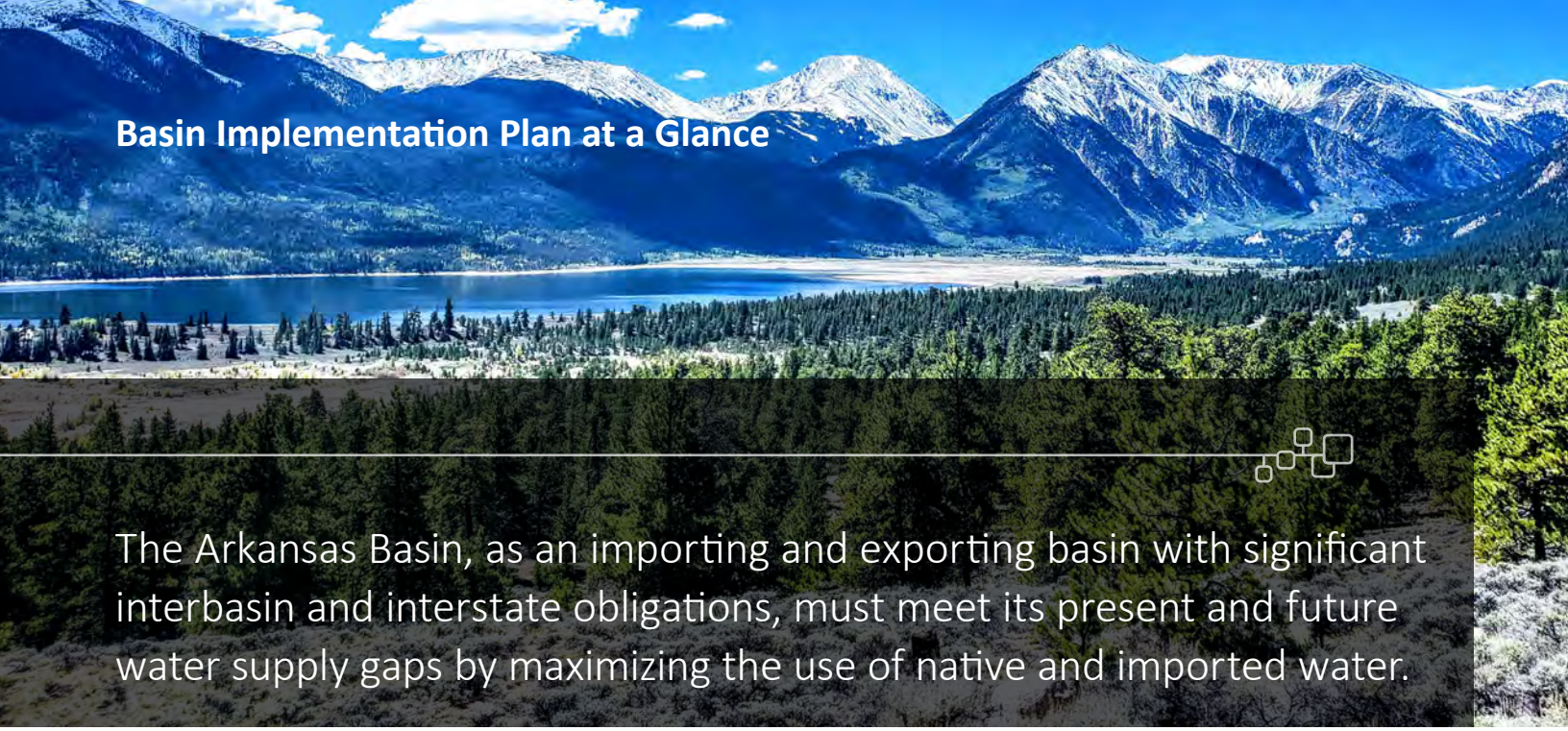
VOLUME 1 • JANUARY 2022

ARKANSAS

Basin Implementation Plan



Basin Implementation Plan at a Glance

The Arkansas Basin, as an importing and exporting basin with significant interbasin and interstate obligations, must meet its present and future water supply gaps by maximizing the use of native and imported water.

KEY ACHIEVEMENTS

Project successes helped local communities while improving local water resources and the environment.

Successes include:

- Arkansas River Watershed Collaborative
- Monarch Pass Forest and Watershed Health Project
- John Martin Reservoir Permanent Conservation Pool
- Arkansas River Homestake Diversion Rehabilitation
- Arkansas Lease-Fallowing Tool

CHALLENGES

Challenges center around consumptive water needs of agriculture and growing communities and nonconsumptive water needs to maintain river flows.

Challenges include:

- Over-appropriated water supply basin
- Complex hydrology and extreme hydrologic conditions
- Complicated administration and Compact compliance
- Declining levels of groundwater
- Reliance on imported supplies

OUTREACH STRATEGIES

The PEPO Workgroup in the Arkansas Basin is unique in structure and vision. The workgroup provides education and outreach to citizens about local water resources topics and issues and provides a platform for water-related dialogue. The PEPO Workgroup works in partnership with and provides a line of communication among the IBCC, CWCB, ABRT, ARBWF, and the public that they serve.

GOALS + OBJECTIVES

The basin has

18 GOALS

centered around:

- ✓ **Critical water storage**
- ✓ **Maximizing water use**
- ✓ **Maintaining existing water uses**

The 18 goals include actions to support storage, municipal/ industrial, agricultural, environmental/ recreational, and watershed needs.

DEMAND, SUPPLY, POTENTIAL WATER NEEDS

Municipal and Industrial:
Between the years 2015 and 2050, the basin population is projected to grow between 45 percent and 61 percent, which will drive increased diversion demand for M&I purposes. Maintaining transmountain diversion supply is critical to meeting M&I needs.

Environment and Recreation:
The Flow Tool fostered an improved understanding of potential streamflow-related risks (both existing and projected) to E&R attributes in the upper region of the Arkansas Basin. Flow Tool results indicated that projected changes in climate will put E&R projected flows, ecology, and attributes at risk.

Agriculture:
Several planning scenarios projected less agricultural demand than the current demand, mainly due to reduced irrigated acres and resulting decreased irrigation water requirement due to urbanization, transfers of agricultural water rights to municipal uses, and declining aquifer levels in the Southern High Plains. However, remaining irrigated acres may experience higher irrigation water requirements per acre as a result of climate change.

STRATEGIC VISION

Key strategies provide a roadmap for meeting basin goals.

These strategies include:

- **Supporting project implementation**
- **Supporting collaboration and partnerships**
- **Targeting funding to meet the Arkansas Basin's goals**
- **Maximizing economic impact of dollars spent**
- **Performing a vulnerability assessment**

FUTURE PROJECTS

More than
$3.5 billion
total estimated costs for project implementation*

361 **Total Projects**

27 **Tier 1 Projects**

265 **Multi-purpose Projects**

119 **Projects meet agricultural needs**

180 **Projects meet environmental and recreational needs**

140 **Projects meet municipal needs**

54 **Projects meet storage needs**

** Total cost based on projects that provided cost information. Future basin projects include both consumptive and nonconsumptive projects that span all sectors of water use in the basin and are at various levels of development from conceptual to implementing.*

List of Arkansas BRT Members

This page recognizes the contributions of Arkansas BRT members.

- **Mark Shea –** *Chair*
- **Mike Fink –** *Secretary*
- **Tim Canterbury –** *At-large Rep Water Rights Holder*
- **Kevin Niles –** *At-large Rep Water Rights Holder*
- **Bob Hamel –** *Vice Chair Nonconsumptive*
- **Karen Salapich –** *At-large Representative*
- **Nick Koch –** *At-large Representative*
- **Matt Heimerich –** *Vice Chair Consumptive*
- **Amber Shanklin –** *At-large Environmental Representative*
- **Paul Fanning –** *Legislative Appointment*
- **Spike Ausmus –** *Baca County*
- **Shiloh Freed –** *Baca Municipal*
- **Mike Weber –** *Bent County*
- **Jeris Danielson –** *Bent Municipal*
- **Jay Moore –** *Chaffee Municipal*
- **Toby Johnson –** *Cheyenne County*
- **Rick Kidd –** *Crowley County*
- **Tracy Pepper –** *Crowley Municipal*
- **Keith Hood –** *Custer County*
- **Greg Felt –** *CWCB Board Member*
- **Sam Stein –** *CWCB Liaison*
- **Abby Ortega –** *El Paso Municipal*
- **Bob Ware –** *Elbert County*
- **Bill Banks –** *Fountain Creek WGFCD*
- **Dwayne McFall –** *Fremont County*
- **Mannie Colon –** *Fremont Municipal*
- **Sandy White –** *Huerfano County*
- **Scott King –** *Huerfano County Water Conservancy District*
- **Al Tucker –** *Huerfano Municipal*
- **Bob Hartzman –** *At-large Industrial Representative*
- **Dan Richards –** *Kiowa County*
- **Sarah Mudge –** *Lake County*
- **Greg Teter –** *Lake Municipal*
- **Tom Verquer –** *Las Animas County*
- **Gil Ramirez –** *Las Animas Municipal*
- **Rego Omergic –** *At-large Local Domestic Water Provider*
- **Brett Dougherty –** *North La Junta Water Conservancy District*
- **Amber Weber –** *Otero County*
- **Tom Seaba –** *Otero Municipal*
- **Tom Grasmick –** *Prowers County*
- **Ron Cook –** *Prowers Municipal*
- **Bud O'Hara –** *Pueblo Conservancy District*
- **Terry Hart –** *Pueblo County*
- **Seth Clayton –** *Pueblo Municipal*
- **Steve Kastner –** *Purgatoire River Water Conservancy District*
- **Gracy Goodwin –** *Saguache County*
- **Jim Broderick –** *SE CO Water Conservancy District*
- **Dan Williams –** *Teller County*
- **Terry Scanga –** *Upper Arkansas Water Conservancy District*
- **Bob Slagle –** *Upper South Platte Water Conservancy*
- **Kent Ricken –** *At-large Water Rights Holders*
- **Carol Ekarius –** *Arkansas River Watershed Collaborative*

Photo by: Rachel Zancanella, DWR

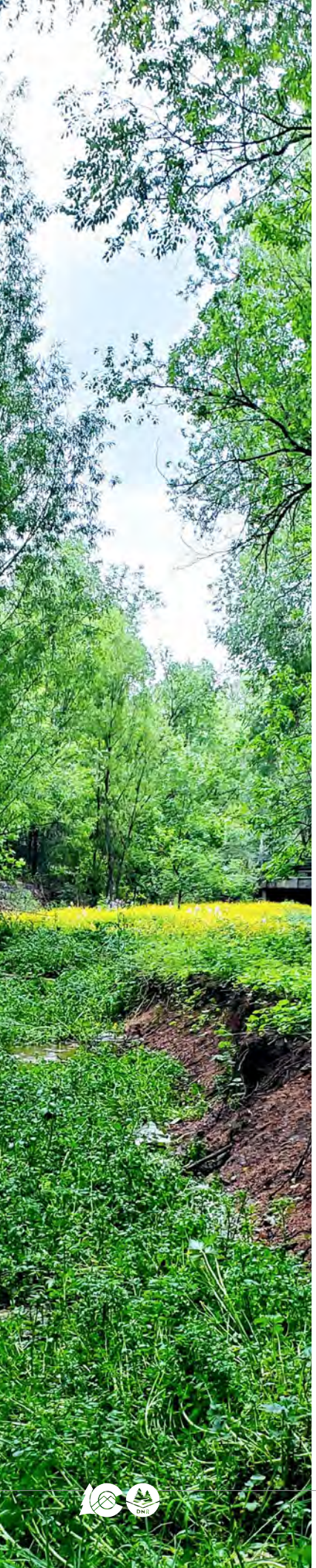


Table of Contents

DISCLAIMER

The Analysis and Technical Update to the Colorado Water Plan and the Basin Implementation Plan (BIP) provide technical data and information regarding Colorado's and the basin's water resources. The technical data and information generated are intended to help inform decision making and planning regarding water resources at a statewide or basinwide planning level. The information made available is not intended to replace projections or analyses prepared by local entities for specific project or planning purposes.

The Colorado Water Conservation Board (CWCB) and basin roundtables intend for the Technical Update and the BIP to help promote and facilitate a better understanding of water supply and demand considerations; however, the datasets provided are from a snapshot in time and cannot reflect actual or exact conditions in any given basin or the State at any given time. While the Technical Update and BIP strive to reflect the CWCB's best estimates of future water supply and demands under various scenarios, the reliability of these estimates is affected by the availability and reliability of data and the current capabilities of data evaluation. Moreover, the Technical Update and BIP cannot incorporate the varied and complex legal and policy considerations that may be relevant and applicable to any particular basin or project; therefore, nothing in the Technical Update, BIP, the associated Flow Tool, or Costing Tool is intended for use in any administrative, judicial, or other proceeding to evince or otherwise reflect the State of Colorado's or the CWCB's legal interpretations of state or federal law.

Furthermore, nothing in the Technical Update, BIP, Flow Tool, Costing Tool, or any subsequent reports generated from these datasets is intended to, nor should be construed so as to interpret, diminish, or modify the rights, authorities, or obligations of the State of Colorado or the CWCB under state law, federal law, administrative rule, regulation, guideline, or other administrative provision.

What is the Basin Implementation Plan?

The Basin Implementation Plan (BIP), developed in a collaborative process by basin stakeholders, focuses on the current and future water needs in the Arkansas Basin, the vision for how individuals and organizations can meet future needs, and the goals and projects that provide a pathway to success. The initial Arkansas BIP was completed in 2015, and this is the first update of that plan.

THE ARKANSAS BASIN IMPLEMENTATION PLAN CONSISTS OF TWO VOLUMES:	
VOLUME 1:	A summary of the Arkansas Basin and its current/future water resources, focusing on goals and strategies to meet its future water needs.
VOLUME 2:	An overview of basin water resources, operations, and administration, including unique constraints and opportunities for water resources planning efforts. Additional details on the information provided in Volume 1, including specifics on technical analyses and project data, are also provided.

Section 1. Basin Overview

The Arkansas River is a major tributary to the Mississippi River, with its headwaters in the Rocky Mountains starting at an elevation of 14,000 feet. The river enters the Great Plains just past Pueblo, Colorado, and continues eastward into Kansas at an elevation of 3,340 feet. The Upper Arkansas River (from the headwaters through Big Horn Canyon) supports significant tourism and recreation. The Middle Arkansas River Valley—which includes the City of Pueblo and Pueblo County, along with the Fountain Creek Basin, the City of Colorado Springs, and El Paso County—comprises the largest urban area. In the Lower Valley below Pueblo, the Arkansas River supports significant agriculture, primarily fodder crops and row crops such as pumpkins, squash, and melon fruits for human consumption. In the Huerfano and Purgatoire River Basins, there is a mix of agriculture, mining, and tourism.

The Arkansas Basin is the largest basin in Colorado, spanning more than 28,000 square miles across the southeast region of Colorado. Grasslands and forest dominate the lands of the Arkansas Basin; grassland covers approximately 67 percent of the basin, primarily in the eastern portion, while forests cover the western region, which lies in the Rocky Mountains. In addition to agriculture, recreation, and natural landscapes, the Arkansas Basin supplies water to approximately 1 million people.

Limited water supplies in all areas of the Arkansas Basin, declining groundwater levels in the nontributary Denver Basin formations and designated groundwater basins, extended droughts, land use planning, growing demand, and economic changes have resulted in competing interests for water use. Rural water users are concerned over agricultural transfers and the impact water availability has on rural communities and agricultural productivity. Concurrently, growth in the Upper Arkansas Basin presents challenges to meeting municipal, industrial, and recreational demands. As a result of the current demand, there is little or no water available for new uses.

In addition to supporting its own demands, water from the Arkansas River flows through Kansas, Oklahoma, and Arkansas before its confluence with the Mississippi River. Along its course, it irrigates millions of acres of cropland and supports significant industry and shipping. The Arkansas River Compact of 1948 (Compact), also known as the Kansas-Colorado Compact, apportions the waters of the Arkansas River between Colorado and Kansas while providing for the operation of John Martin Reservoir.

AGRICULTURE

- The Arkansas Basin is spatially the largest river basin in Colorado, covering slightly less than one-third of the state's land area. Agriculture remains the primary user of water when measured by volume diverted. Producers irrigate more than 737,000 acres in the Arkansas Basin, and nearly half of these acres are located along the river between Pueblo Reservoir and the state line.

WATERSHED

- A 102-mile reach of the Upper Arkansas River is designated as a Gold Medal fishery. The reach is the longest Gold Medal water in the state and embodies approximately 50 percent of the total Gold Medal stream miles in Colorado.
- The Arkansas River is the most-rafted river in the world. The Arkansas River Flow Management Program provides a benchmark for cooperative integration of municipal, agricultural, and recreational solutions in support of recreational boating and a Gold Medal fishery. Browns Canyon, located along the Arkansas River, is the most popular whitewater rafting destination in the United States.

MUNICIPAL AND INDUSTRIAL

- The Arkansas Basin includes about 19 percent of the state's population, and water from the Arkansas Basin serves three of the fastest growing municipalities in the state—Colorado Springs, Pueblo, and Aurora (in the South Platte Basin). Between the years 2015 and 2050, the Arkansas Basin is projected to grow from approximately 1 million to between 1.46 million and 1.63 million people in the low–and high-growth projections, respectively, which is an increase in population of 45 percent to 61 percent.
- Municipal use in the Arkansas Basin is significantly supported by water from the Colorado River Basin. The ability to use and re-use transbasin water as part of achieving maximum beneficial use is a critical component of municipal and industrial supply and contributes important benefits to agriculture, environmental, and recreation uses as well.

COMPACTS AND ADMINISTRATION

- The Arkansas River Compact of 1948 apportions the waters of the Arkansas River between Colorado and Kansas, while providing for the operation of John Martin Reservoir. The primary tool for administering the Arkansas River Compact is the 1980 Operating Principles.
- The Colorado Division of Water Resources (DWR) developed well administration rules to ensure Colorado complies with the Compact, including Irrigation Improvement Rules that require augmentation for any upgrades to water delivery systems, such as drip irrigation or sprinkler systems.
- Water in the Arkansas Basin is used multiple times for all purposes—all uses are fundamentally related and codependent, meaning changes to one use will have impacts on others.

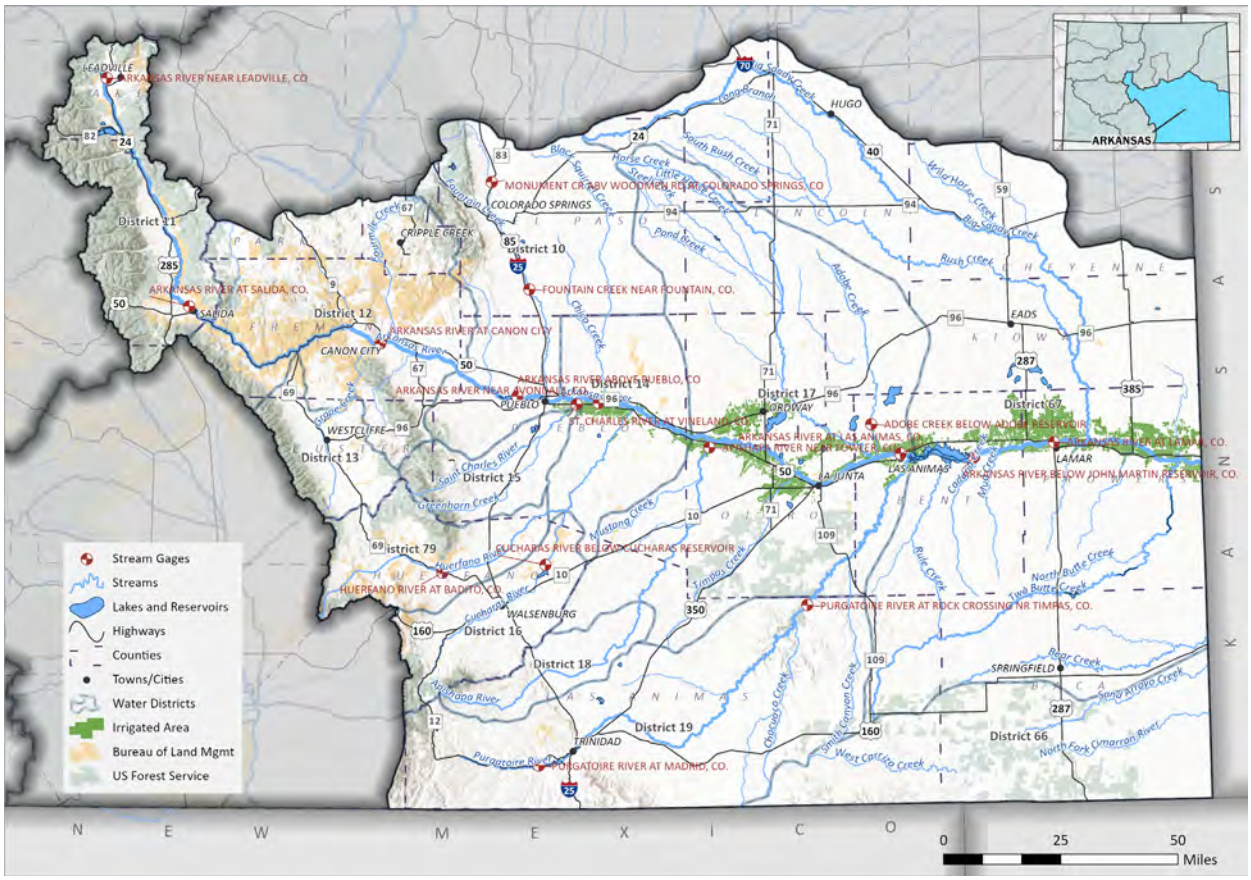


Figure 1. Arkansas Basin Map

Section 2. Basin Challenges

The Arkansas Basin faces several challenges pertaining to consumptive water needs of agriculture and growing communities and the nonconsumptive water needs to maintain flows in rivers. Colorado is unique in that it recognizes tributary groundwater and surface water together in its water allocation system, which poses unique challenges in a water-short basin. Other challenges include operating under the unique constraints of the Compact and the challenges inherent in the extremes of hydrologic conditions from year to year.

KEY CHALLENGES

- **Water-short basin**
- **Complex hydrology and extreme hydrologic conditions**
- **Complicated water rights administration**
- **Declining groundwater levels**
- **Increased demand for augmentation water**
- **Reliance on imported supplies**

Table 1. Key Future Water Management Issues and Challenges in the Arkansas Basin




AGRICULTURE	WATERSHED	MUNICIPAL AND INDUSTRIAL	COMPACTS AND ADMINISTRATION
• Concerns over permanent agricultural transfers and the effects on rural economies are substantial in the lower portion of the Arkansas Basin downstream of Pueblo Reservoir. • Collaborative solutions such as the Super Ditch and alternative transfer methods pilot projects, while difficult to design and decree, are necessary to forestall or minimize loss of irrigated acreage in agriculture.	• Concerns over water quality span protection of aquatic species in the Upper Basin to improving drinking water in the Lower Basin. • Careful management of the environmental and recreational demands that are expected to increase with population growth, given that environmental and recreational demands depend on transbasin supplies, municipal storage, and agricultural demands. • Managing impacts of fires and floods on an increasing frequency and spatial scale.	• Replacement of municipal water supplies that depend on the non-renewable Denver Basin aquifers and declining water levels in designated basins is becoming critical, exacerbated by continued growth in groundwater-dependent urban areas. • Rural areas within the Arkansas Basin have identified water needs but face challenges in marshalling resources to identify and implement solutions.	• All uses not in priority must be augmented through a decreed plan of augmentation to prevent injury to senior water rights and the Compact. Increasing irrigation efficiency, i.e., conversion from flood to center-pivot irrigation for labor and cost savings, will require 30,000 acre-feet (AF) to 50,000 AF of augmentation water in the coming years. • The Arkansas River Compact creates complexity in water rights administration.

CROSS-SECTOR CHALLENGES

- The majority of surface storage reservoirs in the Arkansas Basin were constructed between 1890 and 1930. Many of these facilities need repair or restoration.
- Agricultural water interests have faced encroachment by municipal demands, while environmental and recreational water demands have increased significantly.
- Water management is challenged by extreme or uncertain conditions, influenced by the over-appropriated water supply, reliance on imported water, complex hydrology and water administration, and extreme hydrologic conditions. Maintaining imported water supplies that are increasingly at risk is critical to meeting future demand.

Section 3. Achievements

The Arkansas Basin Roundtable (BRT) has been engaged in a wide variety of projects and activities since the Arkansas BIP was issued in 2015. The ongoing and completed projects have achieved results that further the goals of the Arkansas BRT and provide numerous benefits to agricultural, environmental, recreational, and municipal water users. The following projects are highlighted achievements in the basin, in no particular order.

Arkansas River Watershed Collaborative

The Arkansas River Watershed Collaborative (ARWC) is a community-generated response to wildfire and its effects on water and communities. ARWC was conceived in the Arkansas Basin's 2015 BIP, was formed from the Arkansas BRT in 2017, and is supported by the Colorado Water Conservation Board (CWCB), which promotes local watershed coalitions like ARWC as the most effective way for communities to prepare for and respond to watershed health concerns. ARWC is the nonprofit organization for the Arkansas BRT, and Arkansas BRT members serve as its Board of Directors. ARWC's work includes forest health and wildfire fuels mitigation, post-fire and flood recovery, stream management planning, water quality protection, stream restoration, collaborative development, and stakeholder engagement.

PROJECT PROPONENTS:
Arkansas BRT

TIMELINE: 2017–Present

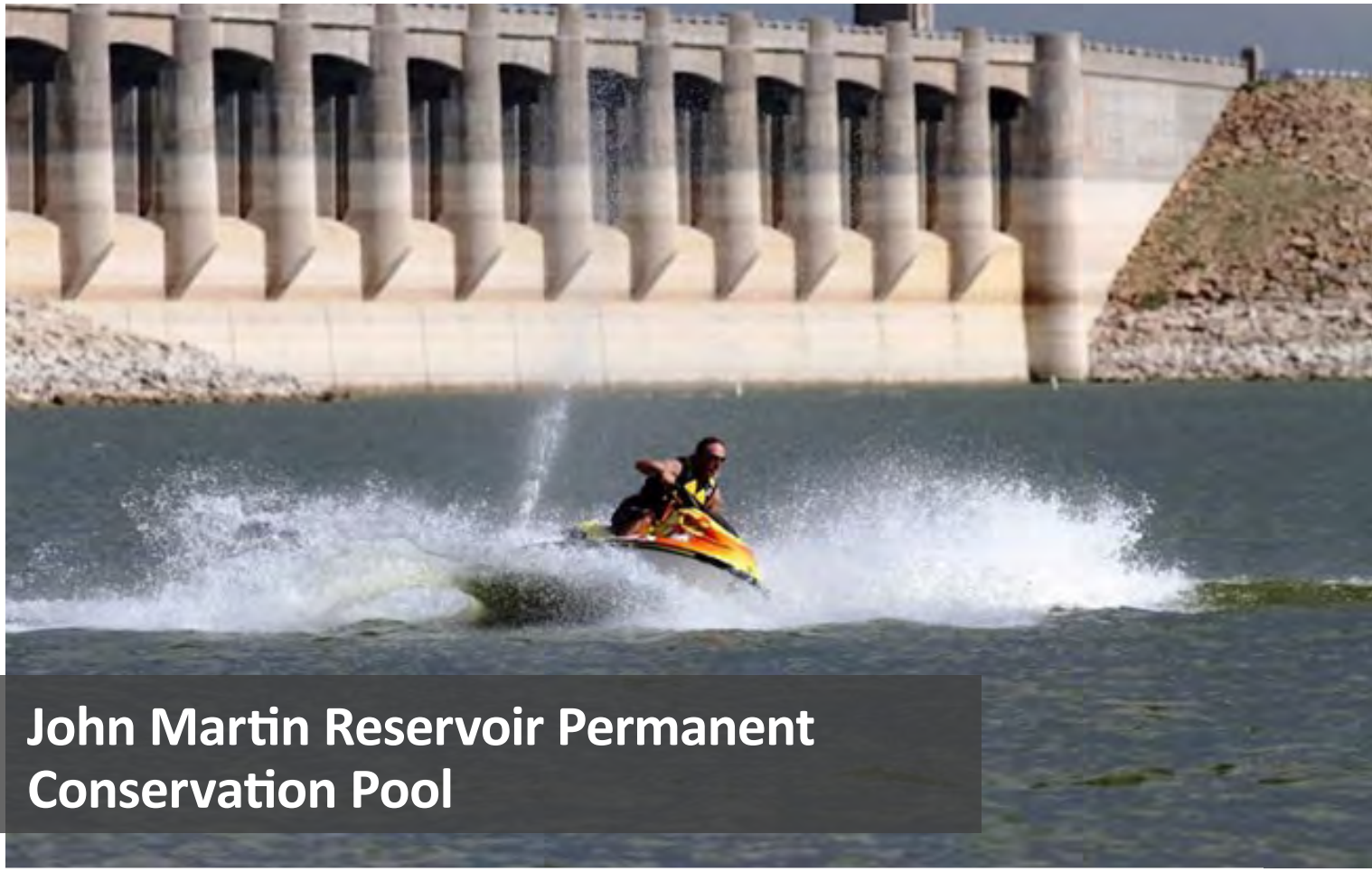
Monarch Pass Forest and Watershed Health Project

New logging technology to remove beetle-kill trees improves forest health. Led by the U.S. Forest Service, Upper Arkansas Water Conservancy District and the ARWC, the Monarch Pass Project is the first in Colorado to employ cut-to-length machinery, which provides a less-expensive, less-damaging alternative to traditional methods of logging on steep slopes. This project also pilots the use of steep-slope, tethered harvesting equipment, which is meant to facilitate forest management projects on steep terrain adjacent to high-value water sources of supply and storage reservoirs. The goals of the project were many, including reducing beetle infestation, improving forest resiliency, reducing fuel loading to minimize the potential for and impacts of wildfire, providing for firefighter and public safety, improving watershed health, protecting infrastructure (including power transmission lines), and improving aquatic ecosystem health. ARWC secured more than $600,000 in matching funds for the project from multiple partners, including the CWCB, the Upper Arkansas Water Conservancy District, Chaffee County, the City of Salida, the Town of Poncha Springs, the Town of Buena Vista, the Pueblo Board of Water Works, Colorado Springs Utilities, and Trout Unlimited. These funds were leveraged to obtain $900,000 in Forest Service funding.

PROJECT PROPONENTS:
U.S. Forest Service, Upper Arkansas Water Conservancy District, and ARWC

TIMELINE: Start 2019, Completion 2022

COST: $1.5 million



John Martin Reservoir Permanent Conservation Pool

Project produces long-sought compromise to maintain a permanent pool for fishery and recreation purposes. This agreement among members of the Compact administration will allow the Lower Arkansas Water Management Association (LAWMA) to transfer water from the Highland Canal on the Purgatoire River in Bent County into John Martin Reservoir on behalf of Colorado Parks and Wildlife (CPW) to maintain a permanent pool for fishery and recreation purposes. Significant benefits include reducing the amount of money CPW must spend to lease Colorado River water to fill the conservation pool; a lower risk of fish loss, saving CPW approximately $165,000 annually in restocking costs when the fishery is damaged; and providing more consistent boating recreation, especially in drought years.

PROJECT PROPONENTS:
CPW, LAWMA, Colorado DWR, CWCB, and Colorado Attorney General

TIMELINE: Start 2017, Completion February 2019

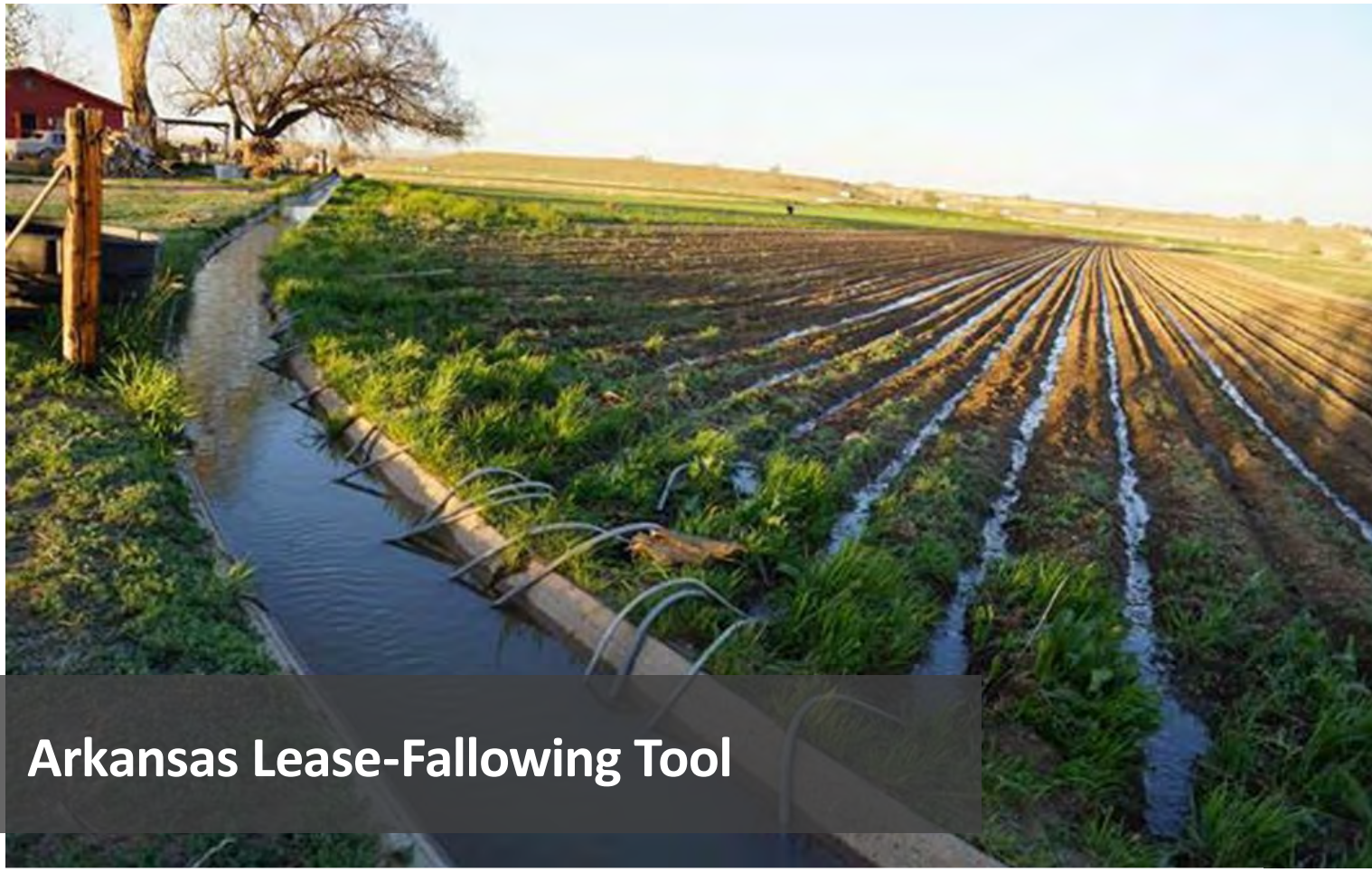
Arkansas River Homestake Diversion Rehabilitation

Colorado Springs and Aurora collaborate with environment and recreation (E&R) interests for infrastructure upgrade. Aurora and Colorado Springs replaced the 1964 Homestake Project diversion on the Arkansas River below Granite with a fish ladder, a spillway for flood-level flows, and a boat chute that allows raft passage. The $9.1 million project allows rafts to safely navigate the entire Arkansas River from Leadville to Cañon City for the first time since the mid-1960s. Water managers from the two cities were joined by the CWCB, the Pueblo Board of Water Works, CPW, and the Arkansas Headwaters Recreation Area in rebuilding the diversion.

PROJECT PROPONENTS:
Cities of Colorado Springs and Aurora

TIMELINE: Start 2019, Completion 2019

COST: $9.1 million



Arkansas Lease-Fallowing Tool

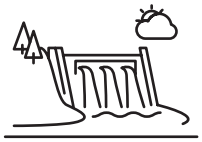
New tool helps streamline temporary water transfers. Lease fallowing is the temporary transfer of water from irrigation to another use, such as municipal use, that keeps the water rights intact while at the same time providing important water supply to municipalities when needed. The Lease Fallow Tool (LFT) was developed as part of Colorado's Decision Support System (CDSS) to simplify and streamline the evaluation of historical consumptive use, depletions, and return flows from irrigation. The LFT is required to evaluate lease-fallowing pilot projects falling under Colorado House Bill 13-1248 using conservative evapotranspiration (ET) measures but can also be used with more accurate ET datasets. Historically, these engineering calculations are an expensive and time-intensive component of water court change cases. Now, with the LFT, the high costs associated with temporary changes of water rights are reduced.

PROJECT PROPONENTS:
CWCB, DWR, Upper Arkansas Water Conservancy District

TIMELINE: Start 2013, Completion 2016

Section 4. Updated Goals and Objectives

The Arkansas BRT was purposefully organized by the Colorado General Assembly to reflect equal representation of the Arkansas Basin geography while providing specific voices for the sectors of water uses. Through a collaborative process, the Arkansas BRT identified its membership's goals and their associated actions. The region's primary stakeholders helped form the goals for the Arkansas Basin, which are categorized as:



Storage

Municipal and Industrial

Agriculture

Environmental and Recreational

Watershed Health

Over time, some of the goals for the Arkansas Basin have shifted and been redirected, while others have stayed consistent or have been refined. An overview of basin goals is provided below by categorized use; a more detailed description of each goal and its associated actions follows.

BASIN GOALS

STORAGE GOALS

- **Continue to develop storage opportunities to support Arkansas Basin needs**
- **Develop alluvial and designated basin aquifer storage in gap areas**
- **Promote multiple uses at existing and new storage facilities**

MUNICIPAL AND INDUSTRIAL GOALS

- **Meet the projected municipal supply gap in each Arkansas Basin subregion**
- **Support regional efforts for cost-effective solutions to local water supply gaps**
- **Reduce municipal users' groundwater dependence on unsustainable aquifers**
- **Develop collaborative solutions among municipal, agricultural, and E&R users of water, particularly in drought conditions**

BASIN GOALS

AGRICULTURE GOALS

- **Support projects within and outside the Arkansas Basin that will help meet the basin's agriculture water supply gap, maintain existing supplies, better manage vulnerable supplies, and maximize use of water users' entitlements**
- **Sustain a productive agricultural economy in the Arkansas Basin that sustains viable rural, agricultural-based communities**
- **Provide augmentation water as needed to support increased farm efficiencies**
- **Support the development of viable alternate transfer methods (ATM)/ water-sharing projects between agriculture and municipal interests to mitigate the impacts of drought, provide risk management for agriculture and municipal interests, and facilitate responsible and sustainable water-sharing arrangements**
- **Sustain recreational and environmental activities that depend on habitat and open space associated with farm and ranch land**

ENVIRONMENT & RECREATION GOALS

- **Support projects and programs within and outside the Arkansas Basin that protect E&R water supply needs, and collaborate with municipal and ag users to enhance E&R values**
- **Maintain or improve native fish populations, restore habitat for fish species, and maintain or improve recreational fishing opportunities**
- **Maintain or improve boating opportunities, including rafting, kayaking, and other non-motorized and motorized boating**
- **Maintain or improve aquatic, riparian, and avian habitat (including wetlands) that would support environmental features and recreational opportunities**

WATERSHED HEALTH GOALS

- **Maintain, improve, or restore critical water supply watersheds that could affect Arkansas Basin water uses and E&R values**
- **Improve water quality as it relates to the environment and/or recreation**

STORAGE GOALS

S1 Continue to develop storage opportunities to support Arkansas Basin needs

The Arkansas BRT acknowledges that increasing available storage and preserving existing storage are critical to the future of the Arkansas Basin. Specific actions to support this goal include:

- Supporting new storage, both within and outside the Arkansas Basin, to help meet the basin's water supply gap, mitigate water supply risks, optimize water resources, and provide multi-purpose benefits.
- Working with the State Engineers Office of Dam Safety to identify storage facilities that can be renovated due to aging infrastructure, restored due to loss of storage from sedimentation or fill restrictions, or enhanced for additional storage.
- Supporting funding, including grant contributions where appropriate, for storage restoration and expansion projects.
- Investigating storage needs on a subregional basis and aligning with planned projects.
- Protecting the ability to store water imported from other basins into the Arkansas Basin.
- Promoting more flexible ways to store fully consumable water.

S2 Develop alluvial and designated basin aquifer storage in gap areas

Groundwater resources are a critical source of supply in several parts of the Arkansas Basin, and the Arkansas BRT recognizes natural storage in aquifers as a potential water management solution. Specific actions include:

- Quantifying alluvial storage opportunities in the subregions of the Arkansas Basin —Upper Ark, Huerfano/Purgatoire, Fountain Creek, and Lower Ark—beginning with locations identified in the Analysis and Technical Update to the Colorado Water Plan (Technical Update) storage memo.
- Developing a feasibility study and action plan for aquifer storage that focuses on the needs and opportunities in different subregions, differentiating between "holding" storage and "recharge" storage.

S3 Promote multiple uses at existing and new storage facilities

Storage facilities can provide unique benefits to the watershed, and careful planning can support multiple uses. The Arkansas BRT recognizes this opportunity and supports this goal with the following actions:

- Supporting rehabilitation efforts with grant funds, especially if the project includes environmental and recreational attributes.
- Engaging CPW and other stakeholders in project discussions.
- Working with stakeholders in the Arkansas Basin to identify and encourage opportunities to create storage for multiple purposes and participants.
- Support State of Colorado efforts to obtain an "if and when" storage account in John Martin Reservoir.

Photo by: Rachel Zancanella, DWR

MUNICIPAL & INDUSTRIAL GOALS

M1 Meet the projected municipal supply gap in each Arkansas Basin subregion

Meeting supply gaps is foundational to the Arkansas BRT's mission. While new sources of supply are not available in the Arkansas Basin, the Arkansas BRT can support water management and planning efforts throughout the basin to help meet future supply challenges. Critical actions include:

- Characterizing current water supplies and future supply vulnerabilities by subregion.
- Supporting projects within and outside the Arkansas Basin that will help meet the M&I water supply gap, maintain existing supplies, better manage vulnerable supplies, and maximize use of water users' entitlements.
- Supporting reasonable efforts to prevent Arkansas Basin water being exported.

M2 Support regional efforts for cost-effective solutions to local water supply gaps

Supporting smaller communities with fewer planning resources is an important mission of the Arkansas BRT and helps fulfill statutory direction to "encourage locally driven collaborative solutions to water supply problems." CRS 37-75-104(1)(a) . Actions to help these communities close their future supply gaps include:

- Providing the opportunity to build partnerships to support the ability of all Arkansas Basin communities—especially small rural communities—to pursue projects and address infrastructure challenges.
- Supporting projects that increase the efficient use of current supplies and the ability to move water to where it is needed.

M3 Reduce municipal users' groundwater dependence on unsustainable aquifers

While groundwater storage is an important asset in the Arkansas Basin, certain aquifers do not provide a sustainable water supply for the future. The Arkansas BRT can assist communities that depend on these unsustainable aquifers by:

- Promoting tools to help manage groundwater resources.
- Characterizing groundwater supply vulnerabilities in the future with respect to both quantity and quality.
- Developing strategies to address groundwater vulnerabilities, including identifying emergency supplies.

M4 Develop collaborative solutions among municipal, agricultural, and E&R users of water, particularly in drought conditions

As future water supplies are reduced through drought or climate change, the Arkansas BRT can provide a collaborative forum for discussion and for developing solutions across all water use sectors. Specific actions include:

- Recognizing the relationship with agriculture goals and renewing the focus on broadening partnerships.
- Documenting lessons learned from existing Arkansas Basin ATM/water-sharing projects and providing recommendations on programmatic elements for water-sharing success.

AGRICULTURE GOALS

A1 Support projects within and outside the Arkansas Basin that will help meet the basin's agriculture water supply gap, maintain existing supplies, better manage vulnerable supplies, and maximize use of water users' entitlements

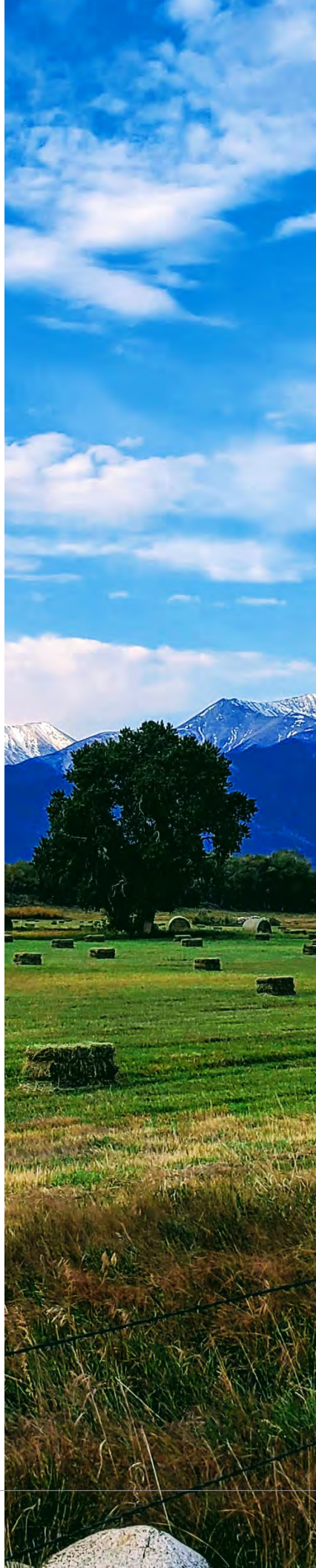
The Arkansas BRT's ability to fund projects can provide opportunities for new projects that aim to reduce the agricultural supply gap. Funding can prioritize those projects that:

- Maintain existing supplies
- Better manage vulnerable supplies
- Maximize use of water users' entitlements

A2 Sustain a productive agricultural economy in the Arkansas Basin that sustains viable rural, agricultural-based communities

At the heart of supporting agriculture is the need to sustain communities that rely on agriculture to survive, many of which exist in the Arkansas Basin. The Arkansas BRT views keeping water in agriculture as critical to its overall mission and has identified specific actions to support this goal:

- Quantifying economic potential/vulnerabilities under the five planning scenarios that reflect plausible alternative Arkansas Basin future conditions for the year 2050 and drivers associated with water demands, supplies, and additional water, as further discussed in Section 5.
- Supporting efforts that maximize productivity while making the most efficient use of agricultural water supplies.



A3 Provide augmentation water as needed to support increased farm efficiencies

With the reliance of agricultural producers on alluvial groundwater supplies, the need for augmentation water continues to increase. The Arkansas BRT can support this need by:

- Supporting augmentation projects that are necessary to allow for increased efficiencies (e.g., transition to sprinklers, canal and reservoir linings, smaller storage at key locations).
- Helping establish long-term sources of augmentation water and ending reliance on municipal excesses and year-to-year leases.

A4 Support the development of viable alternate transfer methods (ATM)/water-sharing projects between agriculture and municipal interests to mitigate the impacts of drought, provide risk management for agriculture and municipal interests, and facilitate responsible and sustainable water-sharing arrangements

Realizing that future water management may include water-sharing partnerships during times of shortage, the Arkansas BRT supports the formation of a committee to research and discuss lessons learned from existing projects and to make recommendations for future projects. The purpose of these projects will be to:

- Mitigate the impacts of drought.
- Provide risk management for agriculture and municipal interests.
- Facilitate responsible and sustainable water sharing arrangements.

A5 Sustain recreational and environmental activities that depend on habitat and open space associated with farm and ranch land

Similar to storage facilities, agricultural lands can provide unique benefits to the watershed. The Arkansas BRT can promote these benefits by:

- Quantifying the value agricultural lands provide as wildlife habitat and for recreation.
- Looking at current multi-purpose projects and identifying successful strategies that support both agriculture and E&R values.

ENVIRONMENT & RECREATION GOALS

ER1 Support projects and programs within and outside the Arkansas Basin that protect E&R water supply needs, and collaborate with municipal and ag users to enhance E&R values

The Arkansas BRT has the ability to bring E&R stakeholders together to collaborate with municipal and agricultural users to enhance E&R values. The BRT can support mitigation of risks to E&R values related to potential future reductions of imported water supplies by supporting projects and developing partnerships with this goal in mind.

ER2 Maintain or improve native fish populations, restore habitat for fish species, and maintain or improve recreational fishing opportunities

Through its project funding mechanisms, the Arkansas BRT can:

- Continue to support the preservation of native fish species.
- Continue to support the Voluntary Flow Management Program (VFMP) and support program refinement for fisheries.
- Support and help maintain the Arkansas River's Gold Medal status.
- Support collaborative stream management plans in high-priority watersheds.
- Support the maintenance of current access areas for fishing to protect riparian habitat and help identify opportunities for additional public access to fishing areas.

ER3 Maintain or improve boating opportunities, including rafting, kayaking, and other non-motorized and motorized boating

Supporting recreational uses of water in the Arkansas Basin has long been a goal of the Arkansas BRT. Specific actions include:

- Continuing to support and refine the VFMP for instream boating, including stream gaging and forecasting technology.
- Supporting the maintenance of current access areas for boating, including maintenance efforts that enhance safety.
- Helping identify opportunities for additional public access to instream and flatwater boating areas.

ER4 Maintain or improve aquatic, riparian, and avian habitat (including wetlands) that would support environmental features and recreational opportunities

Habitat protection is critical to supporting E&R attributes. The Arkansas BRT commits to supporting this goal by:

- Considering the opportunities to enhance E&R values and looking for multiple benefits for all agricultural and M&I projects.
- Supporting the maintenance, improvement, and/or restoration of these habitats.
- Monitoring the provision of water to the John Martin Reservoir wetlands.
- Supporting the maintenance, improvement, and/or restoration of wetlands throughout the Arkansas Basin.

Photo by: Rachel Zancanella, DWR

WATERSHED HEALTH GOALS

W1 Maintain, improve, or restore critical water supply watersheds that could affect Arkansas Basin water uses and E&R values

Protecting watersheds is protecting water supply, and the Arkansas BRT has identified the following actions to support this goal:

- Identifying "at-risk" watersheds with important E&R attributes and/or critical water supply values and promoting proactive wildfire risk reduction through forest health protection and improvement activities in those watersheds.
- Promoting watershed health and water quality as shared values to all Arkansas Basin water users.
- Collaborating with ARWC to define strategies and projects to protect watersheds.

W2 Improve water quality as it relates to the environment and/or recreation

Recognizing that healthy watersheds result in better water quality and more reliable sources of supply, the Arkansas BRT will support efforts to reduce contaminants and improve water quality issues in the Upper Arkansas River (mine tailings) and Lower Arkansas River (salts, selenium), as well as reduce sedimentation from fire-impacted areas.

Section 5. Demand, Supply, and Potential Water Needs

Water in the Basin

The Arkansas River originates in the central mountains of Colorado near Leadville at an elevation of more than 14,000 feet. The river travels eastward through the southeastern part of Colorado toward the Kansas border, and drops more than 10,000 feet to an elevation of 3,340 feet at the Colorado-Kansas line. Tributaries from the southern mountains and drainage from the high plains to the north contribute flow to the mainstem of the Arkansas River.

The Arkansas River depends on snowfall to support the various downstream water uses. Water availability has concrete impacts on the economy and quality of life in the Arkansas Basin, and drought conditions have presented concerns regarding the basin's water future. Key drivers of water availability in the basin include native hydrology, major water uses and return flows, the water rights priority system, the Arkansas River Compact, groundwater pumping with surface returns and stream depletions, and transbasin imports.

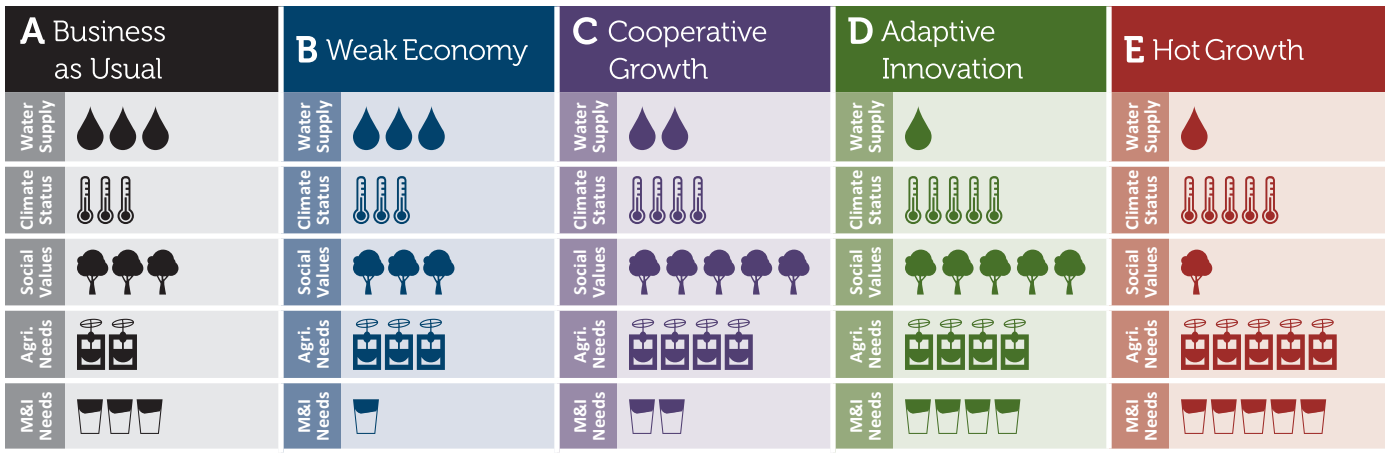
Planning Scenarios

The Technical Update published in 2019 quantified the current and potential future water demands, supplies, and additional water needs associated with the Arkansas Basin under five alternative future scenarios. A key enhancement to Colorado's water planning processes has been the incorporation of scenario planning. The Colorado Water Plan identified five different but plausible future conditions for the year 2050. The scenarios each consider several water resources drivers and how the drivers may change. The drivers included population, urban land use, climate change, industrial water needs, agricultural conditions, and adoption of municipal and agricultural water conservation measures. Refer to the Technical Update, Sections 2.1.3 and 2.1.4, for more details on the scenarios and drivers (**https://cwcb.colorado.gov/colorado-water-plan/technical-update-to-the-plan**).

Water demands, supplies, and potential water needs were quantified for the Arkansas Basin in Section 4.3 of the Technical Update. The analyses in the Technical Update were enhanced with new data during the BIP update. This section summarizes demands, supplies, and potential water needs based on the new input data.

Potential future water needs, aka gaps, were estimated for each planning scenario. Gaps are a characterization of the potential risk that water supplies will not be adequate to meet future demand.

The graphic below provides a brief overview of the drivers and the scenarios.



A Business as Usual

- Population growth increases at trends predicted by the State Demography Office (SDO).
- Future hydrology, per capita water demands and adoption of conservation measures are similar to what has recently occurred.

B Weak Economy

- The world's economy slows, and the state's population growth is less than predicted.
- Hydrology is similar to recent patterns.
- This scenario puts the least amount of stress on future water supplies and is a bookend for scenarios.

C Cooperative Growth

- Statewide population is similar to SDO predictions but is distributed differently across the state.
- Climate is moderately warmer, and irrigation demands increase.
- People seek to mitigate increased demands by more aggressively adopting water conservation.

D Adaptive Innovation

- Both scenarios assume that population growth is higher than projected and both assume a much warmer and drier future climate.
- The scenarios' primary differences revolve around conservation. In the Adaptive Innovation scenario, the state aggressively adopts conservation measures in both municipal and agricultural sectors. In the Hot Growth scenario, conservation is not a focus.

E Hot Growth

THE FUTURE WATER CONDITIONS DESCRIBED FOR THE ARKANSAS BASIN WILL BE IN THE CONTEXT OF THE FIVE PLANNING SCENARIOS.

Refinements to Technical Update Modeling

During the BIP update process, some basins identified enhancements to the Technical Update data, modeling, and analyses. Enhancements included incorporating better municipal water use data, updating operating protocols for basin storage facilities, and revising potential future industrial water demands. Updates to the Arkansas Basin water supply and gap approach were completed in September 2019 during the Technical Update and, at the request of the Arkansas BRT, the Arkansas Basin municipal baseline and projected water demands and agricultural water demands were revisited and updated again in January 2021.

Updated M&I results incorporate revised 1051 reporting data, submitted by the Pueblo Board of Water Works (PBWW) for 2013 through 2016, and data related to the Southeastern Colorado Water Conservancy District Regional Water Efficiency Plan refinements. The explicitly modeled demands for PBWW and Colorado Springs Utilities were also updated, which affected baseline and projected demands for several counties throughout the basin.

Demands were revised in the agricultural analysis to incorporate recent development efforts of the Arkansas River Decision Support System (ArkDSS). Since the Technical Update, the ArkDSS has produced a series of irrigated acreage maps and associated estimates of crop irrigation water requirements, as well as historical estimates of surface water and groundwater supplies used for agricultural purposes. Incorporating these revised components of the ArkDSS into the Technical Update analysis resulted in a better estimate of current agricultural conditions in the Arkansas Basin. Additional benefits of the Technical Update and revisions include:

Detailed hydrographs of projected water supplies and storage volume were not developed because a surface water allocation model is not currently available in the Arkansas Basin.

- A reduction to current irrigated acreage due to more accurate delineations. Total acreage currently irrigated in the Arkansas Basin is approximately 428,900 acres.
- An increase to agricultural demand, largely due to higher estimates of crop irrigation water requirements resulting from use of the Penman-Monteith method as opposed to the Blaney-Criddle method to estimate crop potential consumptive use.
- An increase to the agricultural gap due to the increased agricultural demand.

With the recent model refinements, the revised demand, water supply, and gap results for the Arkansas Basin resulted in:

- Increased agricultural demands and gaps by approximately 5 percent.
- Decreased M&I demands by approximately 15 percent. M&I gaps decreased in some scenarios but increased in the Adaptive Innovation and Hot Growth planning scenarios.
- A less than 1 percent change in the transbasin import supply gap as a result of revisions in the West Slope basins.

Additional information on the refinements to the Technical Update modeling is provided in Volume 2.

Representation of Existing Transmountain Diversions in the Technical Update

Transmountain diversions (TMD), particularly from the West Slope to East Slope, are a critical component of the water supply necessary to meet Colorado's municipal and agricultural water demand now and into the future. Many factors influence the amount and timing of TMDs, including water availability and storage in both the source and destination basins, demands, availability of other water supplies owned by water providers, and operational considerations. All of these factors may change in the future, particularly under climate-impacted conditions.

The Technical Update analyzes Colorado's current and potential future water supplies and demands in the context of five future planning scenarios that were described in the Colorado Water Plan. The planning scenarios do not specifically describe how TMDs may change in the future, though they do describe changes to drivers that impact water availability for TMDs. For example, the planning scenarios that incorporate climate change project a general decrease in streamflow, which could result in a reduction in water available to TMDs. Additionally, the planning scenarios predict an increase in demands, which could result in an increase in TMDs, up to their physical and legal diversion limits, to meet the growing demand. Large storage facilities on both sides of the Continental Divide further complicate how TMDs may operate in the future.

Understanding how these changing factors may impact the future amount and timing of TMDs is complicated from both technical and legal perspectives. **The Technical Update, therefore, assumes that historical levels of TMDs and current operations will continue into the future.** Previous planning efforts, including the 2010 Statewide Water Supply Initiative (the precursor to the Technical Update) and the 2015 BIPs, also incorporated this assumption. In future Technical Updates, water providers with major transmountain diversions should be consulted to understand how their operations could change on both the West and East Slopes under the conditions assumed in the planning scenarios.

The Technical Update provides a summary of the potential decrease in future TMD amounts but it does not apply the decrease in TMDs to projected future gaps. In climate-impacted scenarios, decreases in TMDs could lead to increases in agricultural and M&I gaps in basins that receive these supplies. Projected gaps could further increase because return flows from transmountain supplies can often be reused by the water provider or other downstream users. However, transmountain diverters may adjust their operations and diversions in response to future changes in water availability or increases in demand; therefore, the degree to which gaps may change is unknown.

TMDs are a critical component of Colorado's water resources. Future Technical Updates will seek to better understand potential future operations of existing TMDs and the effects on Colorado's water supply and gap estimates where it is reasonable and legally permissible.

Municipal & Industrial Water Demands

POPULATION PROJECTIONS

The Arkansas Basin includes about 19 percent of the state's population. Between the years 2015 and 2050, population is projected to grow from approximately 1 million to between 1.46 million and 1.63 million people in the low–and high-growth projections, respectively, which is an increase in population of 45 percent to 61 percent. Table 2 shows how population growth is projected to vary across the planning scenarios for the Arkansas Basin.

Current and future diversion demands for municipal water users are driven by population and water usage rates. Population estimates were based on SDO projections, with upward or downward adjustments based on the scenario description.

DEMANDS

The Arkansas Basin average baseline per capita systemwide demand has decreased from 185 gallons per capita per day (gpcd) in 2010 to approximately 159 gpcd. The demand decreased by approximately 15 percent due to the revised water usage information.

Systemwide, all of the projected per capita demands decrease relative to the Baseline scenario. The Arkansas Basin municipal baseline and projected diversion demands in Table 2 (and illustrated on Figure 2) show the combined effect of population and per capita demands. Municipal demands are projected to grow from approximately 178,500 acre-feet per year (AFY) in 2015 to between 247,600 and 277,700 AFY in 2050.

- El Paso County accounts for around half of the baseline demand, followed by Pueblo County at about one-third of the baseline demand.
- All of the planning scenarios result in an increase relative to the baseline, which illustrates how increases in population drive increased demand.
- With the exception of Hot Growth, systemwide demand projections are similar across all scenarios, which demonstrates how pairing of drivers and population can offset each other and narrow the range of results.
- Higher levels of conservation associated with the Adaptive Innovation scenario help limit the impacts of a warmer and drier climate and higher population.
- M&I diversion demand in the Arkansas Basin is projected to grow to become a higher percentage of overall demand.
- Municipal demand is driven by population growth in the Colorado Springs and Pueblo areas; modest increases are driven by large industry and thermoelectric demand.

Photo by: Rachel Zancanella, DWR

GAPS

The M&I diversion demands were compared against available water supply modeled for current conditions and the five planning scenarios. Gaps were calculated when water supply was insufficient to meet demands. The M&I diversion demand and gap results for M&I uses in the Arkansas Basin are summarized in Table 2 and illustrated on Figure 3. Note that annual time series of M&I gaps are not available for the Arkansas Basin because the ArkDSS is currently under development. The following are observations on M&I gaps:

- The M&I gap had a modest reduction as compared to the Technical Update due to the revised estimates of growth into existing supplies for major municipalities in the Arkansas Basin.
- The M&I gap in Adaptive Innovation is projected to be less than in Business as Usual even with high levels of projected population growth and increased outdoor water demands due to a hotter and drier climate.
- M&I gaps may be exacerbated by reductions in transbasin imports in planning scenarios that consider climate change.

Table 2. Summary of Baseline and 2050 Projected Municipal and Industrial Water Demands and Gaps

	Baseline[1]	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Population	1,010,000	1,510,000	1,460,000	1,540,000	1,630,000	1,570,000
Systemwide Per Capita Demands (gpcd)	159	148	147	139	133	159
Municipal Diversion Demand (AFY)	178,500	247,600	238,400	238,600	241,200	277,700
Industrial Diversion Demand (AFY)	58,700	61,700	56,200	60,500	61,100	67,900
Total M&I Diversion Demand (AFY)[2]	237,200	309,300	294,500	299,100	302,300	345,700
Average Annual Gap (AFY)	-	57,300	42,400	54,000	57,200	100,600
Maximum Annual Gap (AF)	-	57,300	42,400	54,000	57,200	100,600

[1]*Baseline year is 2015.*

[2]*M&I demands may vary slightly from the M&I Demand section of the Technical Update (Section 4.8.5) due to differences in geographic distribution of demand for counties that lie in multiple basins.*

Calculation methodologies and assumptions for M&I water demands are available in the Technical Update documentation.

https://cwcb.colorado.gov/colorado-water-plan/technical-update-to-the-plan

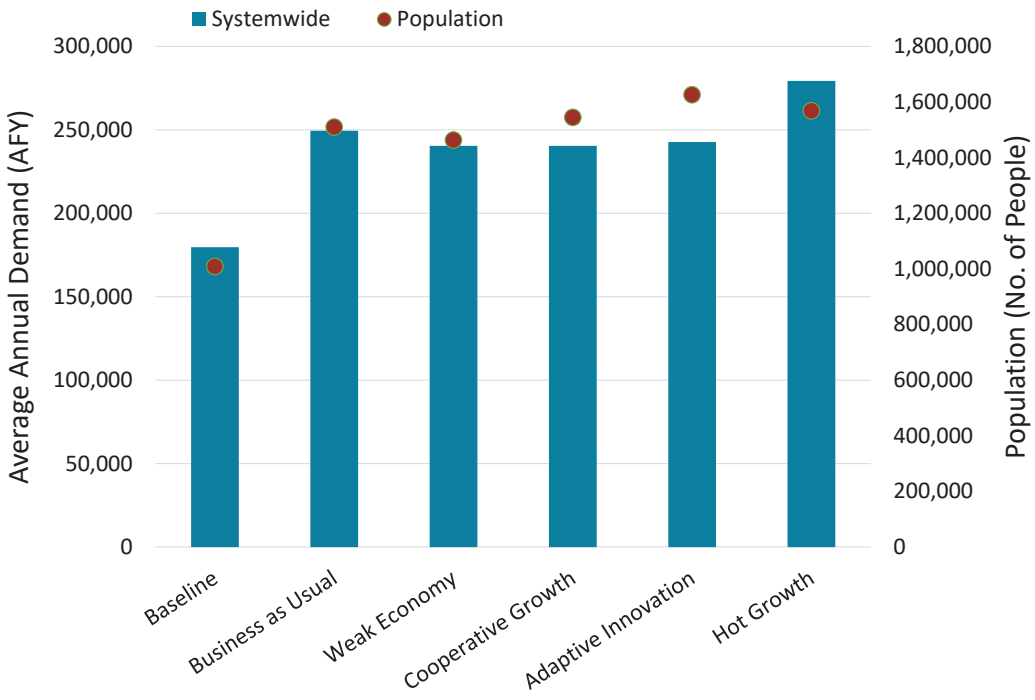


Figure 2. Baseline and 2050 Projected Population and Municipal Demand

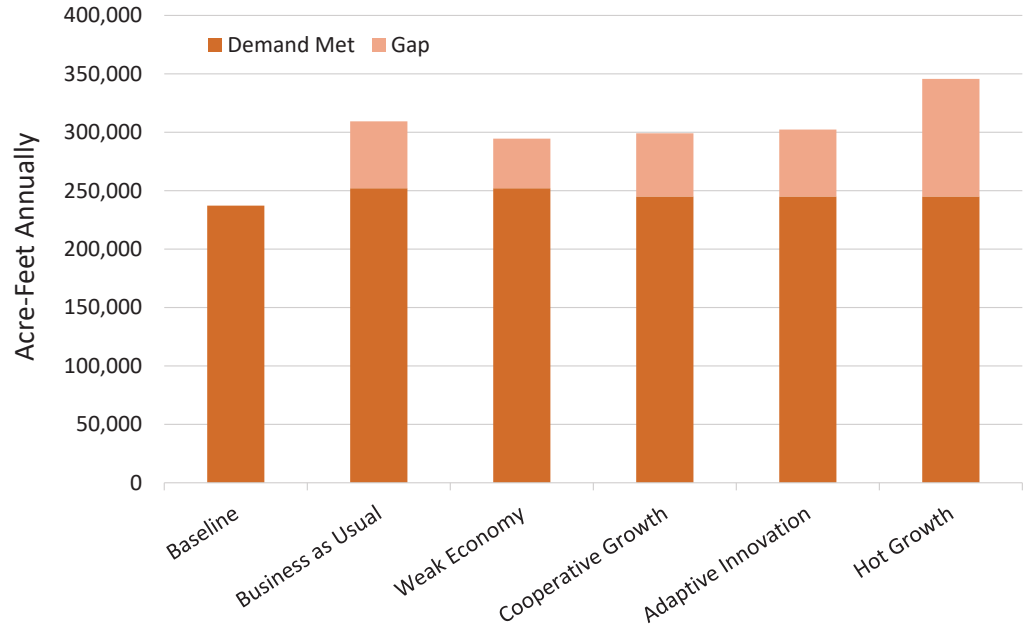


Figure 3. Baseline and 2050 Projected Maximum Annual M&I Demand Met and Gaps

Agricultural Demands

DEMAND

The agricultural diversion demand and the resulting gap in the Arkansas Basin for baseline conditions and the five planning scenarios are summarized in Table 3 and on Figure 4. The following are observations on agricultural diversion demands:

- The lowest agricultural demand is in Adaptive Innovation due to a 10 percent reduction in irrigation water requirement (IWR) and a 10 percent increase to system efficiency, both of which reduce diversion demands.
- All planning scenarios projected less agricultural demand than the current demand, mainly due to reduced irrigated acres resulting from urbanization, transfers of agricultural water rights to municipal uses, and declining aquifer levels in the Southern High Plains, all of which result in reduced irrigated acres.

Agriculture diversion demand represents the amount of water that would need to be diverted or pumped to meet the full crop irrigation water requirement. The diversion demand does not reflect historically applied irrigation amounts because irrigators often operate under water-short conditions and do not have enough supply to fully irrigate their crops.

GAPS

Using recently developed data and models for the ArkDSS, the agricultural diversion demands were compared against available water supply under current conditions and the five planning scenarios. The agricultural demand gaps were calculated when water supply was insufficient to meet demands. An annual time series of gaps in terms of percent of demand that was unmet is shown on Figure 5. The following are observations on agricultural diversion demands and gaps:

- The agricultural gap as a percent of demand is relatively large in the Arkansas Basin. Current farming practices help minimize this gap, which is projected to remain consistent in Business as Usual and Weak Economy; however, climate changes reflected in Adaptive Innovation and Hot Growth are projected to increase water supply gaps up to approximately 50 percent of demand.
- Additional future diversion demands contribute directly to the gap because, due to compact constraints, no unappropriated supplies are available in the Arkansas Basin to meet future demands.

Table 3. Summary of Baseline and 2050 Projected Agricultural Diversion Demands and Gaps

	Baseline[1]	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Irrigated Acreage (acres)	428,000	400,000	397,000	393,000	383,000	383,000
Average IWR (AFY)	1,049,000	983,000	974,000	1,030,000	939,000	1,043,000
Average Annual Demand (AFY)	2,020,000	1,884,000	1,874,000	1,973,000	1,796,000	2,002,000
Average Annual Gap (AFY)	740,000	697,000	695,000	838,000	877,000	978,000
Incremental Avg. Ann. Gap[2] (AFY)	0	0	0	102,000	140,000	241,000
Maximum Annual Gap (AFY)	1,729,000	1,623,000	1,623,000	1,803,000	1,836,000	2,054,000

[1]*Baseline agricultural demands were estimated using a model that used "current" irrigated acreage and cropping patterns and incorporated historical weather patterns.*

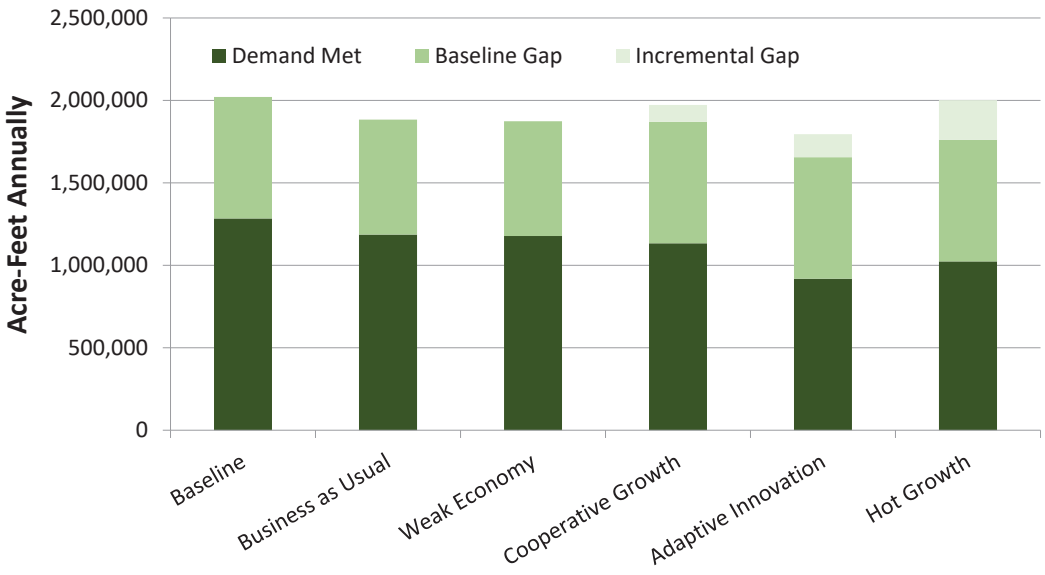
Calculation methodologies and assumptions for agriculture water demands are available in the Technical Update documentation.

https://cwcb.colorado.gov/colorado-water-plan/technical-update-to-the-plan

The Incremental Average Annual Gap quantifies the degree to which the basinwide gap could increase beyond what agriculture has historically experienced under water-short conditions.

While warmer and drier conditions in some planning scenarios may drive on-farm irrigation demand higher, as a whole, overall agricultural diversion demand is expected to decrease in the future due primarily to the loss of irrigated land. It is likely that shortages on remaining irrigated land may increase in some future scenarios due to lower water supplies and warmer conditions.

Figure 4. Baseline and 2050 Projected Average Annual Agricultural Diversion Demand, Demand Met, and Gaps



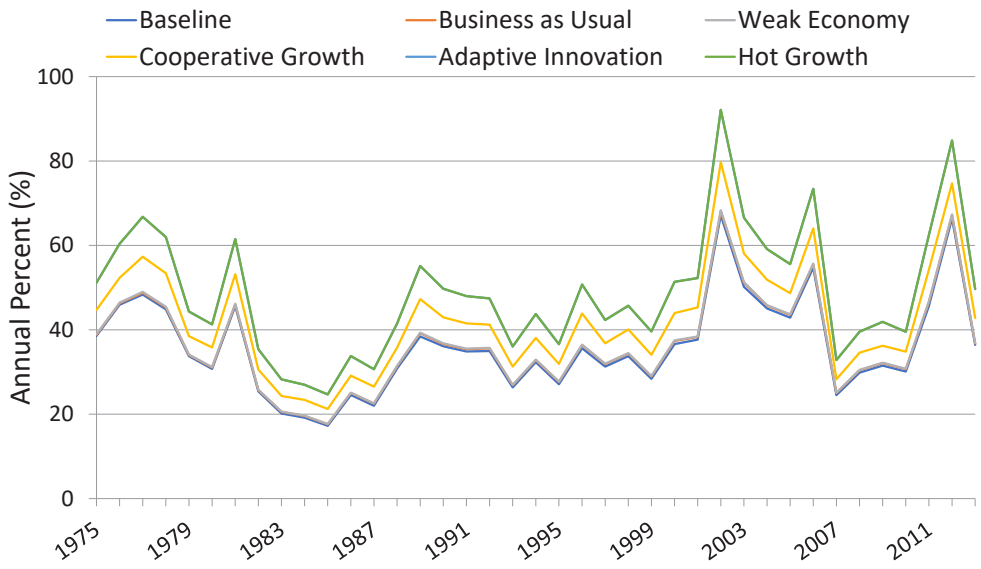


Figure 5. Modeled Annual Agricultural Gaps in the Arkansas Basin (expressed as a percentage of demand unmet) by Planning Scenario

"Modeled Years" are not a reference to historical conditions. Models used to simulate the planning scenarios consider 1975 to recent-year water supplies (in some scenarios, adjusted for climate change impacts), current administrative practices and infrastructure, and projected 2050 demands.

Development of ArkDSS is currently underway. When completed, it will consist of data, tools, and models that can be used to help decision makers at the State and in the Arkansas Basin analyze and plan for current and future water resources conditions.

Environment and Recreation

During the Technical Update, current and future risks to E&R attributes in the Arkansas Basin were evaluated using the Colorado Environment and Recreation Flow Tool (Flow Tool). The Flow Tool was developed to help basin roundtables evaluate their portfolios of E&R projects by fostering an improved understanding of potential streamflow-related risks (both existing and projected) to E&R attributes throughout their basin.

The Flow Tool uses streamflow data from CDSS, modeled streamflow data for various planning scenarios, and established flow-ecology relationships to assess risks to flows and E&R attribute categories at preselected gages across the state. The Flow Tool is a high-level tool that is intended to provide guidance during the Stream Management Plan and BIP development.

A surface water allocation model is not currently available in the Arkansas Basin. As a result, hydrologic datasets in the Flow Tool include only naturalized flows and naturalized flows as impacted by climate change; no management drivers are factored in. Naturalized flows reflect conditions that would occur in the absence of human activities. Baseline flows reflect current conditions as influenced by existing infrastructure and river operations. While observations regarding naturalized flows may be informative, baseline flows reflect actual conditions and the diverse operations of the river's many users. Management drivers impact river flows in the eastern plains. Because a water allocation model that incorporates management is not available, no data-based insights into flow change and risk to nonconsumptive attributes in the eastern plains could be developed. These data do not represent changes in flow due to irrigation, transbasin imports, and/or storage.

Identifying future risks to E&R attributes helps facilitate discussions about projects or strategies that can be implemented to reduce the risks. This type of discussion is similar to and integrates with Arkansas BRT strategies that focus on reducing the risk of experiencing municipal or agricultural gaps.

Description of nodes in the Arkansas Basin

Three water allocation model nodes were selected for the Flow Tool within the Arkansas Basin (Figure 6). These sites were chosen because they are above major water supply and demand drivers, and because future flow changes would likely be associated only with climate change factors. The figure also shows subwatersheds (at the 12-digit HUC level) and the relative number of E&R attributes located in each subwatershed.

- Arkansas River near Leadville, Colorado (07081200)
- Huerfano River at Manzanares Crossing, near Redwing, Colorado (07111000)
- Purgatoire River at Madrid, Colorado (07124200)

Results and observations from Flow Tool analyses using flow data developed in the water supply and gap analyses for naturalized flow and climate change scenarios are described in Table 4.

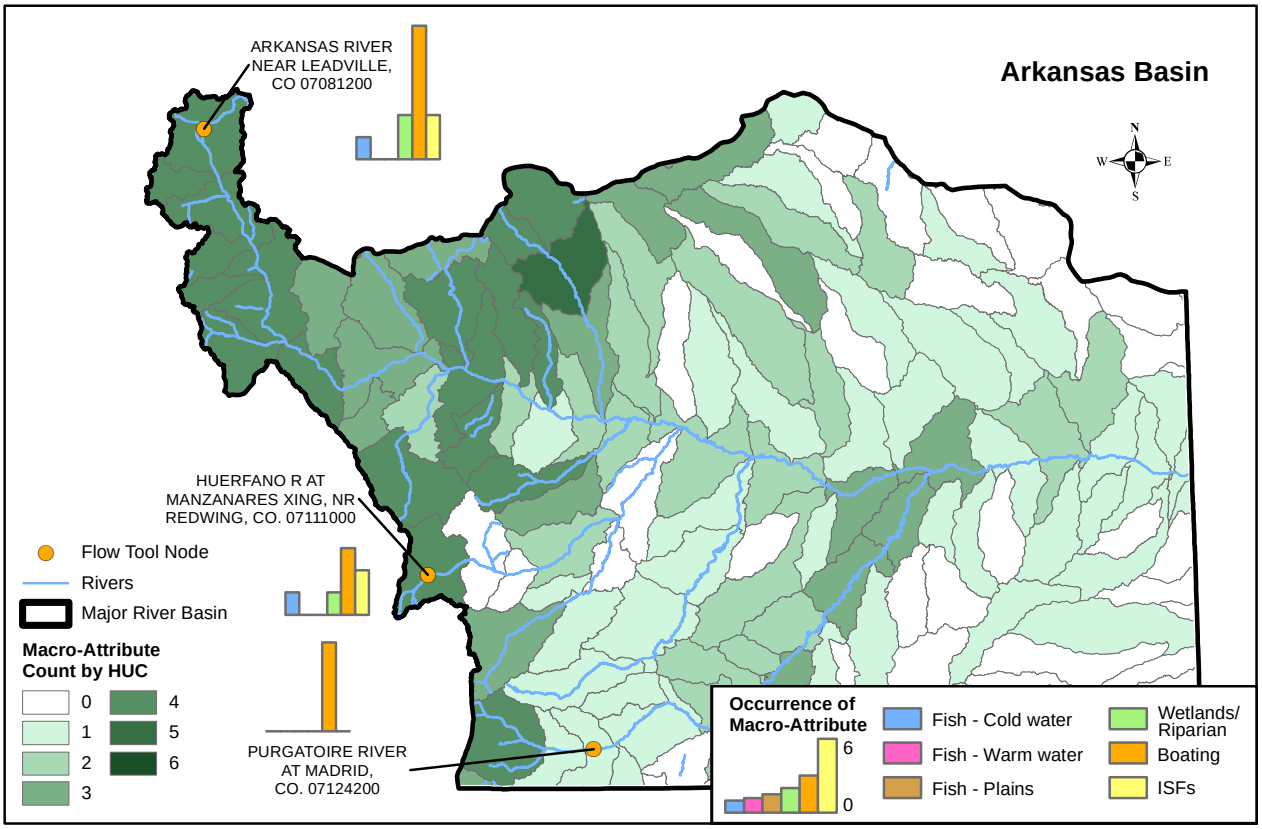


Figure 6. Flow Tool Nodes Selected in the Arkansas Basin

Table 4. Summary of Flow Tool Results

Category	Observation
Projected Flows	• At high elevation locations (e.g., near Leadville), peak flow magnitude is not projected to change substantially; however, peak flow timing may shift to earlier in the year, with April and May flow magnitudes rising and June flows decreasing under the climate change projections. • At montane and foothills locations (elevation range from approximately 5,500 feet to 8,500 feet), peak flow magnitude will likely drop under the climate change projections. • Across all locations, mid–and late-summer streamflow is projected to decrease due to climate change.
Ecological Risk	• At high elevations, peak-flow-related risk for riparian/wetland plants and fish habitat remains low or moderate under future climate change projections. • At lower elevations, the decline in peak flow magnitude is projected to increase the risk status for riparian/wetland plants and fish habitat. The reduction in peak flow may also adversely affect recreational boating. • Metrics for cold-water fish (trout) indicate that even with climate-induced changes to mid–and late-summer flows, flows are projected to be sufficient to keep risk low or moderate, though risk may be higher in July and/or during dry years.
E&R Attributes	• Because future flows under the five scenarios were not modeled in the Arkansas Basin, projected changes to flow at the selected nodes and the associated changes in risk to E&R attributes are entirely attributable to projected changes in climate. • These climate-induced changes are similar to the general pattern seen in many parts of Colorado, i.e., earlier peak flow and reduced mid–and late-summer flows, with reduced peak flow magnitudes in some locations.

Focus Area Mapping

Since the 2005 passage of the Colorado Water for the 21st Century Act (HB-117), the nine basin roundtables and the CWCB have worked to characterize Colorado's E&R water needs. The effort has included extensive inventory, analysis, and synthesized mapping of each basin's environmental and recreational attributes. Through this process, each basin created Focus Area maps that identify streams or watersheds where E&R attributes are located and/or where these attributes may be at risk. The Focus Area maps were included in the 2010 version of the Statewide Water Supply Initiative and were updated by some basins during the development of the 2015 BIPs.

Figure 7 shows the current Focus Area map for the Arkansas Basin. During the BIP update process, Arkansas BRT expressed a need to consider additional spatial data (e.g. burn scar mapping) during future updates to the Focus Area maps or during the development of analysis tools that could provide supplemental information useful for prioritizing SMPs and other watershed health enhancement activities.

More information on the Focus Area maps and specific Focus Area reaches are included in Appendix B of the 2015 Arkansas BIP

The Focus Area maps were created to:

1. **Help guide water supply planning**
2. **Help identify where projects could reduce risks to E&R attributes**
3. **Identify potential collaborative projects**

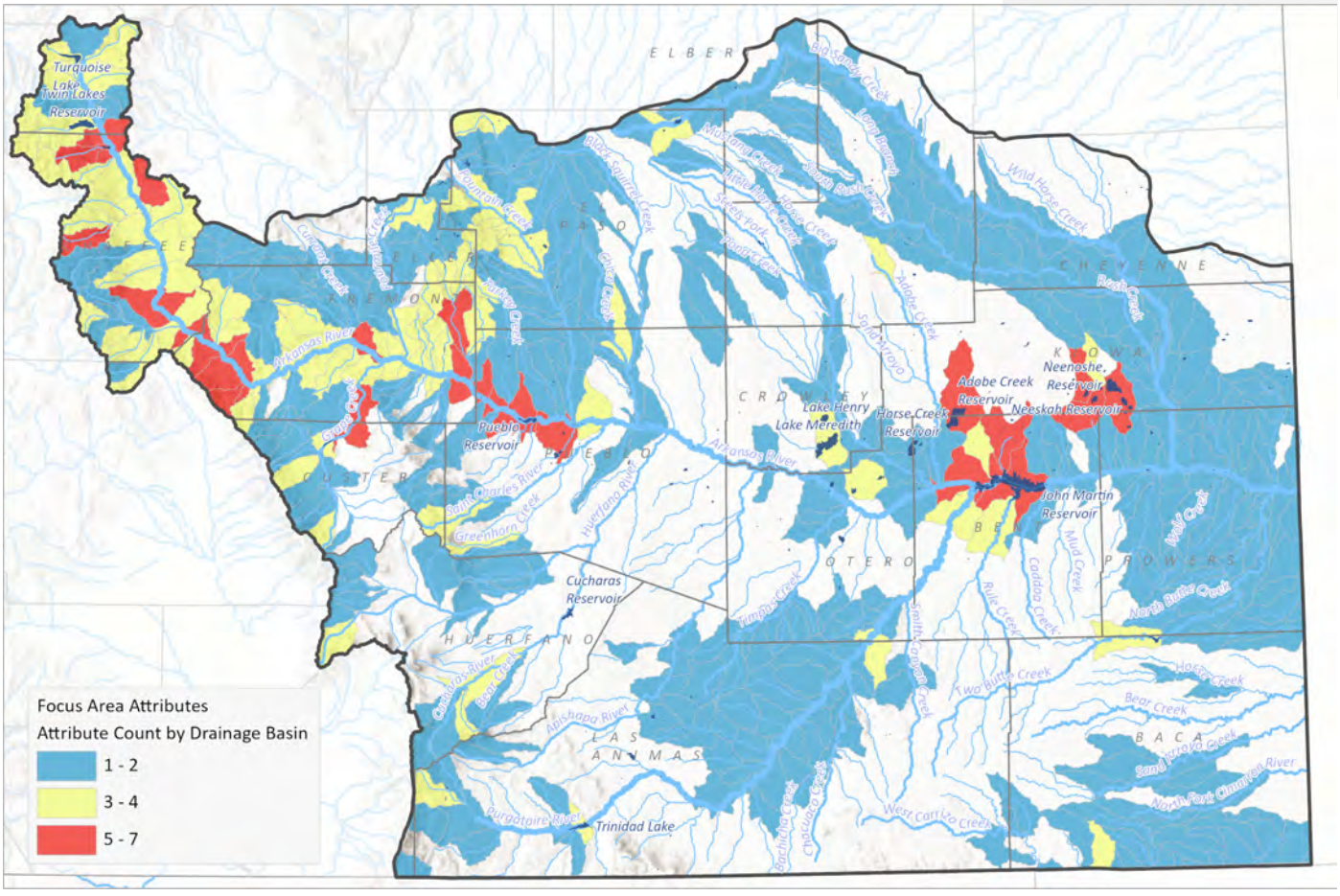


Figure 7. Arkansas Basin Focus Area Map

Section 6. Strategic Vision for the Future

This section describes the Arkansas BRT's strategic vision. It identifies strategies for meeting future needs and example projects that align with the identified strategies.

Summary of Strategies

After revising the Arkansas Basin's goals, the Arkansas BRT considered its influence over projects and activities in the Arkansas Basin in order to develop specific strategies to help guide their efforts over the next 5 years. These strategies can be viewed as major categories of activities that align with basin goals and the projects needed to make progress toward meeting future water shortages. Table 5 shows how each strategy aligns with the Arkansas BRT's goals for the basin.

Table 5. Strategy Alignment with Goals

GOALS	S1	S2	S3	M1	M2	M3	M4	A1	A2	A3	A4	A5	ER1	ER2	ER3	ER4	W1	W2
Support Project Implementation	●	●		●				●		●	●		●	●	●	●		●
Support Collaboration and Partnerships			●				●				●	●				●		
Target Funding	●	●	●	●				●		●			●					
Maximize Economic Impact of Dollars Spent	●		●	●	●			●					●					
Perform Vulnerability Assessment to Identify Need	●			●		●			●				●				●	

1 SUPPORT PROJECT IMPLEMENTATION

Supporting project implementation is foundational to the Arkansas BIP. Projects are how basin stakeholders secure their water future. Through its needs assessment subcommittee, the BRT reviews applications for project funding and makes recommendations to the larger group regarding which projects to support. Since the development of the 2015 BIP, almost $7 million in Water Supply Reserve Fund (WSRF) funding has been allocated to the Arkansas Basin in support of 53 projects. The Arkansas BRT will continue to support project implementation through the allocation of WSRF and Colorado Water Plan funds.

As described further in Section 7, during 2020 a significant effort was made to update the Arkansas Basin's Project Database. More than 150 projects were added to the Project Database, and many projects that were still active from the 2015 BIP were updated with new information. The Arkansas BRT prioritized outreach to smaller communities and rural areas during the 2020 update effort, using BRT members' connections to collect project data. Revisions to basin goals also reflect the BRT's focus on supporting project needs of smaller entities.

Through the Project Database update effort, the Arkansas BRT identified a wide variety of projects that stakeholders are pursuing. Figure 8 shows the number of projects by category. Most projects fall in the watershed and municipal categories, with a significant number of reservoir and agriculture projects as well. Figure 9 categorizes the projects by location and shows the relative number of projects in each subregion.

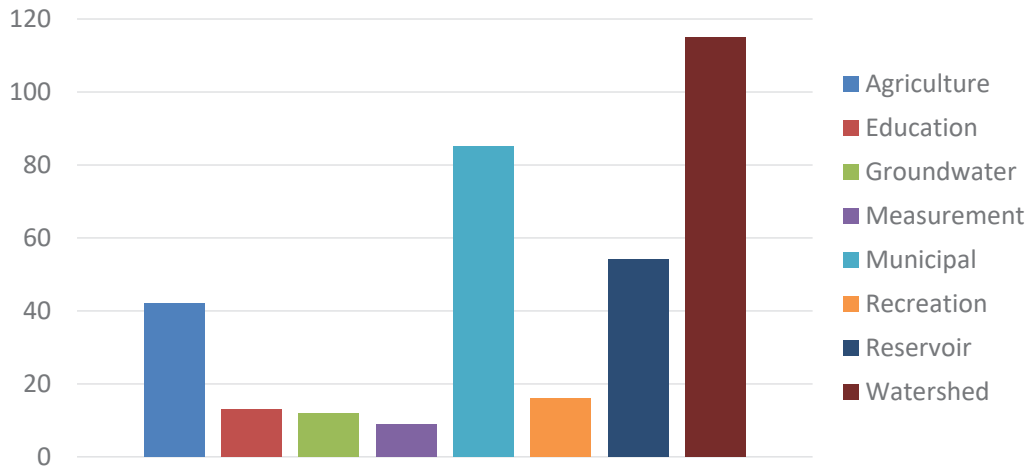


Figure 8.
Arkansas Basin Projects by Category

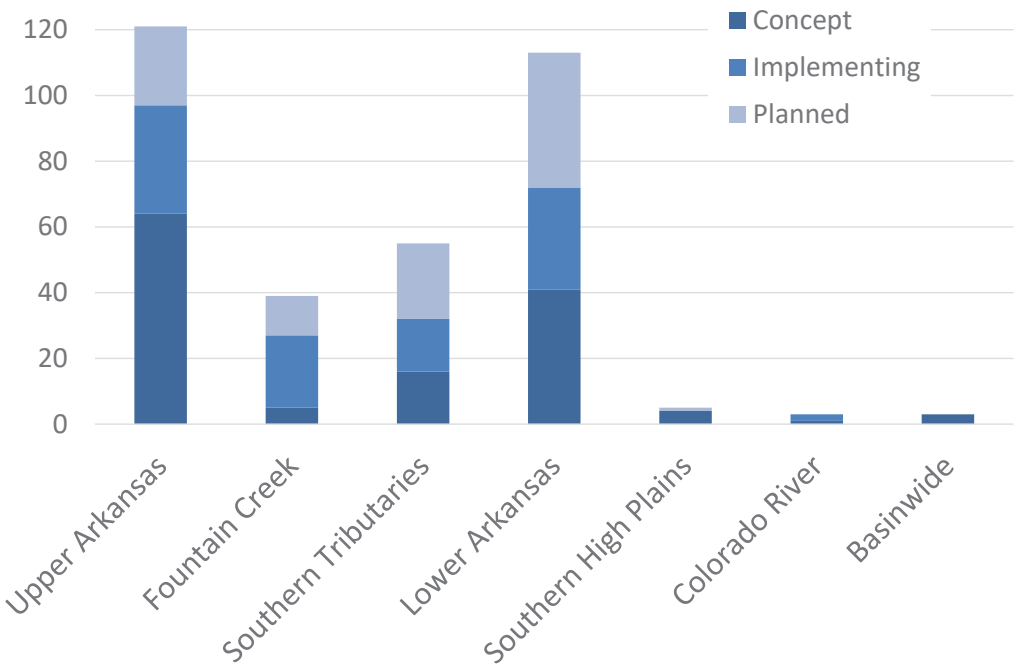


Figure 9.
Arkansas Basin Projects by Subregion

2 SUPPORT COLLABORATION AND PARTNERSHIPS

In addition to providing funding to support projects, the Arkansas BRT has recognized the interdependence of basin water use and has the unique opportunity to support and facilitate collaboration among stakeholders. This collaboration includes education, garnering basinwide support for projects, and facilitating partnerships for funding and multi-purpose projects.

The Arkansas Basin has been at the forefront of the water-sharing concept, initially seeking to provide alternatives to drying-up agricultural lands to supply growing cities. The formation of the Lower Arkansas Valley Water Conservancy District in 2002 and the piloting of ATM projects have paved the way for future water-sharing opportunities. An important function that the Arkansas BRT can perform to help facilitate more water-sharing partnerships would be to commission an evaluation of lessons learned from the currently operating Arkansas Basin ATM projects. Documenting these projects' challenges and successes could have statewide benefits and enhance existing programs.

Water-sharing partnerships can benefit not only agricultural and municipal water users but can provide direct and indirect benefits for E&R interests as well. In its 2015 BIP, the Arkansas BRT recognized the importance of water deliveries to the Lower Arkansas Valley and the dependence of environmental benefits and the recreational economy of the Upper Arkansas Basin on the continuation of those deliveries. The Arkansas BRT's continued support of multi-use projects and multi-use components of water management (such as the VFMP), will become increasingly important as flow regimes continue to be impacted by growth and climate change.

An additional focus of the Arkansas BRT has been the nexus of water supply and watershed health. During the development of the 2015 BIP (and after several devastating wildfires in the basin), the BRT formed a watershed health working group, out of which was formed the ARWC. ARWC brings together Arkansas BRT members, representatives from federal and state natural resource agencies, non-governmental organization stakeholders, and local government officials to identify priorities and strategies to manage watershed health for the protection of water resources. ARWC also works to improve communication and collaboration between entities responding to watershed health-related threats and events, such as wildfires. Additionally, the Arkansas BRT is currently considering adoption of watershed planning principles proposed by the Colorado Forest and Water Alliance, which will support a stronger understanding of forest health risks and impacts to watersheds.

Example Projects

United States Forest Service/Colorado State Forest Service/Colorado Springs Utilities Memorandum of Understanding (MOU) Partnership

The purpose of this partnership is for partners to contribute $3 million annually to support forest restoration and wildfire mitigation projects within the Pikes Peak Catamount, Tennessee Creek and Monument Creek watersheds. This partnership will utilize shared stewardship principals to expand cross-boundary work within the Pikes Peak area. Additional regional planning will involve other local governments and non-profits to increase work on private lands to broaden the scale and pace of work at a meaningful landscape scale. This is a long-term partnership that will extend over several 5-year MOU renewals and 5-year action plans.

Eagle River Joint-Use Project (Eagle River MOU)

The Eagle River Joint Use Water Project (ERMOU Project) derives from the 1998 Eagle River MOU among East and West Slope water users and involves developing a joint use water project in the Eagle River Basin that minimizes environmental impact; is cost effective and technically feasible; can be permitted by local, state and federal authorities; and provides 20,000 AFY average annual yield for East Slope use, 10,000 AFY firm dry year yield for West Slope use, and 3,000 AF of reservoir capacity for Climax Molybdenum Company. The ERMOU Project is proposed as a cooperative alternative to construction of the Homestake II Project in the Holy Cross Wilderness. The ERMOU Project will use conditional water rights held by the ERMOU Parties and a yet-to-be determined combination of gravity diversion, storage, pumping, and/or groundwater infrastructure to develop the contemplated project yield.

ERMOU Parties include: Cities of Aurora and Colorado Springs; Eagle Park Reservoir Company and Climax Molybdenum Company. Yield assumed for 5 years: 10,000 AFY average annual yield for City of Aurora; 10,000 AFY average annual yield for City of Colorado Springs; 10,000 AFY firm dry yield for Eagle Park Reservoir Company; and 3,000 AF storage space for Climax Molybdenum Company.

Chaffee County Community Wildfire Protection Plan (CWPP)

While the planning stage of this CWPP is largely complete, the implementation of mitigation projects will continue for several years. This CWPP is a leading example of how stakeholders can come together and identify local values and create priorities to implement forest mitigation strategies that help establish resiliency throughout the watershed while protecting high risk assets.

3 TARGET FUNDING TO MEET BASIN GOALS

To align Arkansas Basin projects with the BIP strategic vision, the Arkansas BRT will more closely integrate Arkansas BIP goals with funding decisions and promote projects that closely align with BIP goals. This will require good communication of Arkansas BIP goals with potential project proponents. The Arkansas BRT's Public Education, Participation and Outreach (PEPO) committee may incorporate public education of Arkansas BIP goals into its outreach activities and identify high-priority characteristics of projects that will help proponents be more successful in acquiring basin funding. Many of the projects listed in the updated projects list (See Section 7) align with current BIP goals.

Early in its existence, the Arkansas BRT recognized the importance of both supporting grant applicants in the grant approval process while avoiding burdensome review methods. One of the first Arkansas BRT committees formed was the Needs Assessment Committee, whose purpose is to review in detail WSRF grants and recommend them to the voting body of the Arkansas BRT. The Arkansas BRT approved a flow chart (Figure 10) for applicants to follow, with the starting point being grant sponsorship by a Arkansas BRT member. While the Arkansas BRT historically has moved WSRA grants forward by consensus (with an occasional dissenting opinion), the flow chart does provide for a super majority decision if consensus cannot be achieved.

As project proponents move toward implementing a plan of action, competition for funding through WSRA grants will likely become more intense. The review and approval of those grants by the Arkansas BRT will depend on the continuation of a transparent process viewed as fair and equitable by Arkansas BRT members.

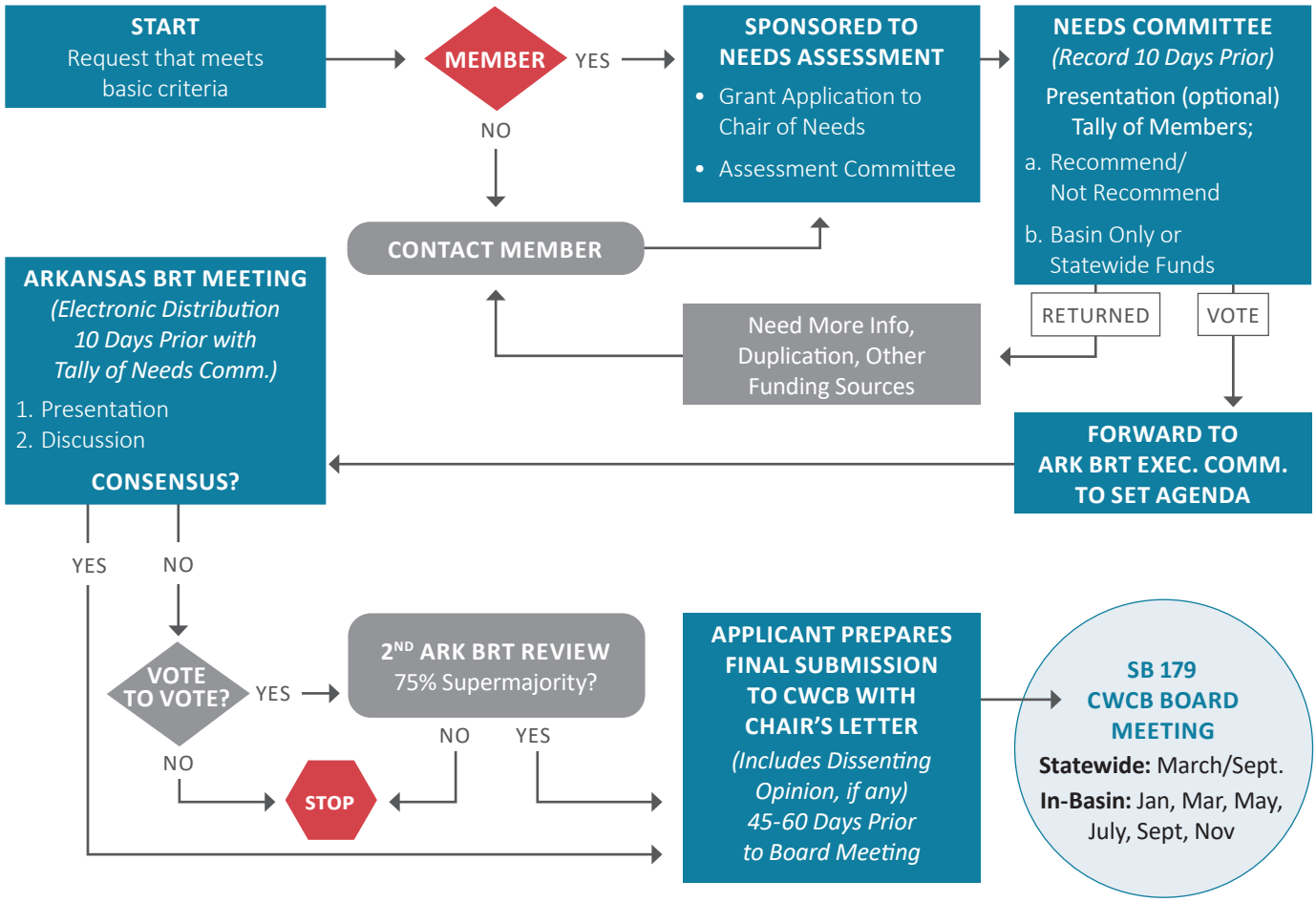


Figure 10. Arkansas Basin Roundtable WSRF Grant Review process

4 MAXIMIZE ECONOMIC IMPACT OF BASIN DOLLARS SPENT

While the Arkansas BRT's ability to award WSRF funding to implement projects is integral to meeting the Arkansas Basin's funding need, the overall need for financial support is greater than the WSRF and Colorado Water Plan funding can bear alone. The Arkansas BRT's ability to bring new partners to the table can be used to maximize the economic impact of WSRF dollars spent. Project proponents are encouraged to seek additional funding opportunities and, when possible, expand the benefits of the project (i.e., multi-use projects) to leverage cost-sharing opportunities.

Many of the high-profile projects that were successfully implemented since the last BIP (see Section 3) were funded through partnerships with other entities, such as:

- CWCB (Colorado Water Plan Grants, Water Project loans, Colorado Watershed Grants, etc.)
- U.S. Forest Service
- U.S. Bureau of Reclamation
- Colorado Division of Parks and Wildlife
- Municipalities
- Water conservancy districts
- Colorado Department of Public Health and Environment
- Colorado State Forest Service
- Colorado Water Resources and Power Development Authority

Example Projects

Purgatoire River Baca-Picketwire Diversion Dam Complex Restoration Project

The purpose of this project is to request a Letter of Support from the Arkansas BRT supporting the Purgatoire Watershed Partnership's grant application to the U.S. Bureau of Reclamation's WaterSMART Cooperative Watershed Management Program Phase II. The project being submitted for funding is entitled the Purgatoire River Baca-Picketwire Diversion Dam Complex Restoration Project. If awarded, the Purgatoire Watershed Partnership–in partnership with local partners, including the City of Trinidad, the Purgatoire River Water Conservancy District, the Baca Ditch Company, the Picketwire Ditch Company, Trout Unlimited, and the Purgatoire River Run Company–will use these funds to implement this on-the-ground watershed management project that will protect and stabilize stream and riverbanks, reduce erosion, improve channel/floodplain connectivity, improve water delivery systems to increase efficiency and address water supply needs, provide fish passage, remove invasive species and restore desirable vegetation, influence water temperature and water pooling to improve aquatic conditions, and improve public safety. Additional project components include incorporating safe water recreation passage over the diversion dam (e.g., for inner tubers), improved fishing opportunities, and improved water flow monitoring and tracking through enhancement of DWR flow-tracking capabilities.

Spring Creek Fire Remediation, Huerfano County

Initiated by Huerfano County Water Conservancy District, with an additional $1 million of CWCB Watershed Restoration Grant funding, this project (for which ARWC is the contractor) seeks to resolve problems within and below the 2018 Spring Creek Fire burn scar (largely hydrophobic soils). The first phase of the project was completed in 2019 with stream clearing, log erosion barriers, sediment basins, etc. The second phase, currently in progress, includes developing a sediment transport model, potential project review by a stakeholder group, and implementing the project within budget.

5 PERFORM VULNERABILITY ASSESSMENTS TO IDENTIFY NEED

The Arkansas BRT's agricultural and M&I goals reflect the need to characterize the types of water supplies used to meet existing demands and to identify vulnerabilities associated with each type of supply. This characterization and vulnerability assessment will allow the Arkansas BRT to implement strategies and develop projects to better manage different types of water supplies in the future. Volume II (Section 4.2) of the Arkansas BIP describes a high-level characterization of water supplies used to meet agricultural and M&I demands in each subregion and a summary of how the types of water supplies may become more vulnerable in the future. A summary of the types of water supply relied upon for M&I use in the basin, and future vulnerabilities of those types of supply, is provided in Table 6. The characterization analysis for the Arkansas BIP is intended to inform the vulnerability discussion at the Arkansas BRT-level on the predominant types of water supplies used by entities to meet their demands. It does not represent entities' complete water rights portfolio nor does it capture the year-to-year variability of water supplies that entities may use. It does, however, underscore the fact that some water supplies that are currently relied upon may not be available in the future. The Arkansas BRT supports investigations of areas with the greatest need and/or the highest risk of future supply insecurity.

Table 6. M&I Supply Vulnerabilities

Supply Type	Future Vulnerabilities
Native Water	• Reductions to runoff volume under climate-adjusted conditions • Existing infrastructure may not be sufficient to divert lower flows • Increased need for carry-over storage • Water quality concerns due to wildfires and lower streamflow
Changed Water Rights	• Senior changed water rights may not yield same amount under climate-adjusted conditions • Increased reliance on changed water rights as other supplies are reduced (i.e. safety net); may lead to increased agricultural dry up • Reductions in exchange potential; may require more infrastructure
Transmountain Imports/Reuse & Project Water	• Reductions to runoff volume on the Western Slope under climate-adjusted conditions • Potential Colorado River Compact administration • Increased reliance on reusable supplies may impact streamflow volume and water quality; may also require additional infrastructure to maximize reuse in the future
Other Reservoir Supply	• Increased competition for existing storage due to increased need for storage and sedimentation concerns

Alluvial Well Supply	• Contamination of alluvial supplies (e.g. Widefield Aquifer)
	• New water quality standards for emerging contaminants
	• Reduction in augmentation supplies:
	  • Reduction in excess municipal supplies/return flows currently leased by augmentation providers as municipalities use these supplies to meet their own growing demand
	  • Potential reduction in transmountain supplies
	  • More competition for all augmentation supplies (e.g., changed water rights), increasing cost of agricultural and M&I water

Nontributary Well Supply	• Declining aquifer levels • More stringent water quality standards

Section 7. Future Basin Projects

The Arkansas BRT, along with other stakeholders, identified projects that will further the Arkansas Basin's progress toward achieving its goals and meeting future water needs. The list of projects is managed in a database that was initially developed prior to the 2015 BIP and was updated in 2020. The Project Database tracks the projects considered by the roundtables through the BIP process, both in the past and into the future. Table 7 provides a snapshot summary of the Arkansas Basin Project Database

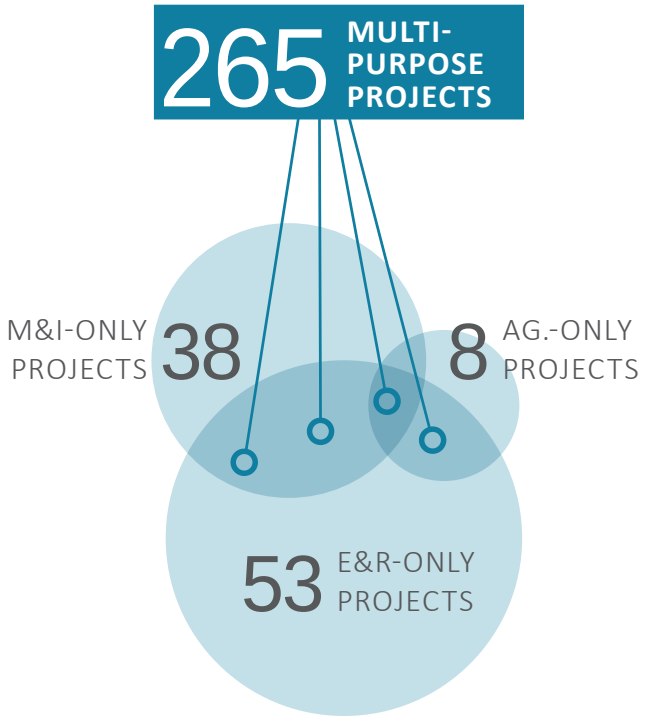
Total estimated project implementation costs top $3.5 billion

(for projects that have identified a project cost)

Table 7. Snapshot Summary of Arkansas Basin Projects

Total Projects	361
New projects added in 2020	151
Projects completed	270
Projects being implemented	103
Projects identified as meeting M&I needs	140
Projects identified as meeting Ag needs	119
Projects identified as meeting E&R needs	180
Tier 1 projects	27
Tier 2 projects	67
Tier 3 projects	152
Tier 4 projects	115
TOTAL COST OF ALL PROJECTS	**$3,636,000,000**
PERCENTAGE OF PROJECTS WITH AN ESTIMATED COST	**34%**

Projects that are concepts, planned, or are being implemented were the basis for the above data summary (with the exception of data specifically describing projects completed or being implemented).



Project Tiering and Level of Readiness

A new feature of the Project Database for the BIP Update is the assignment of "tiers" to projects. The project tiering exercise is a tool that roundtables can use to do a preliminary characterization of their projects and associated project readiness. It facilitates a "first-pass" process and helps standardize data gathering to allow for project updates and movement through the tiers as they advance toward funding. Project tiering was initially developed as a tool for basin-level WSRF grant approval discussions, where the data fields describing alignment with BIPs, local planning, and criticality are likely to be considered. Note that some of these categories are subjective and were considered differently across basins. Tiering has no bearing on whether a project can be funded. Project proponents can apply for CWCB funding whether or not their project is in the database, and inclusion of a project in the database does not guarantee funding. For the CWCB in the long term, it will be useful for identifying immediate and long-term project costs and associated funding needs. Data fields describing level of readiness, alignment with the Colorado Water Plan, and the amount of available project data will also be considered.

TIER 1	**Supported and Ready** *Ready to launch and has full data set*
TIER 2	**Supported and Pursued** *Almost ready to move forward and has a significant amount of data*
TIER 3	**Supported and Developing** *Project is developing but still needs to be fleshed out*
TIER 4	**Considering** *Project not yet moving forward but should be kept on the list*

Additional information on the Project Database, its content, and a description of the tiering process are provided in Volume 2, Appendix B of the Arkansas BIP.

Section 8. Education and Outreach

This section describes PEPO activities and the PEPO Workgroup created through the Colorado Water for the 21st Century Act. The PEPO Workgroup is responsible for:

- Creating a process to inform, involve, and educate the public on water resource issues
- Educating Arkansas BRT members about water issues

The Arkansas Basin PEPO Workgroup members are roundtable volunteers representing agriculture, municipalities, recreation, environment, and education. The PEPO coordinator manages the PEPO Workgroup, which is a committee under the direction of the Arkansas BRT.

Purpose–PEPO promotes education and outreach to citizens in the Arkansas Basin with the primary goals being to inform, engage, and educate citizens about local water resources topics and to provide a platform for water-related dialogue. The Arkansas Basin PEPO Workgroup provides education and outreach on behalf of all water use categories, including municipal supply, irrigated agriculture, recreation, and the environment.

Partners–There are nine roundtables in the state of Colorado and each roundtable has a PEPO coordinator. The PEPO Workgroup in the Arkansas Basin is unique in structure and vision. The Arkansas Basin PEPO Workgroup works in partnership with and provides a line of communication among the Interbasin Compact Committee (IBCC), CWCB, Arkansas BRT, Arkansas River Basin Water Forum (ARBWF), and the public that they serve.

Programs and Projects

Over time, the Arkansas Basin PEPO Workgroup has been awarded several grants from the CWCB to provide education and outreach activities. PEPO Workgroup projects have included:

- Arkansas Basin documentary and webisodes
- Support for communitywide and children's water festivals
- Education to Action Program to promote Arkansas BIP water projects
- Establishing lines of communication between water leaders and the public
- Providing "Water 101" information
- Participating in the annual Arkansas River Basin Water Forum
- Participating in Creek Week cleanups
- Supporting fire and flood recovery
- Education partnerships

Statewide Water Education Action Plan

In addition to working on basin projects and outreach, the Arkansas Basin PEPO Workgroup also supports the Statewide Water Education Action Plan (SWEAP). SWEAP is the first-of-its-kind water education guide that organizations and individual educators can use to realize the outreach, education and public education goals set forth in the Colorado Water Plan. The framework features 10 key outcomes, related strategies, and examples of actions local entities can take to reach their unique audiences. Developed with the assistance of more than 40 water educators statewide, SWEAP will empower Coloradans to take an active role in their communities and make informed decisions about critical water issues.

Arkansas River Basin Water Forum

To provide the best possible outreach to citizens of the Arkansas Basin, the PEPO Workgroup has partnered with the ARBWF, which has been serving the educational needs of the Arkansas Basin for 25 years through an annual water forum that is held in a different Arkansas Basin location each year.