be left in the stream.
Factors Determining Price:	The original land and water right owner lost the farm to foreclosure before it was purchased by the Western River Conservancy. The Colorado Water Trust purchased the land's 5.8 cfs of water rights from the deed holder for $500,000, with funding support from the Walton Family Foundation.
Methods for Overcoming Typical Barriers	
Transaction Costs	Change of water right to add instream flow use; decree in Case No. 14CW3108 entered October 1, 2018. CWCB grant funding and other resources were utilized to facilitate the project and reduce project costs.
Water Right Administration and Accounting	The McKinley Project was a new approach and several steps were taken to maintain historic return flow conditions and ditch operations. Ditch loss from the shares shall be left in the ditch during times of instream flow use; diversions are limited to monthly, annual, and 20-year volumetric limits; measurement and accounting requirements; dry-up provisions.
Reliability:	The McKinley Ditch ATM project is perpetual.

2.3 MCKINLEY DITCH

Infrastructure:	Several ditch modifications were necessary to facilitate the agreement, including installation of a new splitter box and data recording system. A CWCB Water Plan Grant was secured to enable final design and construction of modifications to manage the shares for the split-season operation and to measure and protect the water applied for instream flow use.
Unique Issues Overcome	
Seller Issues:	The property and water rights were in foreclosure.
Buyer Issues:	This was the first agriculture to environmental ATM agreement completed in Colorado and, therefore, significant due diligence was required to confirm all legal aspects of the project. Also, the CWCB board members had to be convinced this was a good use of public funds before authorizing the purchase of a portion of the water right.
Benefits Derived from ATM	
Seller Benefits:	N/A
Buyer Benefits:	Piloting an agriculture/environment ATM and restoring streamflows while keeping agricultural lands in production.
Lessons Learned	
	Social considerations are more challenging than legal or technical issues. More information is needed on impacts of deficit irrigation on high altitude hay operations, which this project will provide.

2.4 GRAND VALLEY WATER USERS ASSOCIATION CONSERVED CONSUMPTIVE USE PILOT PROGRAM (CCUPP)

Project Description

River Basin:	Colorado
Supplier:	Ten Members of the Grand Valley Water Users Association (GVWUA)
Buyer:	Grand Valley Water Users Association (GVWUA), Using Grant Funds
General Narrative Description:	Continued drought and worsening water supply conditions in the Upper Colorado River Basin could increase the risk of Lake Powell storage declining below critical elevations to maintain operational functionality and mandated curtailment of the exercise of water rights to maintain compact compliance. Recent efforts, including the System Conservation Pilot Program (SCPP), have explored voluntary, temporary, and compensated consumptive use reduction programs with the goal of avoiding or mitigating the risk of involuntary compact curtailment or buy-and-dry of agricultural lands and to foster a better understanding of the impacts of such a program. In a desire to proactively learn about some of the benefits and impacts of a potential large-scale fallowing program, the GVWUA implemented the Conserved Consumptive Use Pilot Project (CCUPP). Specifically, GVWUA stated the goals of the project were: 1) **Protection** of GVWUA water rights and western Colorado agriculture as a whole. 1) **Benefit** from continued beneficial use of western slope agricultural water rights and infrastructure investment. 2) **A Seat at the Table for Western Slope Agriculture** in conversations and potential negotiations related to demand management as a drought resiliency measure. The GVWUA CCUPP was part of the broader SCPP. The overall goals of the SCPP were to, among other things, help explore, learn from and determine whether a voluntary, temporary and compensated reduction in consumptive use in the Upper Basin is a feasible method to partially mitigate the decline of or raise water levels in Lake Powell and thereby serve as a useful tool for the drought contingency planning processes in the Upper Basin.
How/Why Parties Came Together:	The purpose of the pilot study was to test the mechanisms necessary for a Western Slope irrigation water provider to intentionally reduce consumptive use in a voluntary, temporary and compensated manner.

Project Facts

Type of ATM Project:	Voluntarily reducing agricultural system demand on a temporary and compensated basis; compact compliance
Sources of Conserved Water:	Full or partial season fallowing; Reduced delivery option offered but not exercised
Transfer Agreement Type:	Water bank; compact compliance
Agreement Length:	Two years
Frequency of Transfer:	Irrigation season (April to November)
Volume/Flow Transferred:	3,178 acre-feet (season total savings)
Unit Price of Water Transferred:	Payments for participation varied per program activity (from $623 to $356 per acre enrolled in program). Prices per acre foot varied depending on the program activity (e.g. full fallow, partial fallowing) selected by the participant.
Factors Determining Price:	At no point were the actions undertaken during the project intended to seek or set a price for Western Slope irrigation water under lease/fallow programs. Money was exchanged only to compensate farmers for their participation in the pilot project.

2.4 GRAND VALLEY WATER USERS ASSOCIATION CONSERVED CONSUMPTIVE USE PILOT PROGRAM (CCUPP)

Methods for Overcoming Typical Barriers	
Transaction Costs	GVWUA utilized funding through the System Conservation Pilot Program, CWCB, and non-governmental partners to offset administration of the program and foregone revenue. Program activities were selected in part for ease of administration, no required instrumentation to measure water use, ability to fit into existing crop rotations, and feasibility to implement on short notice in a 1-year program. GVWUA secured a CWCB ATM Grant to help to hire a consultant team to conduct an operational assessment with the goal of determining feasibility of a demand management program within the GVWUA service area.
Water Right Administration and Accounting	The GVWUA used data from previously completed studies and CoagMet to estimate the reduction in consumptive use that would be realized under the eligible program activities that were part of the project. The non-consumptively used water remained in the GVWUA ditch system to avoid injury to other ditch users. Cooperators participating in the program were covered under SB 13-019 which provides that a determination of HCU may not consider years in which the water right was enrolled in a water conservation program, land fallowing program, and/or water banking program.
Reliability:	The GVWUA CCUPP was a temporary pilot program.
Infrastructure:	The project set aside approximately 20 percent of its budget to fund investments in necessary infrastructure.
Unique Issues Overcome	
Supplier Issues:	Participants were concerned about the protection and continued beneficial use of the irrigation water. SB 05-133 and SB 13-019 provided cooperators with assurance that their participation in the CCUPP would not put them at risk of abandonment or impact future HCU determinations. Specific and enforceable land management measures were designed into the pilot project to alleviate concerns about weed and plant pest issues.
Buyer Issues:	The myriad of unknown tasks and extensive member outreach and coordination required the hiring of a dedicated consultant to manage the program. Extensive time was also required by the GVWUA legal counsel. There has been significant legal work associated with project development and there is ongoing legal due diligence associated with it. Other issues were developing a project with an unknown budget during the early stages of the project, coordinating with the Bureau of Reclamation, and building trust with program participants.
Benefits Derived from ATM	
Supplier Benefits:	Cooperators benefited from the revenue they received for participating in the program, as well as the knowledge that their participation in the project was a proactive way to learn and engage in ongoing discussions about solutions to water use issues in the Upper Colorado River Basin. The CCUPP explored the feasibility of alternative approaches to involuntary compact compliance methods and program activities were selected to achieve agronomic benefits such as potential agricultural diversification and soil health.
Buyer Benefits:	Compensation for administering the program, infrastructure improvements, developing a process for administering future temporary fallowing programs.

2.4 GRAND VALLEY WATER USERS ASSOCIATION CONSERVED CONSUMPTIVE USE PILOT PROGRAM (CCUPP)

Lessons Learned	
	According to the GVWUA: "Putting together the project has been a fascinating exercise and one that consistently required nimble thinking. Conversations with stakeholders, unknown project budgets, Board of Directors reluctance, and discovering the previously unknown complications are just a few of the factors that continually changed the project emphasis." Contracting for agricultural demand management should take place at a minimum one year in advance of the first date or project implementation. The steps leading up to contracting should take place at a minimum two irrigation seasons prior to any expected water savings. It is necessary that any irrigation provider beginning or participating in a demand management project contract for the necessary outreach within their constituents or designate a full-time employee to complete the task. Any long-term and/or large-scale agricultural demand management program should consider the negative externalities within the community in a meaningful manner and take steps to mitigate these impacts. There must be an advocate or advocates to guide the administration of demand management program activities within an organization. Someone who understands the potential risks and benefits and can view of the decisions of the group with an understanding of their apprehensions while continuing to lead the conversations and actions of the organization.

Section 3: Hypothetical Agricultural to Municipal Transfer

This section provides context and considerations for a hypothetical agricultural to municipal water transfer, with a focus on general drivers for why municipal and agricultural entities would enter into a general ATM program (regardless of specific supply or transfer methods used), and infrastructure potentially needed to successfully implement an ATM.

3.1 DRIVERS OF WATER TRANSFER FREQUENCIES FOR MUNICIPAL ATMS

The following presents potential general situations where a municipal water supplier might be inclined to enter into an ATM agreement for a future water supply. The situations are listed in order of the lowest to highest frequency of ATM utilization:

Drought and Drought Recovery Supply: The municipal provider only needs water supplies in drought years and/or the year immediately following a drought as required to recover reservoir levels. Water for the ATM could be supplied by not irrigating select agricultural lands in what might be one, two or three years in a 10 or 20-year period. In most years, the water would remain on the farm lands and be used for agricultural purposes.

Normal and Drought Supply: The municipal provider needs water supplies during all conditions where the municipal provider's existing junior water rights are not sufficient to meet municipal demands. This type of ATM is accomplished by selectively rotating non-irrigated areas during all normal and drought years. Depending on the ability to forecast successive wet years, rotational fallowing might occur in all years except extended wet periods.

Wet, Normal and Drought Supply: The municipal provider needs water supplies during normal and drought years and in some wet years as required to refill reservoirs or aquifers. Due to the limited ability to predict when the municipal provider might not need the supplies, rotational fallowing of agricultural lands is likely to occur under most or all hydrologic conditions. The major difference between this ATM and traditional buy and dry is that rotational fallowing of select farm lands avoids a single piece of land or potentially a single community from having farm lands completely out of production.

Table 1 presents a graphic comparison of the above different drivers for ATM arrangements. As shown, the degree to which historically irrigated lands are no longer irrigated can vary significantly based on the type of ATM agreements implemented. ATM transfer arrangements that are used by the municipal entity primarily for drought and drought recovery supplies result in the least dry-up or fallowing of agricultural lands on average. It is worth noting that an ATM arrangement that transfers a baseload supply (dry, normal, and some wet years supplies) to a municipal entity may not significantly reduce the amount of dry acres as compared to a traditional buy and dry condition, but if the water is transferred using large scale and multi-regional rotational fallowing, the productive and temporarily fallowed agricultural lands can be rotated and a situation where a single area is not being overly burdened with loss of agricultural lands can occur.

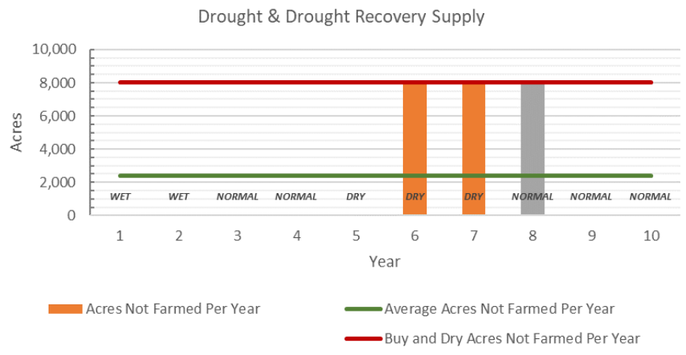
Table 1: Hypothetical Example of Frequency That Municipal Water Providers May Exercise Their Option to Transfer 10,000 AFY of ATM Water

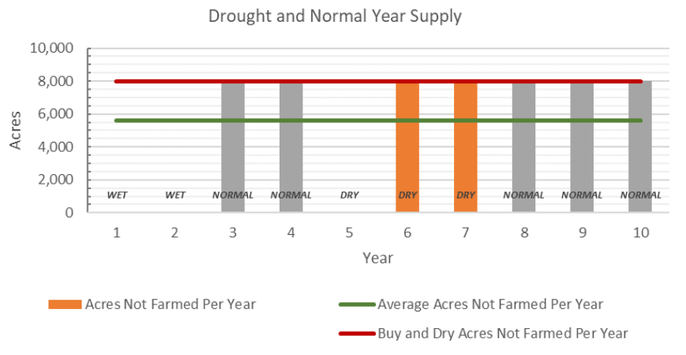
Municipal Supply Need	Dry Years *Assumes 3 in 10 Years Are Dry*		Normal Years *Assumes 5 in 10 Years Are Normal*		Wet Years *Assumes 2 in 10 Years Are Wet*		Typical 10-Year Period With ATMs		Typical 10-Year Period Permanent Buy and Dry
	Number of Dry Years ATM Options are Exercised	Average Dry Year Acres Not Farmed, Per Year	Number of Normal Years ATM Options are Exercised	Average Normal Year Acres Not Farmed, Per Year	Number of Wet Years ATM Options are Exercised	Average Wet Year Acres Not Farmed, Per Year	Years in 10 ATM Options Exercised	Average 10-year Period Acres Not Farmed, Per Year	Average Acres Not Farmed Per Year
Drought & Drought Recovery Supply	2	5,333	1	1,600	0	0	3	2,400	8,000
Drought and Normal Year Supply	2	5,333	5	8,000	0	0	7	5,600	8,000
Drought, Normal, and Some Wet Supplies	3	8,000	5	8,000	1	4,000	9	7,200	8,000

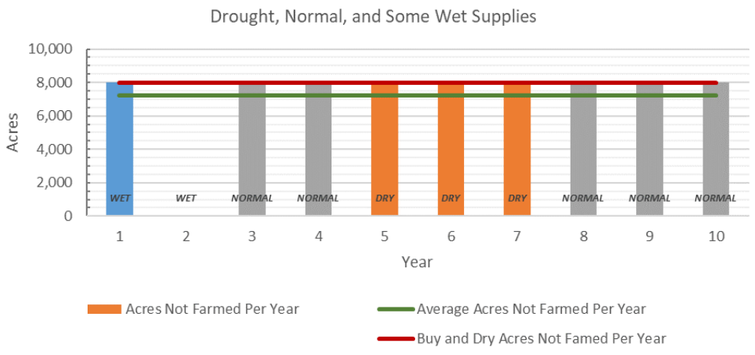
Notes:

Assumed feet per year of HCU per acre of irrigated lands: 1.25 FT

Total acres per year not irrigated to transfer 10,000 AF of Historical CU: 8,000 AC







3.2 INFRASTRUCTURE CONSIDERATIONS FOR MUNICIPAL ATMS

Depending on the configuration and specific details of a particular ATM, all, none, or combinations of the following conveyance infrastructure components may be needed:

Exchange Capability: Depending on the location of the historical diversion point of the agricultural water right and location where the municipal provider needs to take delivery of the water, it may be feasible to exchange the water along a river between the two points. Under this condition, pumps and pipes are not required to transfer the water to the municipal water provider. This condition results in minimal or no conveyance infrastructure costs.

Augmentation Stations: When water from an irrigated parcel on a ditch is transferred to a new use, the ditch headgate may reduce its diversions by the same amount as the transferred portion of its water right, or the water may still be delivered to the farm headgate and routed back to the river and measured through an augmentation station. The latter is becoming increasingly common for several reasons including lack of a ditch headgate bypass structure and to assure that the remaining irrigators on a ditch do not suffer higher ditch losses as a result of the change of use. This feature may also be mandated through the Ditch Company's bylaws.

Return Flow Obligation Storage: Under any agricultural operation, a given amount of water is applied to the fields, and some of that water is consumed due to crop evapotranspiration. Some water is not consumed by crops and is instead returned to the watershed (via groundwater or other flow) and subsequently used by a downstream water user under separate water rights. Under Colorado water law, only the HCU of the crops can be transferred to the municipal water provider under an ATM, while the historical return flows to the river must be replicated in amount and time under the ATM operation to avoid injury to downstream water right holders who may depend on these historical return flows to fulfill their water rights. To replicate the historical return flows when water is not applied to the farm lands, the portion of water that historically deep percolated may be placed in a recharge pond near the farm. Alternatively, storage may be used to hold the water during the historical diversion period and release that water to the river at the estimated time and quantity when the historical return flows would have been returned to the river under pre-ATM operations. In this case, a portion of the consumptive use water credit may be required to replace evaporative losses due to pond or reservoir storage. It may be possible that either the municipal provider or agricultural water right holder has access to sufficient existing storage in the required location to meet the storage needs, but it is also possible that new recharge facilities or storage would need to be constructed or purchased to meet the needs for return flow obligations.

Operational Storage: In addition to storage needed to meet historical return flow obligations, additional storage may be needed to facilitate the water exchange described above, or to hold the water that cannot be exchanged and allow for a steady conveyance flow rate to the municipal provider as described below. Such operational storage could also support the development of water banks which can connect buyers and sellers, allowing interested parties to conduct temporary water trades with reduced transaction costs. Water banks could also help avoid or endure a compact curtailment.

Pipelines and Pump Stations: If the water cannot be exchanged to the required delivery location needed by the municipal provider, pipelines, pump stations, and other conveyance infrastructure would be required to convey the water from the legally allowable water diversion location to the needed delivery location.

Water Treatment Systems: If the water transferred to the municipal water provider cannot meet the drinking water quality goals of the municipal provider using the municipal provider's existing water treatment facilities, additional water treatment facilities may be needed. There could be a wide range of contaminants in the transferred water that can require additional levels of water treatment. Some of the most prevalent and most difficult to manage contaminants include total dissolved solids (TDS), Phosphorus, and organic Carbon.

It is important to note that all potential infrastructure requirements described above would be needed for an ATM project or a traditional buy and dry project. The primary purpose for bringing attention to these infrastructure requirements is to make sure the reader is aware that even if the traditional barriers to ATM projects are reduced or eliminated, there could still be significant infrastructure permitting and infrastructure financing hurdles that would need to be overcome before a municipal water supplier would realize any new supplies from an ATM project. These infrastructure needs also help explain why the municipal sector continues to be interested in acquiring permanent sources of supply instead of ATMs. While not considered in detail here, ATMs addressing non-consumptive needs may require distinct infrastructure improvements such as diversion structure rehabilitation and system modernization. Public and private resources such as the CWCB's grant programs are available to offset infrastructure costs for ATM projects.

3.3 HYPOTHETICAL EXAMPLE OF LARGE-SCALE AGRICULTURE TO MUNICIPAL ATM PROJECT

This simplified example is intended to provide the reader with some context into the potential amount of irrigated lands in the South Platte Basin that might need to be enrolled in a rotational fallowing program as part of a large coordinated ATM program to meet 25 percent of the SWSI 2010 estimated medium 2050 M&SSI gap of 110,000 acre-feet per year:

- Hypothetical amount of water transferred per year = 27,500 acre-feet
- Assumed historical crop consumptive use per acre of irrigated land = 1.25 feet per year
- Amount of lands not irrigated each year = 22,000 acres
- Number of times per decade a piece of land in a rotational fallowing program is not irrigated = 2
- Total acres that might need to be enrolled in a rotational fallowing program = 110,000 acres
- Approximate total number of irrigated acres in the South Platte Basin = 825,000 acres
- Approximately percentage of total irrigated acres enrolled in rotational fallowing program = 15%

This hypothetical example shows that if 15% of the irrigated acres in the South Platte Basin were enrolled in a rotational fallowing program as part of a large-scale ATM, 25% of the previously estimated 2050 M&SSI gap could be met. Of course, larger areas would be required if a greater portion of the gap were to be met with this type of arrangement.

Section 4: Lessons Learned, Data Needs, & General Recommendations

4.1 MONITORING OF ATM IMPLEMENTATION AND EFFECTIVENESS

Section 6.4 of the CWP includes an action to further consider ways to monitor ATMs to aid evaluation of the effectiveness of varying kinds of ATM programs. Monitoring the effectiveness of ATMs would provide valuable insight into the actual benefits and challenges of these programs and could provide guidance for how to refine the terms of ATMs to best benefit all parties and meet Colorado's Water Plan goals. Table 2 includes several data items that, if collected, could provide insight into the effectiveness of ATMs as they are implemented in the future. These monitoring metrics could help give insight to the effectiveness and operation of a single ATM, or a large-scale ATM program across a geographic area to gauge regional or basin-wide trends.

Table 2: Potential ATM Monitoring Data

	Desired Data	Applicability to ATM Monitoring
Monitor ATM Structural Data	Buyer Type, Seller Type, Date of Agreement, Ag. Conservation Method Used, Transaction Method, Term of Agreement, Legal Process Utilized, Allowable Frequency of Usage, Intent of buyer's use for water - percent of water transferred successfully utilized by new use	Indicates effectiveness of infrastructure, ditch operations, and/or exchange mechanisms to move water to desired location
Monitor Frequency, Timing, Amount of Water Transferred, and Number of ATM Transactions	Amount of water transferred (in acre-feet) in drought years and drought recovery years.	When compared to other data points, this information will give an indication of the degree to which ATMs are being used by a municipal water provider as drought and drought recovery supplies instead of baseline supplies.
	Number of transactions associated with the volume of drought year and drought recovery year water transfers.	Indicates if the amount of water transferred via ATM programs is largely driven by a small number of ATM agreements (regardless of the amount of water transferred under the ATM programs) or if dry year transfers are part of a larger and more diverse marketplace.
	Amount of water transferred (in acre-feet) in normal years (non-drought years and non-wet years).	Indicates if water is being transferred to meet a municipal base supply need as opposed to or in addition to a dry year supply need.
	Number of transactions associated with the volume of non-drought year and non-wet year transfers.	Indicates if a single larger transfer is present, or a diverse ATM market for baseline transfers of water exists.
	Amount of water transferred (in acre-feet) in wet years.	Indicates degree to which ATMs are being used by municipal entities to refill storage following drought or non-wet years.
	Number of transactions associated with the volume of wet year transfers.	Indicates if a single larger transfer is present or if a diverse wet year ATM market exists.

Table 2: Potential ATM Monitoring Data

	Desired Data	Applicability to ATM Monitoring
Monitor Sustainability of Farms Under ATMs	Acres historically irrigated (prior to ATM arrangement) in dry, normal, and wet years by specific water rights used to facilitate the ATM agreement.	Provides means for comparing how ATM arrangements change historically irrigated acreage and, by extension, how consumptive use of the agricultural land changes as a result of the ATM program.
	Acres irrigated and crop types used in drought years since ATM arrangement has been active.	Gives indication of how irrigator of agricultural land under ATM program uses water differently under ATM agreements. It is possible that less acres are irrigated, or also possible that fewer crops are grown per year on the same acreage. Additionally, the irrigator may favor different crop types when in an ATM agreement.
	Acres irrigated in normal years during ATM period.	
	Acres irrigated in wet years during ATM period.	Indicates if irrigators return to pre-ATM growing practices in wet years, or if some acres are no longer farmed due to the challenges of increased variability in the water supply due to the ATM arrangement.
Monitor Locations Where ATMs are Feasible	Locations of historical diversions for ag. water rights, and locations of transferred new water use under ATM arrangement.	Indicates if certain types of water rights appear to be favorable for ATM arrangements. For example, favorable types of water rights may include Colorado-Big Thompson (C-BT) water, water rights in a watershed above or closer to metro regions, or water rights located in areas where upstream exchanges are most feasible.
Monitor ATM Economics	Financial terms of each unique ATM arrangement.	Indicates how costs of ATM transactions vary based on location, frequency, timing, amount of water transferred, and infrastructure needed to facilitate an ATM transfer. Includes legal and engineering fees, as well as infrastructure components. These costs can be compared with traditional transactions to evaluate if legislation and/or other steps to reduce transaction costs are effective.

4.2 CONCLUSIONS AND NEXT STEPS

ATMs provide an opportunity to meet increasing water demands of a growing population while maintaining the viability of Colorado agricultural communities. Next steps to be considered include:

- Develop better guidance as to what types of projects and processes further Water Plan goals related to maintaining or enhancing agricultural viability, while meeting potential new demands and addressing other water resource management issues.
- Continue funding for ATM development through CWCB's grant program and other sustainable funding mechanisms.
- Assess institutional support of ATMs and evaluate progress made on addressing the primary barriers to ATM development and implementation and broaden outreach to potential ATM participants such as government open space programs and elected officials.
- Develop additional pilot projects for the varying types of ATM programs and engage in thoughtful monitoring of their effectiveness.
- Work with basin roundtables to consider how ATMs can play a role in addressing basin needs and priorities.
- Further pursue the collection of the recommended monitoring data for ATMs as they are developed and share this information through existing platforms such as CDSS or new platforms such as an ATM data clearinghouse.

References

Colorado General Assembly, HB-13-1130, *Concerning Extended Operation of Interruptible Water Supply Agreements.* (2013)

Colorado General Assembly, HB-13-1248, *Concerning an Authorization of Pilot Projects for the Leasing of Water for Municipal Use.* (2013)

Colorado General Assembly, HB-16-1228, *Concerning an Alternative Transfer Mechanism for Water Rights That Protects the Agricultural Use for Which a Water Right was Originally Decreed While Permitting Renewable One-Year Transfers of a Portion of the Water Subject to the Water Right.* (2016)

Colorado Senate Bill 13-019, *Concerning the Promotion of Water Conservation Measures*. (2013)

Colorado Water Conservation Board (CWCB), "Statewide Water Supply Initiative Report Overview." Department of Natural Resources, December 2011. Available at: http://hermes.cde.state.co.us/drupal/islandora/object/co%3A20209/datastream/OBJ/view

Colorado Water Conservation Board (CWCB). 2013. FLEX Market Model Project Completion Report. Available at: https://www.colorado.gov/pacific/sites/default/files/13WaterResourcesFLEXMarketModelFinalCompletionReport.pdf

Colorado Water Conservation Board (CWCB). 2016. Colorado's Water Plan. Retrieved from https://www.colorado.gov/pacific/cowaterplan/plan

Colorado Water Trust. Little Cimarron River-McKinley Ditch. Available at: https://coloradowatertrust.org/project/mckinley-ditch-little-cimarron-river

Environmental Defense Fund. 2016. Alternative Water Transfers in Colorado: A Review of Alternative Transfer Mechanisms for Front Range Municipalities. Available at: https://www.edf.org/sites/default/files/alternative-water-transfers-colorado.pdf

Grand Valley Water Bank. Conserved Consumptive Use Pilot Project (CCUPP) Development: Process, Procedure and Lessons Learned. March, 2017. Available at http://www.grandvalleywaterusers.com/uploads/8/2/6/0/82606774/03-01-17_ccupp_projectdevelopment_final.pdf.

Larimer County Department of Natural Resources. 2018. Little Thompson Farm ATM Grant Completion Report. Available at: https://www.larimer.org/sites/default/files/uploads/2018/larimer_county_atm_final_report.pdf

Lower Arkansas Valley Water Conservancy District. 2017. Catlin Leasing-Fallowing Pilot Project Progress Report. Available at: http://www.lavwcd.com/uploads/2/4/3/4/24349268/catlin_pilot_project.pdf