

Agricultural/Urban/Environmental Water Sharing:

Innovative Strategies for the Colorado River Basin and the West



Colorado
State
University

COLORADO WATER INSTITUTE

A Collaborative Effort of the Agricultural/Urban/Environmental Water Sharing Work Group

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“We hope what you read, hear, and see in these pages will inspire you. It will take all of us working cooperatively to find opportunities for sharing our precious water resources. Not just for cities, not just for agriculture, but for the environment.”

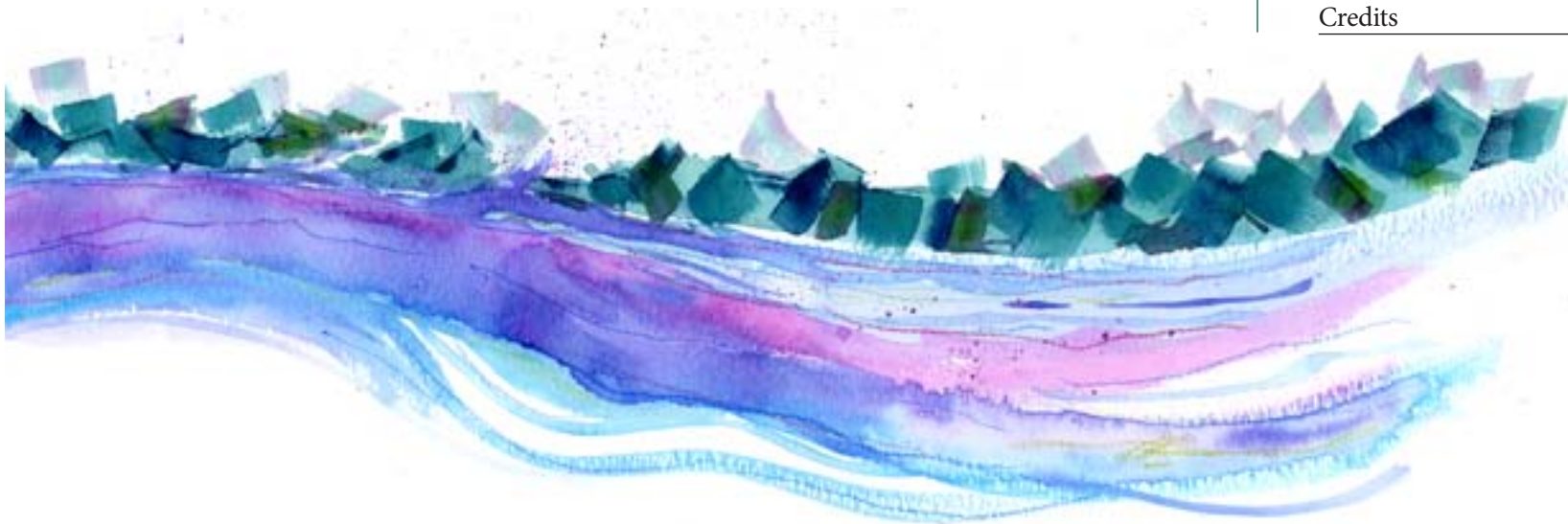
MaryLou Smith,
Colorado Water Institute,
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About this Report

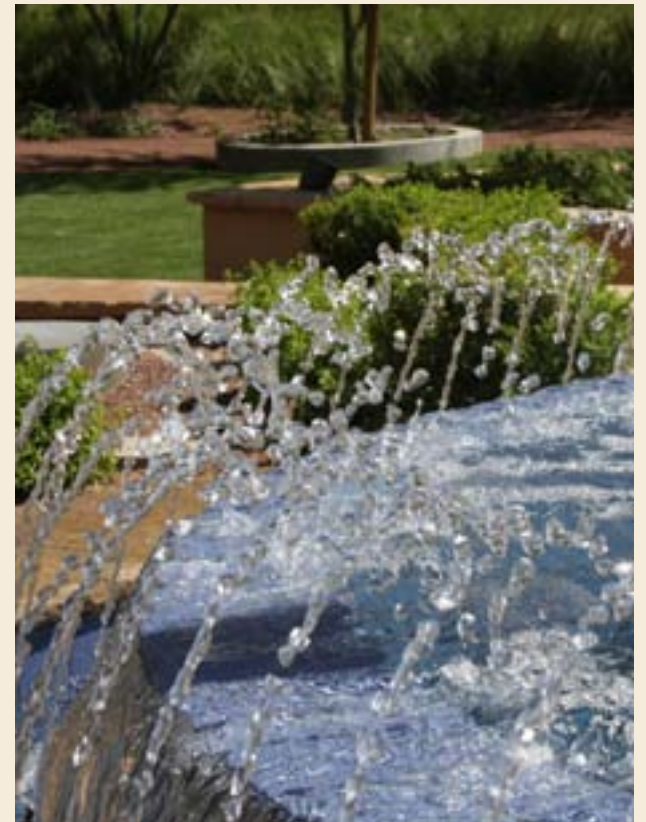
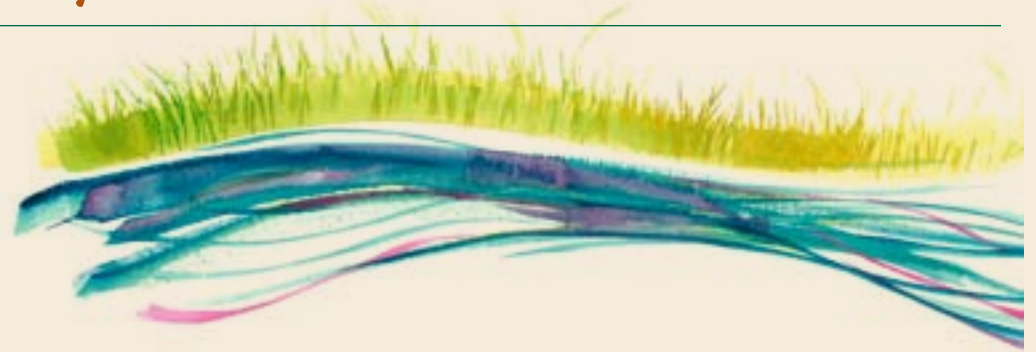
This report summarizes the products of a collaborative effort funded by the Walton Family Foundation to evaluate innovative water sharing strategies, and develop actionable recommendations to improve water sharing opportunities in the Colorado River Basin and throughout the West. The recommendations developed as part of this report are relevant for policymakers, stakeholders and government agencies. The report is divided into the following sections:

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Executive Summary



Responding to a Challenge from the Western Governors

Water used for agriculture in the Colorado River Basin and the western United States is increasingly seen as a potential supply for growing urban and environmental needs.

In 2008, the Western Governors' Association, working through their water arm, the Western States Water Council (WSWC), issued *Water Needs and Strategies for a Sustainable Future: Next Steps*. One of the next steps identified in the report was that "...states, working with interested stakeholders, should identify innovative ways to allow water transfers from agriculture to urban use while avoiding or mitigating damages to agricultural economies and environmental values."

This initiative is a direct and independent response to the WGA's call to action. A diverse Water Sharing Work Group of highly knowledgeable and influential water leaders representing the sectors of agriculture, urban interests, and the environment, set aside parochial positions to collaboratively take on the governors' challenge.

Thanks to funding from the Walton Family Foundation as part of its Colorado River Basin Freshwater Initiative, the Water Sharing Work Group began work on this project – Agricultural/Urban/Environmental Water Sharing: Innovative Strategies for the Colorado River Basin and the West. The Colorado Water Institute at Colorado State University was selected to manage the project.

One of the first issues the group resolved focused on the very nature of water transfers. Some in the group did not want to participate in any process that would somehow encourage additional water to be transferred out of agriculture. An essential first step in building the collaborative process was to come to the decision that the group would focus on ways to improve sharing of water between multiple sectors, and would not seek to find more ways to unilaterally transfer water out of agriculture.

And while the group was able to agree on a broad range of other issues affecting water sharing projects, and appreciate the value of bringing together their diverse interests to develop comprehensive under-

Members of the Agricultural/Urban/ Environmental Water Sharing Work Group

Nathan Bracken—Western States Water Council—UT
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Bill Hasencamp—Metropolitan Water District—CA
Taylor Hawes—The Nature Conservancy—CO
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Tom Iseman—Western Governors' Association—CO
Dan Keppen—Family Farm Alliance—OR
Pat O'Toole—Family Farm Alliance—WY
Mark Pifer—Western Urban Water Coalition and Aurora Water—CO
Jennifer Pitt—Environmental Defense Fund—CO
Ron Rayner—Tumbling T Ranches—AZ
Reagan Waskom—Colorado Water Institute—CO
Facilitator: MaryLou Smith—Colorado Water Institute—CO

standing of the issues, they also recognized that there was a need for additional dialogue on the role of storage. Faced with mounting demands to provide water for urban growth and other beneficial uses, including agriculture, some members of the group identify



themselves as pro-storage. Others remain leery of the potential adverse impacts and costs associated with some storage projects. However, the group generally accepted the concept that there may be benefits to properly sized and located storage in certain circumstances, especially when such projects are

part of a larger, multiple-benefit strategy. The group also generally agreed that when projects have the support of multiple entities, including agriculture, environmental, and urban players, the regulatory process for approval of such projects should be better integrated, more conducive to moving forward, and less embroiled in redundant action by multiple agencies.

While coming to consensus on these issues was not quick or easy, the group is proud of its progress. This report summarizes the results of their collaborative process, including the following components of their initiative:

- Interviews with key players and summaries of key ongoing water sharing strategies from the Colorado River Basin and the West
- Convocation of a workshop of diverse experts, resulting in the development of water sharing Action Recommendations

- Quantification study of agricultural water use and transfers in the Colorado River Basin.

Although WGA and WSWC staff participated in this initiative, neither organization has endorsed this report or its recommendations. Rather, the report is the product of the collective efforts of a diverse group of stakeholders that formed independently of the WGA and WSWC to provide the western governors and other policy makers with actionable information and recommendations to use in avoiding or mitigating the adverse impacts of transfers on agricultural communities and environmental values. To this end, the Group will present this report to the WGA and WSWC in 2011 for their consideration.

Interviews and Strategies

Throughout the communities that rely on the Colorado River, and elsewhere in the West, numerous new water sharing strategies have been launched in recent years, with others under development. The historical practice of permanent “buy and dry” type transfers is beginning to give way to creative water sharing schemes that attempt to provide water for urban needs while maintaining agricultural and environmental benefits. To describe the existing range of western water sharing strategies that could be applied to the Colorado River Basin and elsewhere, and to learn what has and has not worked in terms of multi-use benefit, 50 key players were interviewed. Interviewees were selected based on their involvement with innovative or experimental water sharing scenarios. Those interviewed include environmental and natural resources policy experts, irrigation and environmental engineers, irrigation district managers, economics and law professors, farmers and ranchers, state and federal government officials,



municipal water providers, and attorneys.

Based on those interviews, 11 water transfer scenarios are summarized in this report. These 11 case studies were selected to showcase innovation, geographic areas, and overarching obstacles. All water transfer summaries are enhanced with audio clips from the interviewees themselves.

Innovative water sharing strategies highlighted in this report include:

- Agricultural rotational fallowing for urban supply through leases
- Leasing of interruptible supplies for urban drought relief
- Split year leases between agriculture and environmentalists to keep late season water in the stream for fish

- Storage projects to provide flexibility for maximizing potential to meet multiple needs—agricultural, environmental, and urban
- Deficit irrigation to free up consumptive use (CU) for transfer
- Conjunctive use of groundwater and surface water for maximum beneficial use for agriculture and cities
- Improvements in irrigation efficiencies to produce conserved water that can be transferred to urban areas.
- Development of collaborative stakeholder processes to help review and speed processing of temporary transfers
- Groundwater banking and recharge
- Creation of new institutional and business constructs to facilitate temporary transfers
- Development of a “best management practices” template to guide agricultural transfers
- State funding for research and experimentation of transfer methods alternative to permanent dry up of agriculture.

See glossary on page 45 for a discussion of some of these terms.

Workshop and Recommendations

A key component of this project was the convocation of a two-day highly focused workshop bringing together a diverse group of individuals motivated by their conviction that the status quo will not work – that change is critical. The goal was to come up with actionable recommendations to improve water sharing given intensely competing needs, complex regula-

tions, and variable climate. Thirty-five participants and facilitators met at a ranch above Castle Rock, Colorado, on August 12 and 13, 2010, and came up with the Action Recommendations summarized here.

Each recommendation was carefully crafted and vetted to provide practical and concrete steps that states can take to improve and promote water sharing across their watersheds. While it is clearly understood that this is not an exhaustive list, or that additional innovations may not be necessary on a project-specific basis, it is the first such set of recommendations about how to remedy obstacles to innovative water sharing strategies in the Colorado River Basin and the West. It is hoped that these recommendations will help identify incentives and provide guidance for policy makers who are concerned about how we can most effectively and fairly plan future water supply.

Subsequent to the workshop, some have asked why participants chose to make what appear to be “umbrella” recommendations, rather than specific suggestions relevant to the water sharing strategies uncovered in the interviews. The answer is that there are any number of recommendations that could be made specific to a given strategy. But those recommendations could only be derived from a detailed comparative analysis not feasible to accomplish in a two-day workshop setting. The group chose instead to make recommendations they deemed critical to address the overarching obstacles facing all innovative strategies for sharing water for multiple benefit, regardless of state or strategy. In an effort to make the recommendations actionable, participants provided specific action steps they believe the western governors and



others could adopt. These action steps are not meant to be limiting, but instead, to be seen as exemplary of how we could move forward instead of staying stuck in a study mode.

A full-length set of Action Recommendations, carefully wordsmithed to meet the consensus test, can be viewed in its entirety in the full body of this report.

Summary of Action Recommendations

Pilot an Expedited Water Sharing Program/Project Review Process

In some cases, mutually beneficial water sharing programs which have broad support are delayed or abandoned due to lengthy and costly local, state and federal review processes. Such programs include many beneficial infrastructure projects which could enhance supply reliability for a multitude of parties. Workshop participants recognize the importance of permitting to assure that projects and programs meet a number of desired outcomes. They propose an improved “one-stop-permitting” approach to improve efficiency, reduce costs, and ensure more timely approvals by

reducing repetitive agency information exchanges. Participants recommend the following actions, in summary:

- Governors, in collaboration with stakeholders, would identify a multi-use water sharing project or program, either structural or non-structural, which has broad support of all sectors (agricultural, urban, and environmental), to pilot an expedited review process.
- Governors would appoint a state liaison to guide the project through the local, state and federal approval process.
- Governors would request that the federal government appoint a federal designate to be involved in all aspects of the review process.
- The state liaison and federal designate would work together to initiate planning and coordination meetings, and facilitate concurrent review and permitting process and sharing of state and federal approval resources.
- State liaison would report the outcome of the pilot process and suggest recommendations for improving the initiation, review, permitting, approval and implementation of water programs.
- Governors would convene a multi-state team of agency representatives and stakeholders to review and evaluate each state's pilot effort and seek to develop ideas and opportunities for improvement.

Foster a Flexible Basin-Wide Approach

While cognizant of interstate water compacts and without promoting transfers of water between states or even between basins, workshoppers promote looking at basins and systems as a whole, rather than piecemeal, when looking for water sharing opportunities. Agricultural, urban, and environmental interests

could work much more closely to share infrastructure, time deliveries, and reuse water optimally if we were to develop the tools to simulate the “what ifs.” Specific recommendations include:

- Support development of planning tools for real-time, on-the-ground decision making that could be used to develop better operational management and inform stakeholder driven efforts to consider mutually beneficial water sharing strategies. Basin-scale tools currently available model the Colorado's mainstem and large storage projects, but don't let us see how we might connect the dots throughout the basin to manage water supplies for optimal cooperation.
- Governors would urge state and federal agencies to work cooperatively with stakeholders to identify and implement mechanisms, such as water banking or interruptible supply agreements, to help avoid economic and environmental disruption in times of water crisis.
- Promote and enhance Conservation Title funding to programs such as EQIP and AWEP in the next Farm Bill. These programs are proven to encourage



wise water use, improve water quality, and enhance the environment throughout the West.

Clear Obstacles to Implementation of Creative Water Sharing Strategies

- States are experiencing varying levels of challenge with obstacles to innovation and implementation. However, participants feel strongly that overarching obstacles cause significant roadblocks for all the water sharing strategies identified. These recommendations are an attempt to address some of the most common obstacles.
- Governors would appoint cabinet-level State Water Advocate responsible for empowering the success of water sharing programs with broad support.
- State Water Advocate and appropriate state agencies could work to reduce the costs associated with temporary water sharing arrangements by providing incentives and supporting pilot programs.
- Criteria and thresholds should be developed that define “best management practices” for transfers, much like a check list, that could be used to streamline regulatory approvals.
- State Water Advocate could facilitate a cross-jurisdictional process for regional approaches to infrastructure sharing and development to facilitate voluntary, incentive-based water sharing.
- Encourage state support for the creation of voluntary Water Resource Sharing Zones, similar to economic development zones. Within these zones, water and financial resources might be traded more freely to the benefit of multiple sectors. Other benefits could include: tax incentives, infrastructure sharing, or preservation of open-space values in agriculture.

Design Robust Stakeholder Processes for Multi-Benefit Water Sharing Solutions

Workshoppers outlined characteristics of a robust stakeholder process, emphasizing that the design and implementation of such processes should be given as high a priority as we currently give to the design of engineering solutions to water problems.

- Design structured, facilitated opportunities for diverse stakeholders to experience a constructive exchange of perspectives and ideas.
- Initiate stakeholder involvement early, often before any “formal” process begins.
- Define expectations and design a process to meet those expectations.
- Groups should be given incentives, support and resources to engage effectively, such as analysis of previous collaborative efforts, decision support or funding for small projects and studies.
- Effective, unbiased, research-based public education and outreach



Quantification Study

Quantification of Colorado River Basin agricultural water use and transfers was provided by Dr. James Pritchett, Associate Professor of Agriculture and Resource Economics at Colorado State University. His analysis showed that agriculture in the Colorado River Basin is valuable and diverse. Farms are increasingly stratifying into two types: small farms which generally supplement household income, and large farms that produce the majority of agricultural

goods. Irrigated agriculture is becoming less prevalent near the urban-rural fringe. Farms are becoming more efficient in conveying and applying water. Farms in the Lower Colorado River Basin are more likely to make use of groundwater resources when compared to the Upper Basin.

Permanent water transfers follow the business cycle of urban development, but shorter-term leases are tied to climatic conditions and weather events. Transactions are more prevalent in areas in which physical and market infrastructure exists, and these transfers have smaller average size when compared to large-scale transactions. The greatest number of transactions occurs in Colorado, but the most water has been transferred in California and Arizona. Several questions remain: if farms are becoming smaller does this imply a fragmentation of water rights? If water rights are increasingly held by more people, will this tend to encourage or discourage transactions? A more complete description of this research can be found as special report #21 of the Colorado Water Institute (<http://www.cwi.colostate.edu/publications.asp?pubs=sr>).

Next Steps

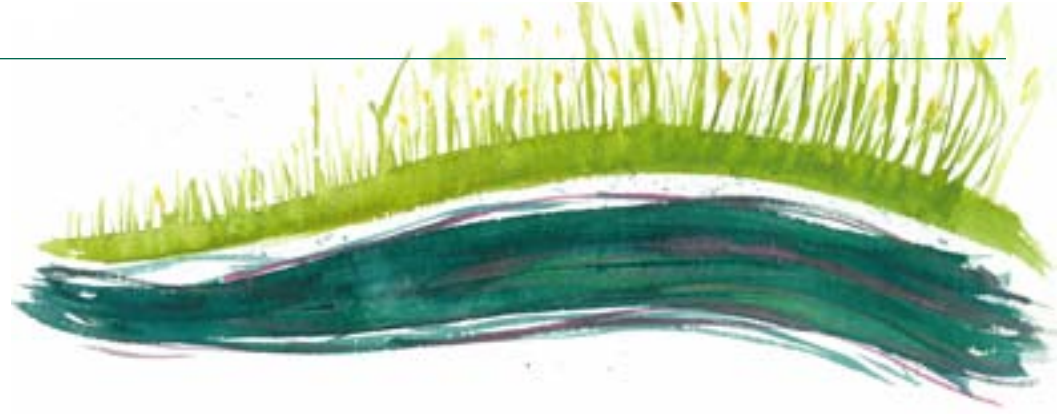
The Water Sharing Work Group advancing this initiative and the workshop participants who developed the Action Recommendations, will present this report

to the Western States Water Council and the Western Governors' Association in 2011.

These dedicated water leaders from agricultural, urban and environmental sectors will continue to work together to encourage action on the part of Western Governors and others, to advance the recommendations developed in this report. They will continue to investigate ways different states in the Colorado River Basin and the West can take water sharing successes and lessons-learned from one area, and transfer them to another. A detailed comparative analysis of the numerous water sharing strategies currently in place may be encouraged for additional study. In addition, they will be working through their respective constituent groups to further the work they have begun here.

Special effort will be made to identify laws and institutions which might be modified to provide more flexibility and effectively promote water sharing, while respecting and preserving individual water rights. It is also anticipated to convene additional groups of agricultural, urban and environmental interests in communities from the Colorado River Basin and throughout the West, to provide opportunities to work together, instead of against one another, to meet multiple water use needs.

Background



Agricultural/Urban/Environmental Water Sharing:

Innovative Strategies for the Colorado River Basin and the West

In 2008, the Western Governors' Association, working through their water arm, the Western States Water Council (WSWC), issued Water Needs and Strategies for a Sustainable Future: Next Steps. One of the next steps identified in the report was that "...states, working with interested stakeholders, should identify innovative ways to allow water transfers from agriculture to urban use while avoiding or mitigating damages to agricultural economies and environmental values."

In March 2009, this Agricultural/ Urban/Environmental Water Sharing Work Group formed as an independent response to the above goal. It consists of highly knowledgeable and influential water leaders from the agriculture, urban, and environmental sectors who have worked together over the last two years to provide the governors with insight and information to consider as they work to implement their 2008 Next Steps recommendation. Thanks to funding from the Walton Family Foundation as part of its Colorado River Basin Freshwater Initiative, the group was able to begin work on this project. The Colorado Water Institute at Colorado State University was selected to manage the project.

In this initiative, the role of the Water Sharing Work Group is to provide expertise and oversight, with the goal of providing practical and significant guidance regarding water sharing strategies to the Western Governors' Association, the US Bureau of Reclamation to inform its Colorado River Basin study, and to other key interests in the Colorado River Basin

and throughout the West. Work Group participants are experts from Colorado River Basin states, representing a diverse group of interests, disciplines and experiences in agricultural, environmental and urban water use.

One of the first issues the group resolved had to do with the very nature of water transfers. Some in the group did not want to participate in any process that would somehow encourage additional water to be transferred out of agriculture. An essential first step in building the collaborative process was to come to the decision that the group would focus on ways to improve sharing of water between multiple sectors, and would not seek to find more ways to unilaterally transfer water out of agriculture.

And while the group was able to agree on a broad range of other issues affecting water sharing projects, and appreciate the value of bringing together their diverse interests to develop comprehensive understanding of the issues, they also recognized that there was a need for additional dialogue on the role of storage. Faced with mounting demands to provide water for urban growth and other beneficial uses, including agriculture, some members of the group identify themselves as pro-storage. Others remain leery of the potential adverse impacts and costs associated with some storage projects. However, the group generally accepted the concept that there may be benefits to properly sized and located storage in certain circumstances, especially when such projects are part of a larger, multiple-benefit strategy. The group also

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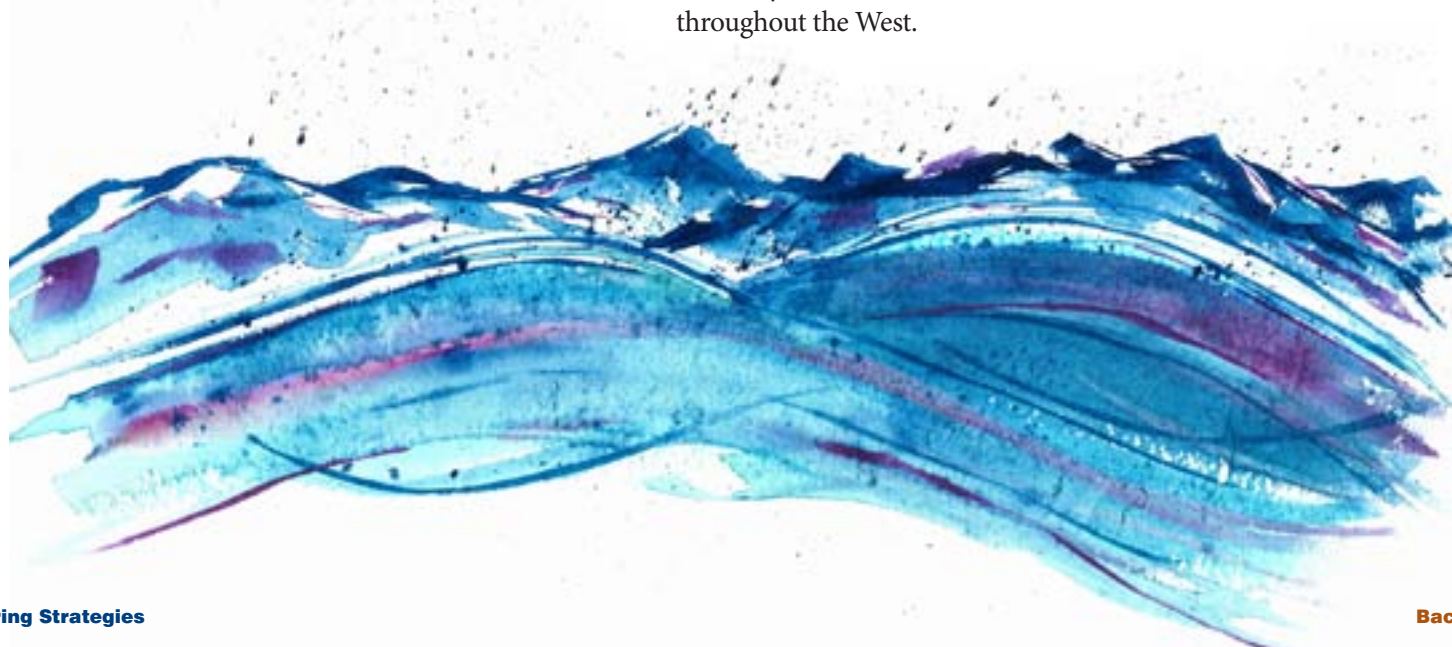
With Walton Family Foundation funding, the group set about to address the following tasks:

- Interview key players involved or experimenting with innovative water sharing strategies to learn what did and did not work in terms of multi-use benefit.
- Summarize key water sharing strategies and innovations from throughout the region
- Convene a Workshop of diverse experts to develop water sharing action recommendations applicable across the Colorado River Basin, including specific recommendations for how to tackle obstacles—policy, legal, institutional, financial
- Quantify agricultural water use and transfers in the Colorado River Basin

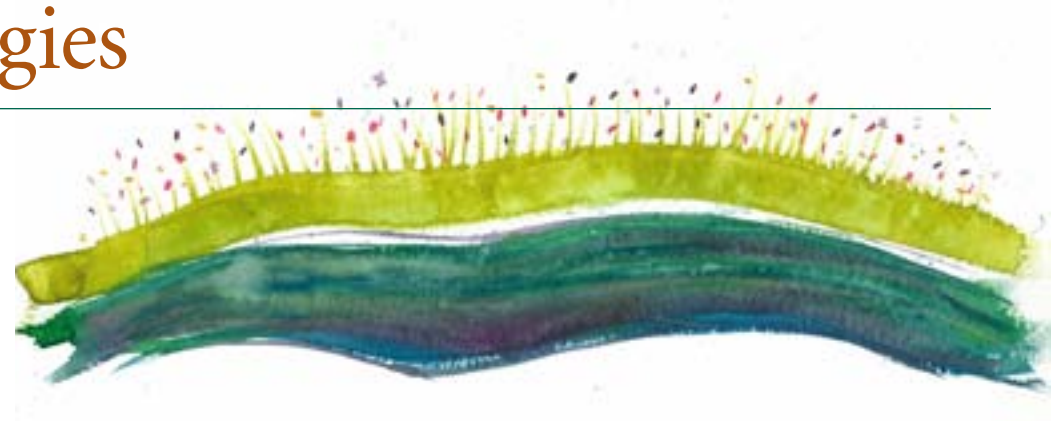
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Mark Pifher—Western Urban Water Coalition and Aurora Water—CO
Jennifer Pitt—Environmental Defense Fund—CO
Ron Rayner—Tumbling T Ranches—AZ
Reagan Waskom—Colorado Water Institute—CO
Facilitator: MaryLou Smith—Colorado Water Institute—CO

- Summarize and report these results to the Western Governors' Association via the Western States Water Council, the US Bureau of Reclamation to inform its Colorado River Basin study, and to other key interests in the Colorado River Basin and throughout the West.



Interviews/Strategies



Water Sharing Strategies: Interviews with Key Players

 [Click to read summaries of all 50 interviews.](#)

Selected from the Colorado River Basin and elsewhere in the West, 50 interviewees were asked to talk about water sharing strategies currently employed in their watersheds, as well as the obstacles they face. From these interviews, 11 innovative water sharing strategies were selected to be showcased in this report. Strategies were chosen to represent different methodologies, geographic areas, and overarching obstacles. Strategies highlighted in this report include the following:

- Agricultural rotational fallowing for urban supply through leases
- Leasing of interruptible supplies for urban drought relief
- Split year leases between agriculture and environmentalists to keep late season water in the stream for fish
- Deficit irrigation to free up consumptive use (CU) for transfer
- Conjunctive use of groundwater and surface water for maximum beneficial use for agriculture and cities
- Improvements in irrigation efficiencies to produce conserved water that can be transferred to urban areas.
- Groundwater banking and recharge
- Development of collaborative stakeholder processes to help review and speed processing of temporary transfers
- Creation of new institutional and business constructs to facilitate temporary transfers

- Storage projects to provide multi-use benefits and flexibility
- Development of a “best management practices” template to guide agricultural transfers
- State funding for research and experimentation of transfer methods alternative to permanent dry up of agriculture.

Interviews showed that in areas where good solutions have evolved, there are usually conflict resolution champions who do things like hiring experts from opposing groups to come to the table and generate solutions together.

However, interviews also clearly showed that states are experiencing varying levels of challenge with obstacles to innovation. The state whose interviewees expressed the least concern was Utah, where it appears that water is being transferred from agricultural lands to urban lands almost entirely by urban development moving onto previously agricultural ground, a pattern which does not have many of the economic disadvantages of removing water from agricultural land for transfer to geographically remote urban areas.

Interviewers found among those interviewed a keen awareness of how institutions hinder innovation. Most believe institutions are rigid and need to evolve. One example is that in most states, conservation isn't seen as a beneficial use. Those interviewed in states where transfers must go through a court system were frustrated at the high cost of transacting creative water sharing solutions. Those from states with an administrative system reported frustrations, but generally less conflict and more cooperation.

Arkansas Basin Roundtable Develops Template for Ag to Urban Water Transfers

Reeves Brown: rancher, and member of Arkansas Basin Roundtable, Colorado

The Arkansas Basin Roundtable is one of nine groups created by the Colorado legislature in 2005 to bring together stakeholders in each of the state's major water basins to address projected future gaps between water supply and demand. The roundtables have brought a greater diversity of stakeholders to the table such as environmental interests who earlier were often left out of water conversations.


The Arkansas Basin, covering most of the southeast quadrant of the state, has lost some 15 percent of its irrigated agriculture to urban water transfers since 1950. Projections are for the basin to lose that much more by 2030. Agricultural and urban stakeholders on the roundtable did not see eye-to-eye on what to do about ag to urban transfers, so the roundtable created a Water Transfer Guidelines Committee to answer the question, "If water is going to be transferred from agriculture, how can it be done without harming rural communities and other third parties to the transactions?" After two years of intense facilitated meetings they produced a template detailing factors to be taken into account if and when transfers take place. State leaders cited it as an exemplary process: stakeholders on opposite sides of the table working out their differences to cooperatively tackle a significant issue with high stakes.

The template is intended for use by buyers and sellers putting together a water transfer deal, as

well as by communities and other third parties who would be affected. It is structured around three focus areas: Considerations, Questions, Mitigation. What are the considerations to be addressed when contemplating a transfer? What questions should be asked specific to each of those considerations? What mitigation might be needed? Considerations range from effects on water quality, to the size of a transfer relative to an affected area. An example of a question is, "Will the transfer reduce the tax base of the affected areas?" An example of a mitigation strategy is, "Assist in agricultural modernization such as niche market development."

The Arkansas Basin Roundtable adopted the report, with virtually all members impressed with its breadth and depth. However, they could not agree on what action should be taken in response to it, splitting into three primary points of view: 1) If the guidelines don't form the basis for new water transfer regulation, we are only giving lip service to the rights of third parties such as rural communities. 2) The guidelines should not result in regulation. Nothing should come between willing buyer, willing seller in agricultural water transfers. 3) The guidelines raise consciousness about the effects of transfers on agriculture and rural communities. Now we should turn our attention to creative incentives for keeping agriculture in the valley—without transfers.



 Listen to Reeves Brown
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A Market Transaction Approach in New Mexico

Beth Bardwell: New Mexico Audubon, New Mexico

Recent Federal review of Rio Grande river management wasn't satisfying either irrigators or environmentalists. The Elephant Butte Irrigation District (EBID) was not happy with the preferred alternative coming out of the National Environmental Policy Act (NEPA) process, because it would reduce depletions from agriculture without acquiring agricultural water rights. Environmental groups, such as New Mexico (NM) Audubon, did not like the preferred alternative because they didn't consider it far-reaching enough. Believing they could come up with something better, the two groups began to collaborate on a variety of water sharing strategies.

A key component was to simplify environmental water transactions within EBID's existing framework. Conceptually, irrigating for habitat is like irrigating for a crop. So NM Audubon and EBID are currently developing an environmental water transaction program where Audubon can buy water rights from willing sellers.

Then Audubon asked EBID whether they could become an EBID constituent, just as if they were a farmer. EBID agreed. EBID routinely does surface water transfers from one farmer to another without permits from the State Engineers Office. EBID is kept whole in the transfer, and they have the authority to

approve or deny the transfers under existing district policies. They don't lose any water-righted acreage, it's just going to a different crop.

But there are many obstacles ahead, namely endangered species issues, agency approvals, and money. As a point of departure, ag-environment in-district transfers have not previously been allowed within the US Bureau of Reclamation's Rio Grande Project, a single purpose project authorized solely for irrigation. Although there is some precedent in this regard, they are forging into unresolved territory.

In addition, some water rights NM Audubon acquires may provide habitat for species susceptible to being listed as threatened or endangered, specifically the Southwest Willow Flycatcher. EBID is worried that in dry years, species will get precedence over agriculture. EBID and NM Audubon are working with US Fish and Wildlife to get assurance that if EBID takes these proactive steps now, they can be assured that water shortages will be shared in low water years.

And, of course, where should the money come from to buy water rights? Private groups? The Federal government? Audubon hopes to find funding for what can be billed as mitigation, water credits or "environmental services."



 Listen to
Beth Bardwell
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Colorado Investigates Alternative Transfer Methods via a \$3M Grant

Andy Jones: grant recipient and water attorney, Colorado

Since its inception in 2007, the Alternative Transfer Methods Grant Program of the Colorado Water Conservation Board (CWCB) has so far awarded \$1.5 million to water providers, ditch companies, and university groups to fund projects investigating the technical, legal, institutional and financial incentives needed for successful alternative water transfers.

In the Lower Arkansas River Valley, grant funding is providing for continued economic and engineering analyses of the Super Ditch Company which recently incorporated to provide a venue for irrigators to collectively lease agricultural water to cities while maintaining long term ownership of the water.

Colorado State University Cooperative Extension is conducting a four-year study to assess various technical aspects of returning fallowed land to production and maintaining or improving crop yields on those lands. The study is ongoing through 2012 with test plots in the Arkansas River Basin.

Another grant funded the Colorado Corn Growers Association, working with Ducks Unlimited and the City of Aurora, to develop three demonstration projects in the South Platte River Basin northeast of Denver. Two are wetlands projects designed to recharge the alluvial aquifer, which can be used to augment out-of-priority groundwater pumping. The third demonstration project is creating a marketing mechanism and business plan for water transfers.

An additional project in the South Platte River Basin, supported by the Parker Water & Sanitation District and Colorado State University, involves a four-year study to quantify savings in consumptive water use from deficit irrigation. By reducing the amount of water irrigated crops consume, the difference between historic and future consumptive use can be computed. With approval of the State Engineer's Office, it is believed that this volume of water could be transferred to municipal use.

A second round of grants in 2011, to total another \$1.5 million, will fund activities which build on the first set of projects, digging deeper into obstacles and how they might be overcome. The CWCB expects to fund projects which investigate:

- Barriers to acceptance of alternative transfer methods by cities and farmers
- Further technical analysis of transferable consumptive use
- Administrative and legal barriers
- Institutional framework and water supply delivery options necessary to implement an alternative transfer method
- Potential third party concerns.



 Listen to Andy Jones
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Keeping Farmers on the Land and Fish in the Stream in the Pacific Northwest

David Pilz: Freshwater Trust, Oregon

The Freshwater Trust works with landowners and irrigation districts in the Pacific Northwest to buy and lease water for instream flows. Their goal is to keep farmers on the land, and more water in the streams. And they have funding to help do it—some \$600 thousand to one million dollars each year paid out by the Bonneville Power Administration as part of mitigation for their storage projects in the Columbia River Basin.

A typical Freshwater Trust deal often involves connecting with local landowners who own key water rights in a given area. According to senior flow restoration manager David Pilz, initially there was a push to buy the water rights, but they have learned that many projects don't need to involve outright purchases.

One example of a water purchase scenario took place on the Austin Ranch along the Middle Fork of the John Day River where they worked with rancher Pat Voigt. ([Click here to see a short video documentary of this project](#)). Their strategy in this case was to get Voigt's agreement to shorten his irrigation season, ending hay production in the middle of July instead of September. Although he loses his third cutting of hay, he gets to keep the first two most productive

cuttings, and the fish get water when they need it in the middle of July.

Navigating state requirements for changing water rights to instream flows, on a permanent or temporary basis, can be a complicated and lengthy process. In each case, The Freshwater Trust is looking for ways to make the process less onerous for all involved.

This was the challenge along the upper Lostine River. The Trust was looking to get more water in the stream, but was faced with five irrigation ditch companies and more than 100 landowners. Rather than contracting with each irrigator individually, they decided to contract specifically with the ditch companies, and came up with a management agreement to leave a certain amount of water in the river at certain times—without changing their water rights. Since the water rights weren't modified, state regulation wasn't necessary, and the process became much simpler. The Freshwater Trust monitors upper Lostine River flows twice during the season, and after each sends a check to the irrigation districts.

These and numerous other projects are keeping the Freshwater Trust focused on a clear objective to maintain and restore rivers' biodiversity, while preserving an understanding and appreciation for agriculture.



 Listen to David Pilz
david@thefreshwatertrust.org

Imperial Irrigation District Conservation Provides Water for Urban Use

John Eckhardt, Imperial Irrigation District, California

Halla Razak, San Diego County Water Authority, California

In Southern California, municipalities partner with irrigation districts and pay for irrigation delivery system improvements, on-farm irrigation efficiency enhancements, land fallowing programs, and environmental conservation—so they can use the conserved water. How did these complex agreements come about? As demands for Colorado River water increased in other states, California had to find a way to reduce its deliveries from the river. For many years, more than half the water the Metropolitan Water District (MWD) supplied to southern California was water not needed by other Colorado River Basin States. In 2003, for the first time, California was limited to its annual Colorado River apportionment of 4.4 million acre-feet. Agricultural to urban water transfers, rather than significant new capital projects, were seen as the best method to voluntarily bring water into urban areas. Additionally, San Diego County Water Authority (SDCWA) was looking for independent supplies of water.

Given the Imperial Valley's geographic proximity to San Diego and the more than 3 million acre-feet per year of water under the Imperial Irrigation District (IID) control, IID became a logical partner with SDCWA. IID already had an agreement where MWD would fund conservation measures and receive up to 110,000 acre-feet annually, but additional conservation actions were available. It took 10

years and critical legislation, but by October 2003 a series of comprehensive water sharing agreements, called the "Quantification Settlement Agreements" were completed to ultimately provide an additional 280,000 acre-feet of water annually to the San Diego region and 103,000 acre-feet annually to the Coachella Valley.

In the ramp-up period, conserved water would be provided by both fallowing and conservation measures. Following a 24-year ramp-up, all the water will come from conservation measures. During the past seven years, the IID has developed a detailed roadmap for how to conserve water for transfer, including water delivery system improvements and a voluntary on-farm incentive-driven irrigation efficiency improvement program.

The IID-SDCWA transfer is fundamental to the Colorado River Quantification Settlement Agreement and California staying within its 4.4 million acre-feet apportionment. Over the life of the agreement's 45-year term nearly 30 million acre-feet of water will be moved from agricultural to primarily urban use and to-date over 550,000 acre-feet has been transferred. Two remaining challenges are resolution of a legal issue concerning the constitutionality of the State backstopping funding for environmental mitigation and the State fulfilling its legislative obligation to restore the Salton Sea.



 Listen to John Eckhardt
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Small Storage Project and Coalition Building Benefit Agriculture and the Environment in Wyoming

Larry Hicks: Little Snake River Conservation District, Wyoming

In 1984, the Wyoming Legislature authorized a water storage project in the Little Snake River Basin to mitigate shortages caused by Wyoming's only large trans-basin diversion, which took place in the early 1980s and removed 21,000 acre-feet of water from the basin. The mitigation, a 23,000 acre-foot reservoir, took over 20 years to permit and build, but now provides a fishery, recreation, and late season irrigation water for ranchers in this Colorado River headwaters basin.

Wetland and stream channel impacts had to be mitigated in order for the High Savery Dam and Reservoir to be permitted. In addition, the Little Snake River Conservation District also significantly enhanced environmental attributes along the river corridor to maximize the benefits of the stored water. They installed multiple structures and restored stream channels and riparian zones to enhance fisheries and terrestrial wildlife habitat for 25 miles along Savery Creek from the dam to the Little Snake River. In the end, they will have modified every diversion structure in the Little Snake Basin for fish passage.

These efforts have resulted from building a broad coalition among the agricultural community, wildlife

and conservation organizations, and government entities—local, state, and federal. They also leveraged construction funds from multiple sources, including the US Department of Interior, Natural Resource Conservation Service (NRCS), Wyoming Wildlife & Natural Resources Trust Fund, US Fish and Wildlife Service-PFW, and Wyoming Water Development Commission.

Project proponents feel that the High Savery Dam and Reservoir Project can provide a template for how to bring in all the players to work together, and how water storage can give a community the flexibility it needs to support local fisheries, improve agricultural irrigation, and provide a buffer against energy and municipal water demands.

A difficult permitting process, as well as strong local collaboration, make this small storage project a good example of water sharing lessons learned. The story of this storage project is instructive not only for the multiple hurdles it overcame, but also as an example of how even small projects can leverage resources and build relationships to make watershed improvements that benefit agriculture and the environment.



 Listen to
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Sustainable Surface and Groundwater Management Benefits Cities, Farmers and Fish

Curt Aikens: Yuba County Water Agency, California

Flood Control and Water Supply

Yuba County in the heart of California's Central Valley has historically faced severe flood control and water supply problems. To confront these problems, community leaders established the Yuba County Water Agency (YCWA) in 1959 to serve not just farmers, but all of Yuba County. One year later, 92 percent of the voters supported a large revenue bond to build New Bullards Dam and Reservoir to deliver surface water to local farmers and reduce flood risk.

Completed in 1970, the project resolved issues related to the division of the county into north and south basins, with the north relying on surface water diversions from the Yuba River, and the south unsustainably drawing on groundwater. With new surface water deliveries to the southern part of the county, the groundwater aquifer was restored to historic levels. Farmers voluntarily agreed to forgo their surface water and the water was transferred to cities. Irrigators were paid for the transfer, then pumped groundwater to irrigate their crops. YCWA's progressive groundwater management plans have helped the agency pioneer the responsible transfer of water supplies from agricultural to urban uses.

Instream Flows and the Lower Yuba River Accord


In 1988, a fishing alliance complained that the project was reducing instream flows to the detriment of fish

in the Lower Yuba River. The conflict was not resolved until 20 years later, when 18 entities entered into an interest-based negotiation and completed the Lower River Yuba Accord.

The accord has three main agreements. The first establishes significantly higher instream flows for wild salmon and steelhead on the Lower Yuba River, up to 170,000 acre-feet of additional water annually. These higher flows are invaluable to one of the last wild salmon runs in California's Central Valley. The second assures annual water transfers to California's Natural Resources Agency for fish and wildlife, and to cities and farms who receive their water supplies from the State Water Project and Central Valley Project. YCWA is currently transferring on average 150,000 acre-feet of water annually, and using the revenues from transfers to improve fisheries habitat and strengthen flood control levees. The third agreement establishes a series of conjunctive use agreements with seven local irrigation districts. Actively managing both surface and groundwater resources enables YCWA and the districts to be better stewards of their water rights and water supplies, which strengthens agricultural productivity.

YCWA's leadership through the accord is an example of how agricultural, environmental and urban water sharing strategies can be enhanced.



 Listen to
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Farmers Use Surface Water from Central Arizona Project, Bank Groundwater for Future Use by Cities

Brian Betcher, Maricopa-Stanfield Irrigation and Drainage District, Arizona

In 1990, Arizona passed legislation to allow farmers to use Central Arizona Project (CAP) water allocated to cities, in order to leave more groundwater in place for future use by those cities. This supplemented CAP surface water supplies already available to irrigated agriculture. The idea was that cities with unused allotments on the Colorado River could make them available to farmers at an incentivized rate, instead of losing the water downstream to other users. Farmers who would otherwise be pumping groundwater to irrigate their crops, agreed to use the cities' allotments of CAP water instead, and leave groundwater in place. Cities who sign onto this program gain "storage" credits which allow them to pump the "stored CAP water" in future years for drought mitigation or to supply urban growth. Farmers also participate in "in lieu recharge" programs through irrigation districts such as the Maricopa-Stanfield Irrigation & Drainage District (MSIDD) in south-central Arizona.

Before MSIDD built its canal system allowing farmers to access Colorado River water from the Central Arizona Project, farmers exclusively pumped groundwater to irrigate the 80,000 acres in the project. Prior to CAP water availability, farmers in both MSIDD and its sister district, the Central Arizona Irrigation and Drainage District, each pumped between 300-400 thousand acre-feet of groundwater per year. The CAP was built largely to reduce groundwater pumping in those areas of the state where aquifer depletion was a

concern, such as these districts, as well as to provide a supply of renewable water for anticipated growth.

However, when first made available to the districts, the cost of CAP water was high relative to the cost of pumping, so farmers continued to rely on their groundwater supplies. Over time, the various irrigation districts worked with CAP to develop pricing programs that would incentivize their collective use of Colorado River water in order to reduce continued groundwater pumping.

Banking groundwater for future use by cities became an additional tool. Some irrigation districts made deals directly with nearby cities. But others, like MSIDD, partnered with the Arizona Water Banking Authority (AWBA). The AWBA, created by statute in 1996, acts on behalf of all municipal and industrial users who have a basic CAP allocation and wish to participate in these programs. The AWBA is also responsible for administering in-lieu water storage for the State of Nevada. MSIDD has "stored" a significant amount of water on behalf of the AWBA and Nevada.

According to University of Arizona professor Bonnie Colby, the availability of CAP surface water creates a unique opportunity to provide credits in lieu of pumping groundwater—allowing groundwater in and around Maricopa to recharge. She points out, however, that the reality of urbanization means this will be a temporary opportunity to manage resources.



 Listen to
Brian Betcher
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Palo Verde and MWD's Land Management, Crop Rotation and Water Supply Program

Ed Smith: Palo Verde Irrigation District, California

In 2001, the Palo Verde Irrigation District came together with the Metropolitan Water District of Southern California (MWD) to develop a land management, crop rotation and 35-year water supply program providing up to 111,000 acre-feet of agricultural water per year for urban use. Participants committed to stabilize the farm economy in the Palo Verde Valley, and support the \$800 billion economy of Southern California. An important component of the transfer involves funding of community improvement programs to help mitigate any third party impacts from the program.

Fallowing is a key component of this water transfer strategy. The program stipulates that approximately 6,000 to 26,500 acres will be fallowed every year district-wide. District fallowing amounts vary year to year, depending on MWD's water demands, but annually there is a minimum of seven percent of the district's acreage fallowed, with a maximum of 29 percent.

For participation in the program, farmers received a one-time payment of \$3,170 per encumbered acre in 2004. In addition, they are paid an annual payment of \$602 per non-irrigated acre starting the first year of the program in 2005, with an agreed upon price escalation for the following years which in 2010 increased the annual payment to \$681 per non-irrigated acre. On an average 100-acre farm, this trans-

lates into cash payments of \$110,900 in 2004 for the one-time sign-up and annual payments ranging from \$6,100 to \$23,800 in 2010. Landowners have to allow a fallowing easement on up to 35 percent of their farms, fallow lands based on MWD's call, implement land management plans, provide program-related data, and pay irrigation district water tolls and taxes.

Impacts of land fallowing can reach far into a community, and many cannot be accurately predicted into the future. To address these concerns and help compensate the Palo Verde community as a whole, in 2002 a nine-member Community Improvement Program was established from a cross-section of local business and community leaders. The group oversees distribution of six million dollars provided by MWD in 2004 for community improvement programs such as education and job retraining of workers impacted by the fallowing.

In response to a drought emergency declared by Governor Schwarzenegger in 2009, Palo Verde also agreed to participate in a one year, short-term supplemental fallowing program, separate from the existing 35-year program. Farmers voluntarily fallowed up to an additional 15 percent of their irrigated land in return of a one-time payment of \$1,665 per non-irrigated acre. The one-year program terminated in 2010.



 Listen to Ed Smith
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Irrigators Negotiate Municipal Water Leases, Keep Water Ownership

Peter Nichols: general counsel for the Super Ditch Company, Colorado

In the lower Arkansas Valley of Colorado, almost 80,000 acres of farmland have been dried up and the water transferred to cities since 1950—about 15 percent of historically irrigated land. A similar amount is projected to be lost to “buy and dry” in the next 20 years. Concerned about economic and social effects in rural communities, voters formed the Lower Arkansas Valley Water Conservancy District in 2002 to address the issue.

Inspired by Metropolitan Water District of Southern California’s lease of water from irrigators of the Palo Verde Irrigation District, they set about to see if ditch company shareholders in the lower Arkansas Valley might band together to lease water to municipalities as an alternative to further permanent transfers. They formed the “Super Ditch” in short order. It is not actually a ditch at all, but instead a collective bargaining agent for irrigators to voluntarily cease irrigation on part of their land and temporarily lease irrigation water to cities and others. Engineering and economic studies showed the concept to be feasible, and a steering committee of farmers began to work out the details.

The foundation of the Super Ditch is for farmers to pool some of their water and lease it—not sell it—allowing them to reap the long-term appreciation of the water as an asset while benefitting from an ongoing lease revenue stream.

An early obstacle was that ditch companies were hesitant to sign on without knowing what the leases would look like, but potential leases weren’t likely until there was a leasing entity in place. The solution was for individual ditch company shareholders to incorporate the Super Ditch. Now, with two letters of lease intent in hand, efforts are underway to convince three of the ditches to change their articles of incorporation and/or bylaws to allow shareholder participation.

Other obstacles still to be faced include county permits and the required State Water Court cases to exchange water to the point of delivery to municipalities and change the type and place of use of the water rights. These cases are expected to be complicated—perhaps the largest such cases ever filed in Colorado. To allow the leases to move forward, the Super Ditch expects to operate under a substitute water supply plan approved by the State Engineer while the cases are pending in water court, although the company is exploring a change in state law to allow an administrative approval of leases without water court adjudication. Despite these hurdles, Super Ditch participants are determined to stay the course. Says one stakeholder, “This is the best chance we have to save our water.”



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Working Group Helps Make Temporary Transfers Quick and Efficient During Times of Drought

Bob Barwin, Washington Department of Ecology, Washington

The state of Washington has long been interested in developing effective ways to facilitate the voluntary transfer of water while preserving existing water rights and providing water for presently unmet and future needs. Transfers are seen as achieving a variety of water resource management objectives, including drought response, improving streamflows, and reserving water supply for future uses.

The Yakima River Basin Water Enhancement Project was established in 1994 to address the dual problems of salmon habitat degradation and inadequate dry year irrigation water supply, by facilitating ways of making water supply in the Yakima more flexible and responsive to current needs. An advisory committee was formed to consider more innovative ways to free up water for current needs, such as water transfers, water banking, dry year options, and the sale and leasing of water for agricultural users and instream flows.

During the 2001 drought year, the water enhancement project advisory committee came up with the idea of the Yakima Basin Water Transfers Working Group and a process to facilitate quick and efficient temporary transfers. The Working Group would review proposed transfer requests and make recommendations to both the state Department of Ecology and the Bureau of Reclamation who in turn would recommend water users' motions to the Superior Court for temporary transfers, if they met the Working Group's

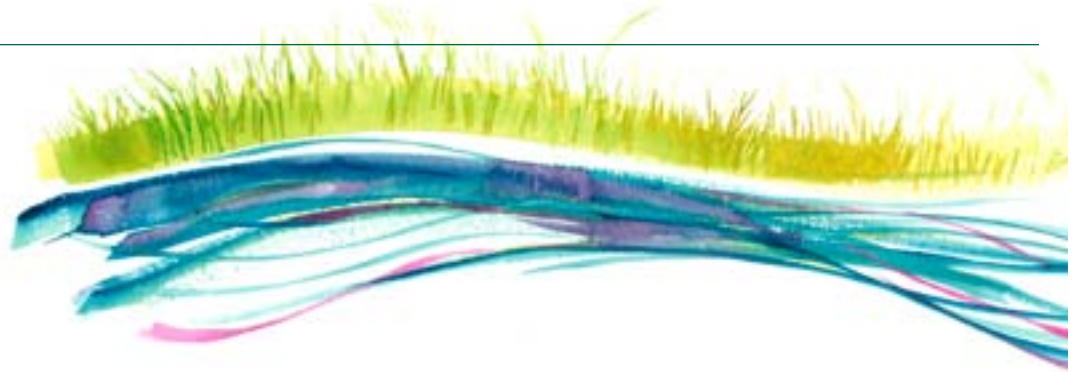
approval criteria. Using this process in 2001, 40,000 acre-feet were transferred in just four months. The process was repeated in 2005, with even better results. They not only transferred 50,000 acre-feet in just two months, but the quality of proposals was better so that impairment and consumptive use issues could be more easily and quickly ironed out.

The Yakima Basin Water Transfers Working Group is a strictly voluntary group of professional water managers, engineers, hydrogeologists, fisheries biologists, irrigation districts, law firms and the like. There is no chartered attendance; they all go to the scheduled meetings as they wish. They are there to review proposals and provide input. They look to identify and resolve problems. For instance, if there is a return flow issue, there is enough experience in the room to answer it. They all have sufficient knowledge of how the Yakima Project operates. The Working Group provides a venue for getting objectors together ahead of time to work out conflicts. The head of the Department of Ecology listens to the whole group and then decides what to recommend to the Superior Court or, in the case of permanent transfers, whether to approve, deny, or condition an application to change a water right. There is no statutory authority for him to impose what the group thinks, but the group has credibility. It exists because it is relevant. The Working Group continues to meet at least monthly.



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Workshop



Tackling Obstacles to Water Sharing Strategies

A key component of this project was the convocation of a two-day workshop bringing together some of the best minds in the business to come up with real-world solutions to the challenges of sharing water in a world with intensely competing needs, complex regulations, and variable climate. They committed their time because they are convinced that the status quo has to be changed. Thirty-five participants and facilitators met at a ranch above Castle Rock, Colorado, on August 12 and 13, 2010, and set about to develop specific, actionable recommendations for how to remove obstacles to innovative water sharing strategies.

The Agricultural/Urban/Environmental Water Sharing Work Group selected workshop participants from those participating in the earlier interviews. All members of the Work Group also participated in the workshop. A representative mix of practitioners and academics added to the strength of the group as did a mix of those falling in the categories of attorney, engineer, farmer, economist, professor, policy analyst, irrigation district manager, and municipal water provider. Several participants are in their 30s; one participant tops 90!

In advance of the workshop, participants were asked to complete two assignments. The first assignment asked: Who are you? What experiences/insights

brought you to this place in your life where you are so engaged with water? The second assignment asked: What “ingredients” do you have to share with the group—the raw material from which we will build an understanding and actionable policy recommendations?


This homework served at least two purposes. First, all participants were given a quick preview of the full range of experience and vision of the entire group. Secondly, the responses of individual participants helped the Work Group design the workshop process.

At the workshop, participants were divided into four sub-groups, each addressing one of the following themes identified from the interview process and participants’ background information:

- Improving the State and Federal Regulatory/Statutory/Oversight Process
- A Flexible, Watershed Based Approach
- Water Sharing Transaction Strategies
- Creating Positive Stakeholder Processes for Sharing Water

The resulting recommendations from each of the sub-groups were then vetted and agreed upon by the entire group. These recommendations provide the basis for the Action Recommendations detailed in this report.

 [Click to see video of workshop participants and process in Windows Media Format](#)

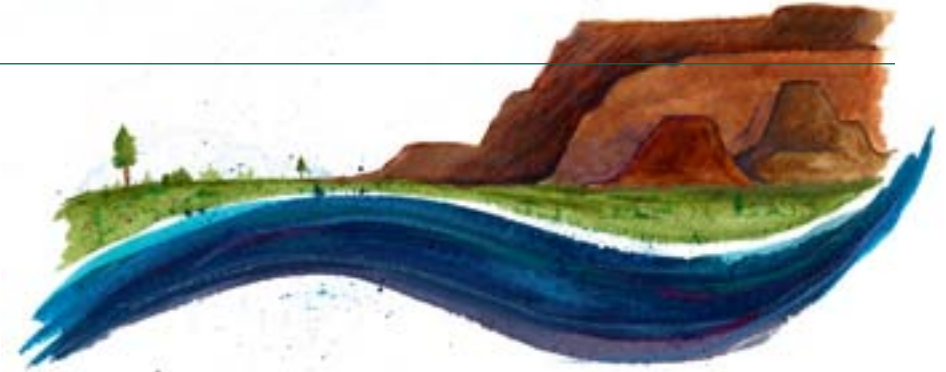
 [Click to see a short introductory video hosted on YouTube](#)

**Workshop Participants, including members of the Agricultural/
Urban/Environmental Water Sharing Work Group**

Curt Aikens—Yuba County Water Agency—CA
Beth Bardwell—Audubon New Mexico—NM
Brian Betcher—Maricopa-Stanfield Irrigation District—AZ
Peter Binney—Black and Veatch—CO
Nathan Bracken—Western States Water Council—UT
Reeves Brown—3R Ranches—CO
Bonnie Colby—University of Arizona—AZ
Todd Doherty—Colorado Water Conservation Board—CO
John Eckhardt—Imperial Irrigation District—CA
Bill Hasencamp—Metropolitan Water District—CA
Taylor Hawes—The Nature Conservancy—CO
Larry Hicks—Lower Snake Water Conservancy District—
WY
Jonne Hower—Western Federal Agency Support Team
(WestFAST)—UT
Tom Iseman—Western Governors' Association—CO
Ron Jacobsma—Friant Irrigation District—CA
Andy Jones—Lind, Lawrence & Ottenhoff Law Firm—CO
Jack Keller—Keller-Bleisner Engineering—UT
Dan Keppen—Family Farm Alliance—OR
Larry MacDonnell—University of Wyoming—WY
Peter Nichols—Trout, Raley, Montaña, Witwer & Freeman
Law Firm—CO

Pat O'Toole—Family Farm Alliance—WY
David Pilz—Freshwater Trust—OR
Jennifer Pitt—Environmental Defense Fund—CO
Mark Pifer—Western Urban Water Coalition and Aurora
Water—CO
Ron Rayner—Tumbling T Ranches—AZ
Halla Razak—San Diego County Water Authority—CA
Adam Schempp—Environmental Law Institute—Washington
DC
Loretta Singletary—University of Nevada Extension
Service—NV
Morgan Snyder—Walton Family Foundation—Washington
DC
Dick Wolfe—Colorado State Engineers Office—CO
Facilitators
MaryLou Smith—Colorado Water Institute, Colorado State
University—CO
James Pritchett—Colorado State University—CO
Reagan Waskom—Colorado Water Institute, Colorado State
University—CO
Vince Roos—Facilitator—CA
John Foster—Facilitator—CO
Tara Steckley—Facilitator—CO

Recommendations



Recommendations: Targeting Overarching Obstacles to Water Sharing Strategies

When this project was conceived, the Western States Water Council and the Walton Family Foundation made it clear they wanted this collaboration to result in real-world guidance, not merely an academic overview or a listing of complaints. This thinking provided the basis for these Action Recommendations.

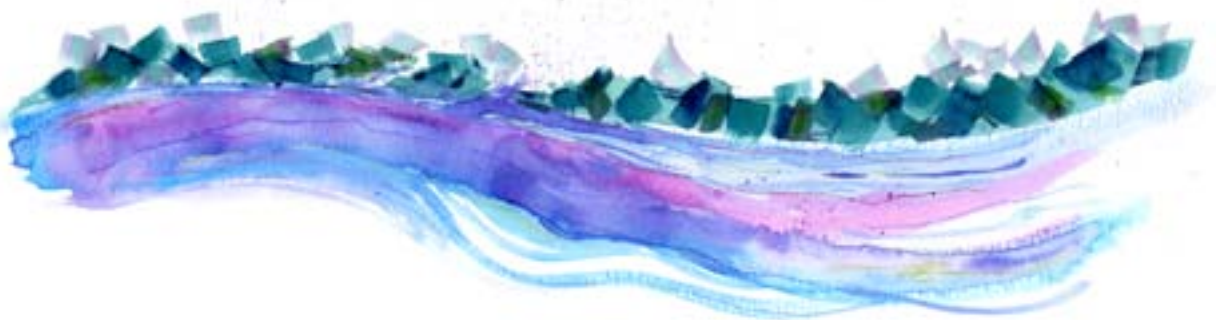
The guidance contained in these Action Recommendations is designed to help improve water sharing scenarios, including specific recommendations for how to tackle obstacles—policy, legal, institutional, and financial. It is also hoped that these recommendations will help identify incentives and provide guidance for policy makers who are concerned about how we can most effectively and fairly plan future water supply. Though these recommendations are directed at the Colorado River Basin, most if not all are relevant to the whole of the West.

Subsequent to the workshop, some have asked why participants chose to make general recommendations, rather than specific suggestions relevant to the water sharing strategies uncovered in the interviews. The answer is that there are any number of recommendations that could be made specific to a given strategy. But those recommendations could only be derived from a detailed comparative analysis

not feasible to accomplish in a two-day workshop setting. The group chose instead to make recommendations they deemed critical to address the overarching obstacles facing all innovative strategies for sharing water for multiple benefit, regardless of state or strategy. In an effort to make the recommendations actionable, participants provided specific action steps they believe the Western Governors and others could make. These action steps are not meant to be limiting, but instead, to be seen as exemplary of how we could move forward instead of staying stuck in a study mode.

Workshoppers felt strongly that overarching obstacles cause significant roadblocks for all of the strategies. Mindfulness of these obstacles strongly influenced their development of recommendations. It is their hope that action to pursue these recommendations will significantly open up opportunities for all the water sharing strategies to move forward.

In addition, the group feels that the gamut of water sharing strategies West-wide should be explored more fully so that lessons learned from each could be



applied to other states or watersheds. This sort of detailed, comparative analysis of the multitude of water sharing strategies currently in place would be complex and require extensive research, but may take place in a later study.

Recommendation: Piloting an Expedited Water Sharing Program Review Process

A number of water programs can be undertaken to promote the sharing of water between sectors. Such water sharing programs are broadly considered to include features such as contracts, leasing arrangements, water banks, infrastructure improvements, environmental restoration, and related projects. The process for initiating, reviewing, permitting, approving and implementing such water sharing programs can be adversarial, costly and time consuming. In some cases, mutually beneficial water programs with broad, multi-sector support may be delayed or abandoned under the current review paradigm. In order to learn how the process may be improved, the workshop participants recommend a *pilot expedited review process in each state*. The pilot could involve the following steps:

- Governor, in collaboration with stakeholders, would identify a multi-use water sharing project or program which has broad support to pilot an expedited review process.
- Governor would appoint a liaison with experience in the regulatory arena to guide the project through the local, state and federal approval process.
- Governor would request that the federal government appoint a lead federal party designate to be involved in all aspects of the review process.

- The state liaison and federal designate would work together to establish milestones and ensure they are met in the review, processing, permitting and approval of the project.
- The state liaison and federal designate would work together in initiating planning and coordination meetings of parties with affected interests, and facilitate concurrent review and permitting process and sharing of state and federal approval resources. This “one-stop-permitting” approach would improve efficiency by reducing costs and repetitive agency information exchanges and by ensuring more timely approval.
- The process should include the best available information.
- The review should support adaptive management processes if adjustments or mitigation is necessary to protect the future interests of affected parties.
- The state government liaison would report the outcome of the pilot processes and suggest recommendations for improving the initiation, reviewing, permitting, approving and implementation of water programs. Governors could convene a group of agency representatives and stakeholders to review and evaluate each state’s pilot effort and seek to develop ideas and opportunities for improvement.



Recommendation: Fostering a Flexible Basin-Wide Approach

Watersheds are highly interconnected, complex systems; however, current management of water resources does not always recognize the complexity of these interrelationships. The workshop participants believe that coordinating decisions about water infrastructure, storage, release, and other programs at the watershed level would lead to solutions for agriculture, energy, environmental, tribal, and urban interests that might not otherwise be obvious when working only at smaller scales. Benefits include, but are not limited to, enhanced reliability, flexibility and resiliency of water systems. A watershed-based approach is a new paradigm in decision making in the Colorado River Basin, and western policymakers can play an important role in fostering basin-wide, mutually beneficial decisions. Specific recommendations include:

Colorado River Basin Management Tool

Workshop participants recommend that a planning tool be developed that accurately depicts the complexity of the Colorado River Basin's flows and uses. The

tool should include contributions for agricultural, environmental, tribal and urban needs across the Basin, and improve tools that currently only model the Colorado's mainstem and largest storage projects.

A sufficiently comprehensive planning tool ensures holistic examination of management strategies in the basin by first benchmarking the current use of water resources including water quality, quantity and timing of flows. We need a tool that has the capacity to simulate management strategies under varying climatic conditions while recognizing allocation institutions and jurisdictions such as the Colorado River Compact. The tool can leverage existing state and federal studies of river flows (e.g., Colorado River Basin Water Supply and Demand Study).

Watershed Scale Scenario Modeling and Studies

Workshop participants recommend the use of the planning tool to inform stakeholder driven, basin-wide studies that consider mutually beneficial water sharing strategies (e.g., benefits from sharing infrastructure and multi-purpose projects that benefit the environment.) Through such research, workshop participants believe we can develop better operational-management tools, including strategic storage and real-time decision support systems; supplemental supplies (e.g., reuse, groundwater storage, desalination, demand management); additional conveyance for interconnectivity and flexibility; and opportunities to improve water institutional frameworks at multiple scales in the basin.



Watershed Based Advance Planning

Enhancing watershed reliability, flexibility and resiliency implies advance planning. Workshop participants recommend that Governors urge state and federal agencies to work cooperatively with stakeholders in the identification and implementation of mechanisms that meet water supply related obligations (including, but not limited to, water for critical habitat or endangered species and interstate water compacts) in advance of water supply crises, to avoid social, environmental and economic disruption. Examples include mechanisms such as water banking and interruptible supplies, but these mechanisms require advance planning and approval. This recommendation should lead to thoughtful consideration of third party effects and enables development of interagency and stakeholder relationships in advance of crises.

The US Farm Bill

The US Farm Bill is an important catalyst for encouraging wise water resource use, improving water quality and enhancing the environment. The Farm Bill directly influences watershed approaches with specific programs (e.g., the 2007 Farm Bill's Chesapeake Bay Watershed Initiative), and encourages producers to adopt best management practices (BMPs) enhancing agriculture water conservation, improving water quality and safeguarding habitat. BMPs include projects such as land leveling, drip irrigation systems and improved storage and conveyance. Workshop participants support a coordinated effort among Western Governors and Congressional Repre-

sentatives to promote and enhance Conservation Title funding to programs such as EQIP and AWEP in the next Farm Bill. These programs enhance water flexibility, reliability and resiliency of all western watersheds including the Colorado River Basin.

Recommendation: Clearing Obstacles to Implementation of Creative Water Sharing Strategies

The group endorses a grassroots cross-sector approach in facilitating water sharing initiatives. Specific recommendations include:

Advocacy of Collaborative Solutions – State Water Advocates

Workshop participants believe having a cabinet-level State Water Advocate responsible for empowering the success of mutually beneficial water programs with broad support, would be a powerful step toward the success of programs such as:

- Temporary transfers
- Cross-sector partnerships
- Infrastructure (modernized storage and conveyance, re-operation, reuse of existing supplies)
- More effective market incentives
- Environmental restoration and revitalization



Reduce Costs for Temporary Water Sharing Arrangements

For multiple reasons, water transfers that result in the permanent transfer of water from agricultural land may be detrimental to all sectors (e.g., a smaller economic base in rural communities). Workshop participants believe that regulatory (transfer) costs and insufficient infrastructure are significant barriers to temporary water transactions that might be used in lieu of permanent fallowing. Workshop participants recommend that the aforementioned State Water Advocate and appropriate state agencies encourage temporary transactions with incentives and pilot programs. One example of project advocacy: criteria and thresholds should be developed that define “best management practices” for transfers, much like a check list, that can be used in lieu of expensive regulatory approval or to streamline regulatory approval. Criteria might include benefits to multiple sectors, broad support from effected interests, environmental benefits or minimization of adverse impacts, and minimization of impacts to economies in basin of origin, among others.

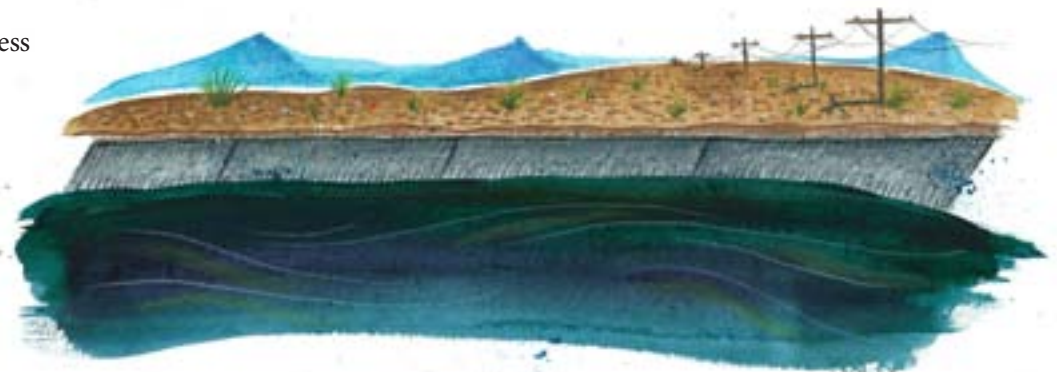
Encourage Mutually Beneficial Infrastructure Sharing and Development

The workshop participants recommend the State Water Advocate facilitate a cross-jurisdictional process for regional approaches to water infrastructure to facilitate water sharing. This approach will encourage infrastructure sharing and development that optimizes the use of existing water resources and infrastructure. Importantly, the process should be multi-sector and multijurisdictional with timely milestones. The process must not lead to takings of vested property rights including water rights but instead must be voluntary and incentive based.

Water Resource Sharing Zones

Workshop participants recognize that a broad sharing of resources, including water, can enhance opportunities for all sectors. Participants recommend state support for the creation of voluntary water resource sharing zones, similar to economic development zones, based on grassroots water partnerships between municipal/industrial, agricultural and environmental uses. Within these zones, water and financial resources might be traded more freely to the mutual benefit of sectors. Elements within such a water sharing zone might include:

- Support for local economic development which simultaneously addresses environmental needs
- Tax incentives to encourage water sharing
- Programmatic approval of defined temporary transfers
- Development of value-added agricultural sector (e.g., processing, branding, retail)
- Environmental restoration and preservation
- Preservation of recreation and open space values of irrigated agriculture
- Infrastructure resource sharing



Recommendation: Design A Robust Stakeholder Process for Multi-Benefit Water Sharing Solutions

Developing successful water sharing strategies requires effective collaboration between multiple parties with diverse interests. Past experience has shown that effective collaborative processes are critical components of successful water sharing efforts. States should encourage the use of collaborative approaches to develop water sharing strategies. Such collaboration would reduce conflict, provide stakeholders with a vested interest in outcomes and create solutions that help satisfy the diverse needs of the urban, energy, agricultural, and environmental sectors. Workshop participants recommend that decision makers foster the following principles to pioneer effective and sustainable collaborative processes.

Develop Sustainable Partnerships

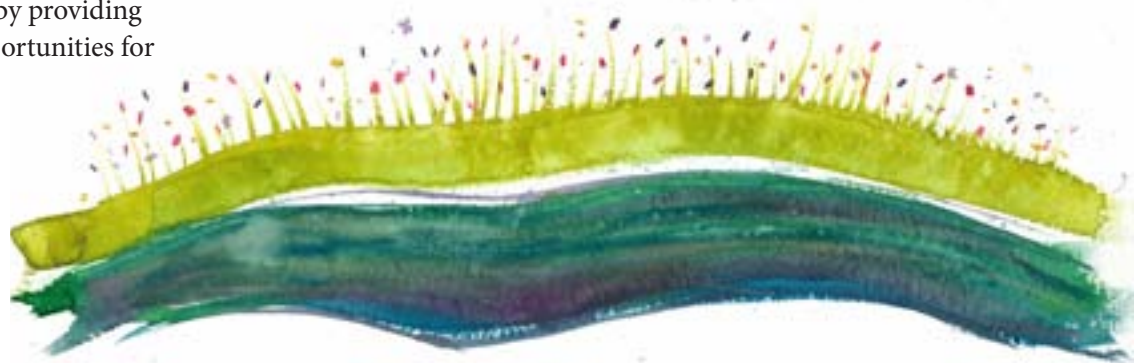
Successful collaboration requires developing sustainable partnerships. Such partnerships are based on high trust levels and effective communication. Western states' governments have a clear understanding of the statutory, regulatory and political processes that often generate conflict among stakeholders. Western states' governments can develop and empower sustainable partnerships by providing appropriately structured, facilitated opportunities for diverse stakeholders to experience a constructive exchange of perspectives and ideas, fostering collaborative learning and problem solving.

Early Broad Stakeholder Involvement

Successful collaboration requires the early identification and involvement of a broad range of interested stakeholders including decision makers; environmental, urban and agricultural groups; local, state and federal agencies; and other interested parties—often times before any “formal” process commences. Further effort is needed to select appropriate representation of affected groups and agencies. At its inception, a collaborative effort, while recognizing legal and legislative constraints, should not be unduly limited by them.

Define Expectations and Design a Process to Meet Those Expectations

Once stakeholders have been identified, a well-designed process should lead them to define reasonable expectations for the collaborative process and anticipated outcomes. That is, the process should be designed to ensure that stakeholders acknowledge, understand and legitimize one another's values as representative of each sector's water use. Timelines to reach specified goals should be established. Rules for communication and decision-making should be agreed upon and established. These include details



such as how the group communicates, defines consensus and plans to address impasses that are both substance and process related. Objective evaluation should be included as part of the overall process design. This includes routine stakeholder feedback as well as formal systematic assessment of progress toward short, medium and long-term stakeholder established goals.

Interest-based negotiation is one type of collaborative process that has repeatedly satisfied diverse needs and expectations involving complex natural resource conflict. Stakeholders should draw on the successes of and lessons learned from prior examples and case studies. Successful collaborative processes are those that effectively address stakeholder needs and encourage the development of outcomes that address multiple needs and values. Success is also indicated by those processes that produce flexible, adaptive solutions and that continue to engage interested stakeholders in ongoing assessment of the results. Should circumstances require it, successful processes can “begin again” and provide a marker for excellence in public problem solving.

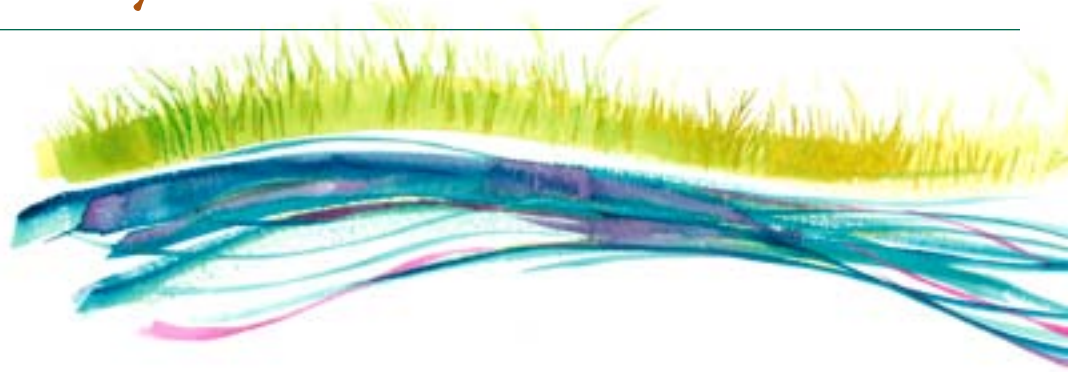
Process Tools and Incentives

Groups should be given incentives, support and resources that facilitate measured and significant progress toward satisfying recommendations. Some possible tools that collaborators can utilize to develop effective processes include but are not limited to: (1) analysis of previous collaborative efforts, or case studies, to determine why they were successful or unsuccessful; (2) pilot projects in appropriate circumstances; (3) generating and sharing useful information about settings, resources, the physical system and its constraints; (4) decision support; and (5) consistent and excellent facilitation. Tools that model particular scenarios and tradeoffs may also be employed where appropriate. Incentives for undertaking such processes could include funding for studies and small projects.

Effective Public Outreach and Education

Water issues are complex, so much so that widespread dissemination of information about the collaborative process and a concerted effort to educate the public about specific water issues are critical. Affected interests play an important role in educating their respective groups and the public about the collaborative process and water issues. Such education will vary depending upon the needs of each collaborative effort, but should occur throughout the collaborative process and should be research based and unbiased.

Quantification Study



Quantification Task: A Description of Agriculture Production and Transfers in the Colorado River Basin

Developing innovative water sharing mechanisms requires an understanding of the current status and underlying trends in agricultural water use, as well as a recent history of water transfers between users. This quantitative study analyses agricultural water use in the Colorado River Basin and recent water transfers.

Data used in this summary is drawn from three primary sources: the United States Department of Agriculture's (USDA) Agriculture Census that surveys all farms and ranches at five year intervals; the USDA Farm and Ranch Irrigation Survey (FRIS) that is a five year recurring sampling of irrigation practices across the US; and the Water Transfer Database housed at the Bren School of Environmental Science and Management at the University of California, Santa Barbara. A single clearinghouse does not exist for transactions in the Colorado River Basin states, rather a monthly trade periodical The Water Strategist reports on water transactions that occur in the West. To supplement this data, we relied on personal interviews with the US Geological Survey, US Department of Agriculture – National Agriculture Statistics Service, US Bureau of Reclamation and others.

A more complete description of this research can be found as special report #21 of the Colorado Water Institute (<http://www.cwi.colostate.edu/publications.asp?pubs=sr>). The following text provides selected themes from the larger report.

Changing Agricultural Water Use in the Colorado River Basin

Agriculture in the Colorado River Basin is diverse and generates sizable economic activity. Water from the Colorado River is used to irrigate approximately 3 million acres of cropland producing such disparate commodities as grass hay, durum wheat, alfalfa, corn and cotton, as well as high value vegetables and fruit crops. The basin grows fifteen percent of the crops in the United States as well as thirteen percent of its livestock.

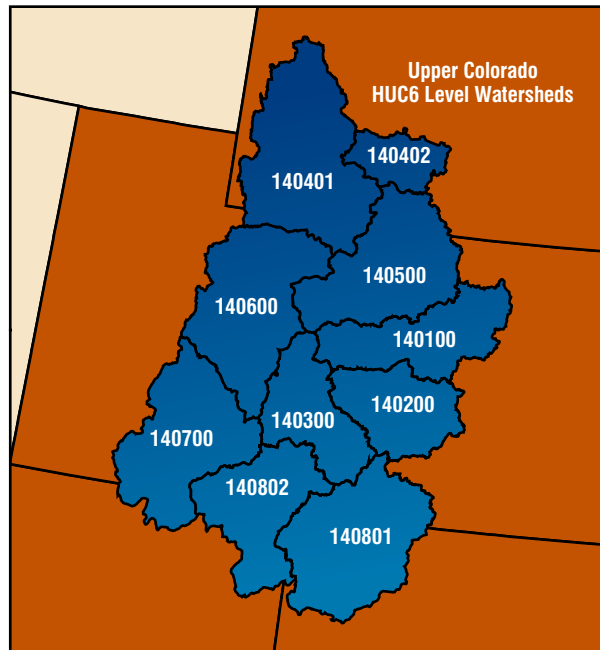
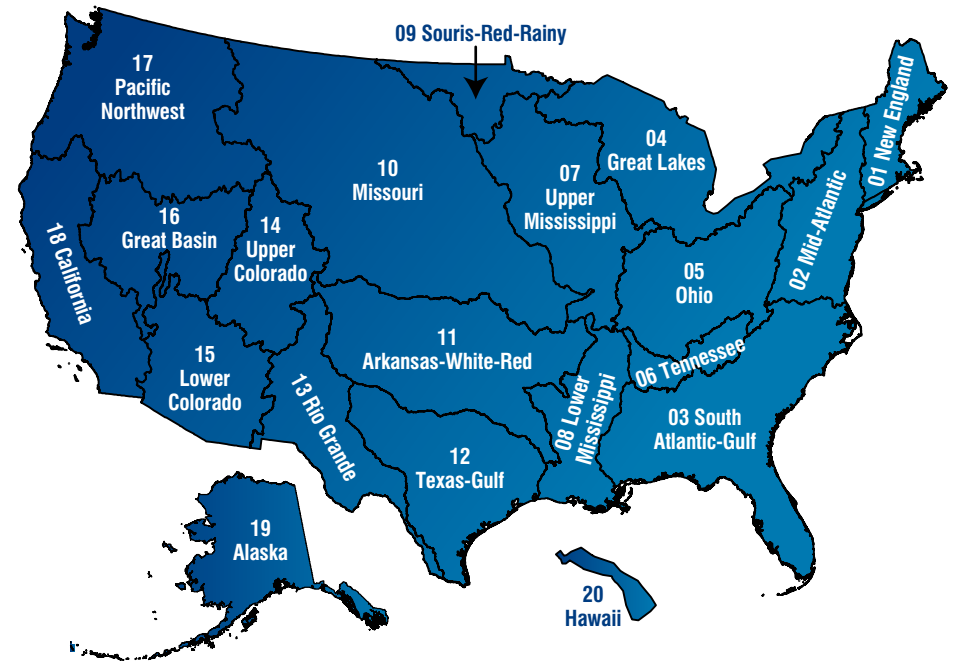
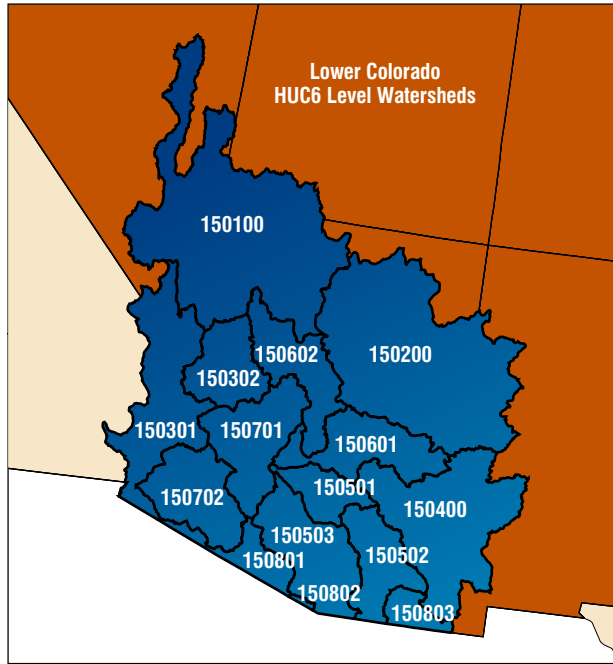
The USDA Census of Agriculture (Ag Census) adds richness to our understanding of Colorado River Basin agriculture. Ag Census data for the Upper and Lower Colorado River Basin includes irrigation water sourced from the Colorado River mainstem, Colorado River tributaries and groundwater aquifers.

The Colorado River Basin is divided into upper and lower basins in part because climactic conditions dictate differences in agricultural activity. According to the 2007 Ag Census, the Upper Colorado Basin (Water Resource Region 14) consists of 1.36 million acres of irrigated cropland with a crop mix of primarily irrigated forage crops such as corn silage, grass and alfalfa hay. These crops are critical inputs for extensive cow/calf, feedlot and dairy industries.

Areas Not Included in Colorado River Basin Statistics

The Imperial Irrigation District (IID) is not included in the Lower Colorado Basin Water Resource Region, but it does receive water resources from the Colorado River basin. The IID irrigates more than 460,000 acres of high value fruit and vegetable crops.

In addition, lands irrigated by transmountain diversions in the state of Colorado are not included in the Upper Basin's agricultural statistics. This includes irrigation by the Colorado Big Thompson (CBT) project in northern Colorado. This diversion conveys approximately 215,000 acre-feet of Colorado River water to Colorado's Front Range and South Platte Basin providing water to approximately 630,000 acres of crops that include sugar beets, vegetables, corn for grain, alfalfa and corn silage, as well as supplying 30 cities.



The US Geological Survey defines 20 Water Resource Regions (WRRs) in the US, and the two relevant to this study are the Upper Colorado (14) and the Lower Colorado (15). These water resource areas are further divided into smaller hydrologic units defined around particular drainages: 10 hydrologic units in the upper basin, and 15 hydrologic units in the lower basin. National Agriculture Statistic staff categorize data from the Ag Census and the Farm and Ranch Irrigation Survey according to these WRRs.

Agriculture in the Lower Colorado Basin (Water Resource Region 15) benefits from a longer growing season and closer proximity to large urban food markets and distribution infrastructure. Cropping is more diverse and generates higher sales value per acre of irrigated cropland with a crop mix that consists of alfalfa hay, durum wheat, orchards and vegetables. The 2007 Ag Census reports irrigated cropland in excess of 936,000 acres in the Lower Colorado Basin, mostly in Arizona.

	Upper Basin	Lower Basin
Change in Total Number of Farms 2003-2008	Increased by 1,700	Increased by 158
Change in Irrigated Acres 2003-2008	Decreased by 6,000	Increased by 38,000*
	Percent of Irrigated Land	Percent of Irrigated Land
Small Farms (less than 49 acres)	9%	3%
Medium Farms (50 to 1,999 acres)	66%	42%
Large Farms (more than 2,000 acres)	23%	55%

Source: 2003 and 2008 Farm and Ranch Irrigation Survey (FRIS)

* A contradiction exists between the USDA 2008 FRIS survey and the USDA Census of Agriculture Watersheds report released in 2009. The FRIS reports an increase of irrigated acres of 38,000 between 2003 and 2008, while the USDA Census of Agriculture reports a decrease of nearly 70,000 acres of irrigated land between 2002 and 2007. The difference might be explained by data collection methods as the FRIS is a sampling while the Watersheds report is a census of all operations. Notable is the Bureau of Reclamation's Lower Colorado River Accounting that suggests lands irrigated using mainstem Colorado River water decreased by 20,000 acres. This accounting uses satellite imagery to calculate irrigated land.

Trends in Irrigated Acreage and Farm Size

Agriculture is evolving in the Colorado River Basin, and ownership is gravitating toward two farm categories: small acreages whose revenues are used to augment household income, and large, commercial producers that are responsible for the vast majority of agriculture production and farm gate sales.

According to the USDA Farm and Ranch Survey, the number of small farms in the Upper Colorado Basin increased from 50 to 71 percent between 2003 and 2008. This dramatic increase follows a pattern of ex-urban development in the intermountain West where large parcels are divided into smaller, single-family operations with irrigated forage and pasture as the major agricultural activity and substantial off-farm income. And there are fewer medium-sized farms, though they still crop two-thirds of the irrigated acres.

In the Lower Colorado Basin, the increase in irrigated acreage was not uniformly distributed. Irrigated acres were lost in northwest and southwest Arizona with gains in central Arizona. There are fewer farms compared to the Upper Basin, and the size distribution is shifting to larger farms. Small farms are maintaining their share of total irrigated acres, while farms in the medium-sized classification are either acquiring other medium-sized farms, or these farms are being subsumed by large farms.

It is unclear if the predominance of small farms leads to a fragmentation of

water right holdings in the Colorado River Basin, but it seems likely. If true, then ownership is being spread among more operators with less reliance on irrigated agriculture as a source of income. At the same time, a significant proportion of agricultural water rights are being utilized by a relatively small number of large farms.

Colorado River Basin Water Transfers

The Bren Water Transfer Database collects transactions from The Water Strategist, and the comments that follow are specific to transfers among Colorado River Basin states that appear in the Water Transfer Database.

Water transfers in the West tend to follow urban development cycles. Peak transaction activity is associated with intensive urban development, and then transactions are reduced when the macroeconomic business cycle turns and output lags. Periods of less frequent transactions and smaller cumulative transaction amounts correspond to economic slowdowns in 1996-1998 and 2001-2003. Most recently, the number of transactions is increasing but the cumulative size is declining. In addition, leases are becoming more prevalent compared to outright sales.

Population growth and urban development does not occur evenly across the western landscape. Some areas grow more rapidly than others. Likewise, water transfers in the Colorado River Basin tend to be uneven through the time period 1988–2008.

Upper Colorado River Basin Water Transfers

In the Upper Basin, relatively fewer transactions have occurred as cities have not grown relative to the urban corridors in the Lower Basin.

In Wyoming, the frequency of transactions has only recently begun to increase, and the amount transacted has also started to expand. Wyoming water transactions are primarily leases with one-third of the leases from agriculture to urban use and one third of the leases involving agricultural, urban and environmental use. Further west, Utah transactions have involved a surprising amount of leases (38 percent) with the most activity generated in the early 2000s.

Colorado is an interesting case when it comes to transfers. Very few transactions have taken place within the Colorado's portion of the Upper Colorado Basin; however, a significant number of transactions involve Colorado River water diverted to the Colorado Big Thompson Project (CBT). Indeed, transactions in the CBT dwarf transactions throughout the West accounting for slightly less than one-half of all transactions in the Bren database. These transactions are quite small compared to the remainder of the West, with more than 80 percent of transactions involving 10 acre-feet or less. The largest share of transactions occurred in 1998 and 1999 on the heels of tremendous urban development in the northern corridor of Colorado's Front Range.

Transactions in the Lower Colorado River Basin

The Lower Colorado River Basin is characterized by fewer and larger transactions. Water transaction activity was most intense during the early to mid-2000s with fewer transactions recently. The average size of transactions during the last five years is smaller than those experienced in the 1990s perhaps because of a maturing water market and less development pressure. In the Lower Colorado Basin, 66 percent of transactions were sales rather than leases and fully

68 percent of transactions were urban to urban. Only 13 percent of the transactions were from agricultural to urban use.

Factors Encouraging Transfers

Subsequent analysis of transactions suggests that several key factors tend to encourage transfers within both the upper and lower basins. Transactions depend importantly on a sufficient amount of surplus in the transaction; that is, buyers must be willing to pay a sufficient sum for the transaction, sellers must be willing to accept the proffered amount, and the difference between these two must sufficiently outweigh transactions costs.

Transfers appear to be tightly correlated with urban development suggesting that buyers in rapidly developing areas tend to have a stream of investment capital with which to purchase water rights and the associated infrastructure.

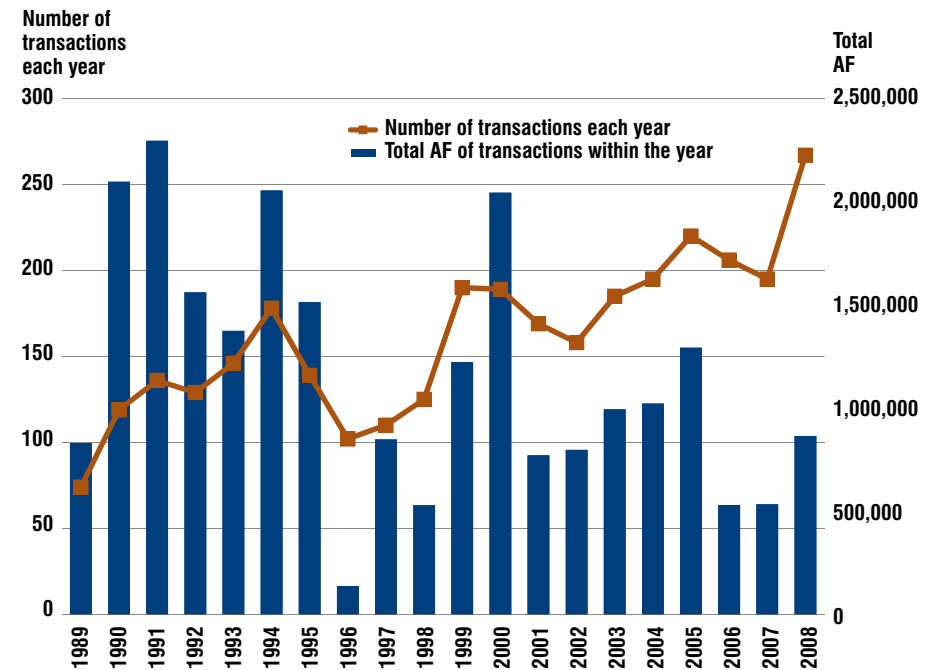
Transactions are encouraged if infrastructure exists within an active market. Likewise transactions are encouraged when a relatively simple property rights structure exists and there is a less costly legal adjudication of the water right.

Agricultural ownership of water appears to be increasingly fragmented across operations leaving a concentration of water rights in the hands of fewer, larger holders. By no accident, these producers also generate the greatest amount of sales and economic activity in the agricultural sector. Large producers are important stakeholders in discussions centered on creating water sharing opportunities between diverse interests. The urban-rural fringe may also be an area in which innovative gains might be made, in part because this is the

geographic location where transfers are most likely to occur—albeit sourcing diversions that may exist some distance away.

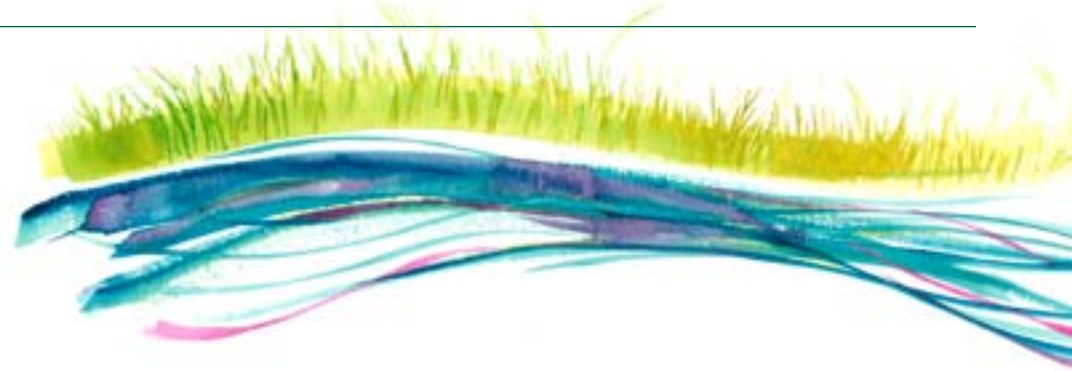
Lastly, increased water resource flexibility—whether in its physical distribution or in the legal/institutional framework in which transfers are consummated—appears to increase the frequency of transactions among interests but also reduces the size of the average transaction. More frequent transactions may be more desirable from a societal perspective as it avoids crossing a tipping point of economic activity in the area of origin for water transfers.

Number of Water Transactions and Cumulative Acre-Feet of Transactions in the Colorado River Basin States



Source: Bren Water Transfer Database 1988-2008

Next Steps



The Water Sharing Work Group advancing this initiative and the workshop participants who developed the Action Recommendations, will present this report to the Western States Water Council and the Western Governors' Association in 2011.



These dedicated water leaders from agricultural, urban and environmental sectors will continue to work together to encourage action on the part of Western Governors and others, to advance the recommendations developed in this report. They will continue to investigate ways different states in the Colorado River Basin and the West can take water sharing successes and lessons-learned from one area, and transfer them to another. A detailed comparative analysis of the numerous water sharing strategies currently in place may be encouraged for additional study. In addition, they will be working through their respective constituent groups to further the work they have begun here.

Special effort will be made to identify laws and institutions which might be modified to provide more flexibility and effectively promote water sharing, while respecting and preserving individual water rights. It is also anticipated to convene additional groups of agricultural, urban and environmental interests in communities from the Colorado River Basin and throughout the West, to provide opportunities to work together, instead of against one another, to meet multiple water use needs.

Glossary/Reference



Glossary

Definition of terms below summarized primarily from these two sources:

- Colorado Water Conservation Board's Statewide Water Supply Initiative, Phase 2, Section 3 Alternative Agricultural Water Transfer Methods to Traditional Purchase and Transfer. For more detail, see <http://cwcb.state.co.us/public-information/publications/Documents/ReportsStudies/TechnicalRoundtableReportFinalDraft.pdf> (refer to Section 3, Alternative Agricultural Water Transfer Methods to Traditional Purchase and Transfer)
- Meeting Colorado's Future Water Supply Needs: Opportunities and Challenges Associated with Potential Agricultural Water Conservation Measures, September 2008, Colorado Agricultural Water Alliance. For more detail, see <http://www.cwi.colostate.edu/publications/sr/20.pdf>.

One alternative transfer method may resemble another based on three fundamental elements: 1) the term length of an agreement, 2) which party retains ownership of the water right and 3) who or what triggers the transfer. Parties often structure arrangements in ways that encompass various methods.

Interruptible Supply Agreements may consist of temporary or long-term arrangements in which agricultural water is temporarily transferred for other purposes in other locations while irrigation is temporarily suspended. Exercising such an agreement is typically triggered on an as-needed basis and often includes dry-year needs or drought recovery.

Long-term Rotational Fallowing Programs are a type of interruptible agricultural transfer arrangement involving several agricultural parties and one or more municipal/industrial, environmental or recreational users. Each agricultural participant would agree not to irrigate a set amount of acreage for certain years out of a set period of years that could relate to the number of agricultural users or the irrigated area participating in the rotational fallowing program.

Deficit irrigation/Reduced Consumptive Use for Transfer. Transferring the portion of a water right that accrues to the stream system as return flow is generally not allowed. Only that portion of the water right used by the crop, its consumptive use, can be transferred. That portion can be made available for transfer through various methods, often called deficit irrigation, or reduced consumptive use. Various methods used include decrease in irrigated acres, choice of crops which require less water, and application of less water than is desired by the crop

for optimal yield. When such methods reduce yield, the revenue difference is presumed to be justified by revenue derived by lease of the conserved water. Split year leases are a type of deficit irrigation in which water is leased for just part of a year, usually freeing late season water for fish by farmers choosing to forego late season irrigation.

Water banks generally act as a legal mechanism to transfer water from water right owners that may not need water in a given year to water users having an annual or short-term demand versus a long-term supply need. Water banks have been applied to stored surface water, direct delivery water, and stored groundwater. They may follow a deposit/withdrawal model or a clearinghouse model. In the first form, anyone qualified may make water deposits and the bank manages water withdrawals. In the second form, the bank helps transferors and transferees find each other, using imposing standard requirements for participation.

Conjunctive use of groundwater and surface water refers to the alternative use of either source of water in various configurations to achieve optimal results and minimize negative impacts. In most places this is very difficult to achieve because of different laws applying to each type of water source.

Groundwater banking and recharge can take several forms but generally refers to the practice of storing surface water in aquifers, thereby “recharging” water lost earlier from such aquifers.

Improvements in irrigation efficiencies to produce conserved water for transfer is often thought to be an under-utilized source of agricultural water which could be made available for other uses such as urban demand or environmental needs. However, except for places where the return flow would otherwise not accrue to other water rights holders (as would be the case when return flows find their way to the ocean) irrigation efficiencies can reduce diversions but not consumptive use, the transferrable part. This issue is quite complex and deserves additional research.

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Agricultural/Urban/Environmental Water Sharing: Innovative Strategies for the Colorado River Basin and the West

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