

COLORADO'S **WATER PLAN**

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1. Introduction: Collaborating on Colorado's Water Future

Colorado's Water Plan

People love Colorado. Our population ballooned from 1 million in 1930, to over 5 million today, and is projected to grow even faster in the future. So how do we ensure that this population growth doesn't change what we know and love about our state? When it comes to our water, this plan has answers.

In the following pages we chart a course to achieve collaborative, balanced water solutions to Colorado's water needs, both now and in the future. The gap between our water supply and water demand is real and looming. Drought conditions, such as those experienced in 2013, coupled with our projected population rise, will further widen this gap.¹ The Colorado Water Conservation Board (CWCB) designed this plan to be a dynamic document that evolves as Colorado grows and transforms. The plan reflects the most current water data and will be updated by the CWCB as needs and projections change. This comprehensive water plan is the first of its kind for Colorado: a plan by Coloradans, for Coloradans.

As Colorado's water planning and policy agency, the CWCB has a diverse set of responsibilities. These include stream, watershed, and lake protection, water conservation, flood mitigation, stream restoration, drought planning, water supply planning, and water project financing. The CWCB also works to protect the state's water apportionments in collaboration with other western states and federal agencies.² In May 2013, Governor John Hickenlooper issued Executive Order (EO) D 2013-005 that directed the CWCB to prepare a water plan for Colorado (see Appendix A).

A summary of the key directives to the CWCB outlined in this executive order are as follows:

- A. Colorado's water policy must reflect its water values.
- B. The CWCB will work with the Governor's Office to complete the final plan no later than December 10, 2015.
- C. The CWCB is directed to align state water projects, studies, funding, and other efforts as part of the Colorado Water Plan to the greatest extent possible.
- D. The CWCB is directed to align the state's role in water project permitting and review processes with the water values...and to streamline the state role in the approval and regulatory processes regarding water projects.
- E. The CWCB is directed to utilize the Interbasin Compact Committee and the Basin Roundtables in drafting the Colorado Water Plan. The CWCB is also directed to review and build upon discussions and points of consensus that have emerged as part of the Interbasin Compact Committee and Basin Roundtable processes so as to capitalize on the momentum generated by these grassroots efforts.
- F. The CWCB is directed to work with its sister agencies and other relevant state agencies as needed.

- G. The Colorado Water Plan will reaffirm the Colorado Constitution's recognition of priority of appropriation while offering recommendations to the Governor for legislation that will improve coordination, streamline processes, and align state efforts.

Colorado's water values

This plan acts as a foundation for Colorado to honor the state's core water values. These water values, set out in the Governor's executive order, were developed by assessing the grass roots work done by the Interbasin Compact Committee and basin roundtables.

Colorado's water values³

- A productive economy that supports vibrant and sustainable cities, viable and productive agriculture, and a robust skiing, recreation, and tourism industry;
- Efficient and effective water infrastructure promoting smart land use; and
- A strong environment that includes healthy watersheds, rivers and streams, and wildlife.

Our history of collaboration

The year 2015 marks over a decade of unprecedented efforts engaging diverse stakeholders and developing water planning information, which is ultimately the foundation for Colorado's Water Plan. During this past decade, Coloradans from all sectors identified the need for a focused plan for the future.

The roots of the water plan started with the droughts in 2002 and 2003. When some municipalities were weeks away from running out of water, the need for a comprehensive analysis of Colorado's water needs were apparent and sparked the Statewide Water Supply Initiative (SWSI).⁴ The Colorado Water Conservation Board (CWCB) leads SWSI, an ongoing analysis of Colorado's water resources that provides key technical data and information used to guide decision making. SWSI also takes different climate variability scenarios into account. As a result of SWSI and other technical work, Colorado has more information today than ever before about available water supplies and agricultural, environmental, recreational, and community water needs.

In 2005, Colorado leaders recognized the need to depoliticize water issues for the good of the entire state. The General Assembly passed and Governor Bill Owens signed House Bill 1177 that created 10 essential stakeholder engagement bodies: the Interbasin Compact Committee (IBCC) and nine basin roundtables.⁵ The 27 members of the IBCC represent every basin and water perspective in Colorado. The IBCC agrees that steps must be taken in the near future to avoid the undesirable consequences that will result from growing water gap.⁶

In 2014, each basin roundtable developed a draft Basin Implementation Plan (BIP) that examined their future water needs and provided strategies for addressing those needs. The basin roundtables brought together representatives from the business community, local government, water users, as well as stakeholders representing the environment, agriculture, recreation, and various industries. Providers from each of Colorado's major river basins and the Denver metro area began mapping out each basin's needs. The grassroots approach of the basin roundtables and IBCC, which engaged hundreds of stakeholders across sectors and regions, enabled citizens in each basin to share their vision for Colorado's water future, "produced informed discussions, provided a forum for building consensus, and generated momentum."⁷ The last decade has been focused on actively engaging communities through concerted public involvement, and developing balanced, locally-driven, and collaborative water management solutions – the building blocks of the water plan.

Why do we need a water plan?

Colorado is widely regarded as one of the best locations to live, work, and play.⁸ As a result, more people are moving to Colorado and staying. Water is vital to retaining the state's quality of life in the midst of robust growth, but it is an unpredictable resource. As an example, in 2013 Colorado suffered from systemic drought and deadly flooding simultaneously.⁹ Water supply uncertainty is dramatically increased by climate variability and change. Since projections indicate the likelihood that there will be wide variability in precipitation in the future, the state faces the possibility of a significant water supply shortfall within the next few decades, even *with* aggressive conservation and new water projects.¹⁰ A gap is quickly emerging between our shrinking water supply and the demands of population growth. Colorado's Water Plan is the map that will guide decisions and actions in the face of future water needs and demands.

These are the primary challenges Colorado faces:

- **Growing water supply gap:** The gap between municipal water supply and demand is growing, and conservation and the completion of proposed water projects are likely insufficient to address projected 2050 shortfalls that could total more than 500,000 acre-feet statewide.¹¹
- **Agricultural dry-up:** Irrigated agriculture is being lost by the purchase and permanent transfer of agricultural water rights. At the current rate of transfer, there will be a major reduction in Colorado's agricultural lands in the future. This could impact Colorado's economy and food security. In addition, rural communities could dry-up along with agriculture if enough agricultural business goes away.¹²
- **Critical environmental concerns:** An increasing number of fish species in Colorado are at risk of becoming endangered due to habitat loss. This risk has the potential to increase if agricultural, municipal, and industrial water needs are set up to clash with environmental and recreational water needs.¹³
- **Variable climatic conditions:** Climate change and associated impacts make it more difficult to meet Colorado's future water needs because of diminishing supplies, increased demand for water, and the wide variability predicted in the future. This is discussed at length in Chapters 4 and 5.¹⁴
- **Inefficient regulatory process:** Colorado requires a more efficient regulatory process if we are to effectively respond to our water challenges. By encouraging up-front collaboration and resource-prioritization, Colorado can do its part to move multi-partner and multi-purpose projects forward more quickly.¹⁵
- **Increasing funding needs:** Colorado faces a financial gap in addressing future environmental, recreational, agricultural, and communal needs. Without adequate investment, Colorado cannot effectively address the above-listed challenges.

Colorado's Water Plan as a roadmap

This plan is focused on achieving the right balance of water resource management. It recognizes that water is important for all sectors and regions in Colorado and greatly affects people's livelihoods.



Water connects Colorado. While the vast majority of our precipitation falls west of the continental divide, the vast majority of our people reside to the east. Through a vast network of infrastructure, we move water from the west to the east in large quantities every year. Western slope ranchers finish their cattle on the eastern slope, have them slaughtered and distributed there. The eastern slope consumes western slope peaches and wine. The western slope offers world-class recreational opportunities, and Front Range families are the largest user of these recreational opportunities and own many of the second homes in western slope communities. The Front Range is the economic hub of Colorado, accounting for almost 75 percent of the state's gross domestic product.¹⁶ Water is one of our most critical, contentious, and shared resources, but because we are all connected, Colorado's success depends on the ability of all regions to work collaboratively to solve challenges.

This plan takes into account Colorado's history, legal system, policy structure (which includes local, state, and federal laws, institutions, and players), and institutional arrangements that influence decisions about Colorado's scarce water resources. Colorado's Water Plan affirms the private ownership of water rights under the state's prior appropriation system. Further, this plan supports the authorities and responsibilities of local governments and water providers established by state law. It recognizes the limited statutory role of state agencies in decisions regarding the allocation and reallocation of water to various beneficial uses and the overlay of federal regulatory and permitting processes that pervade water resources management decisions in Colorado. Thus, the plan advocates for cooperation among parties so that no one governmental agency, water provider, or private party is compelled to go it alone and make unilateral decisions.

This plan is a framework to guide future decision-making and to address water challenges with a collaborative, balanced, and solutions-oriented approach. The innovative and creative work accomplished by Coloradans to date is recognized with the acknowledgement that there is much work to do. Although moving beyond the status quo can be both difficult and complicated, it is our responsibility as Coloradans to come together to find compromises and opportunities to ensure that our state remains a vibrant place to live, work, and play for years to come.

The goal

Colorado is composed of vibrant and sustainable cities, viable and productive agriculture, a robust recreation and tourism industry, and a thriving environment. The goals of the water plan are to defend Colorado's compact entitlements, improve the regulatory processes, and explore financial incentives while honoring Colorado's water values and to ensure that the state's most valuable resource is protected and available for generations to come.

Chapters 2 through 5 focus on the foundational elements that guide Colorado's water management. These include descriptions of Colorado's legal structure and critical facts about supply and demand.

Chapters 6 through 11 establish action steps to help Colorado respond to future challenges. These sections show how Colorado can advance conservation, reuse, alternative agricultural transfers, and multi-purpose and collaborative projects while protecting the health of rivers, streams, and watersheds. Chapter 9 addresses increased funding opportunities, more efficient and effective permitting, and enhanced education for citizens. Because the various factors affecting forecasts, hydrology, the economy, and the fields of science and technology will continue to be dynamic, Chapter 11 suggests a timeline for updating the plan every four years.

¹ Colorado Water Conservation Board (CWCB). *Statewide Water Supply Initiative 2010*. January 2011.

² Colorado Water Conservation Board. "About the CWCB." Accessed October 17, 2014.

<http://cwcb.state.co.us/about-us/about-the-cwcb/Pages/main.aspx>.

³ Executive Order D2013-005 of May 14, 2013, Directing the Colorado Water Conservation Board to Commence Work on the Colorado Water Plan. 2013.

⁴ Colorado Water Conservation Board (CWCB). *Statewide Water Supply Initiative 2010*. January 2011.

⁵ C.R.S. § 37-75-104 & § 37-75-105.

⁶ Colorado Water Conservation Board (CWCB). *Statewide Water Supply Initiative 2010*. January 2011, 7-2.

⁷ Executive Order D2013-005 of May 14, 2013, Directing the Colorado Water Conservation Board to Commence Work on the Colorado Water Plan. 2013.

⁸ OEDIT. *Living in Colorado*. Colorado Office of Economic Development and International Trade. 2014.

⁹ NOAA Climate.gov. *Despite Fall Floods, Drought Persists in Southeastern Colorado. Despite Fall Floods, Drought Persists in Southeastern Colorado*. February 18, 2014.

¹⁰ Colorado Water Conservation Board (CWCB). *Statewide Water Supply Initiative 2010*. January 2011.

¹¹ Colorado Water Conservation Board (CWCB). *Statewide Water Supply Initiative 2010*. January 2011.

¹² Colorado Water Conservation Board (CWCB). *Alternative Agricultural Water Transfer Methods Grant Program Summary and Status Update*. November 2012.

¹³ Colorado Water Conservation Board (CWCB). *Nonconsumptive Needs Assessment Focus Mapping*. July 2010.

¹⁴ Lukas, Jeff, Joseph Barsugli, Nolan Doesken, Imtiaz Rangwala, and Klaus Wolter. "Executive Summary." In *Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation*. Second ed. University of Colorado Boulder, 2014.

¹⁵ Eklund, Larry quoting John Wooden in *Be Quick—But Don't Hurry: Finding success in the teachings of a lifetime*, 2001.

¹⁶ Denver Metro Chamber of Commerce. *Water*. October 30, 2014.

2. Our Legal & Institutional Setting

2.1 Colorado Water Law & Administration

In order to plan for the opportunities and challenges apparent in Colorado's water future, we must understand the legal framework upon which they rest. The evolution and history of Colorado water law is as rich and complicated as the history of the West itself. From the People's Ditch of San Luis, the oldest operational water right in Colorado developed prior to the creation of Colorado territory,¹ to the innovations of Aurora's Prairie Waters project, the result of this complex and varied history is the current massive body of law, legal precedent, rules, and regulations that govern this valuable resource.

Water users in Colorado's semi-arid climate need a flexible system that honors private water rights, provides reliable administration, and responds to changes in supply and demand. Through ever-evolving case law, policies established by state and local government, and laws passed by the General Assembly, Coloradans are working together to provide this system.

The Prior Appropriation System

The foundation of Colorado water law is the prior appropriation system, a framework for establishing one water user's priority for use over that of another. Colorado was the first to formalize the prior appropriation system, in a set of principles known as the "Colorado Doctrine," which was adopted in the 1860's prior to Colorado obtaining statehood in 1876.² This legal system is shared in a pure or hybrid form with most western states.

The heart of the prior appropriation system is found in the Colorado Constitution which states that: "The right to divert the unappropriated waters of any natural stream to beneficial uses shall never be denied. Priority of appropriation shall give the better right as between those using the water for the same purpose"³ . . . The simpler distillation of this legal framework is "first in time, first in right."⁴

The Colorado Doctrine

- All surface and groundwater In Colorado is a public resource for beneficial use by public agencies and private persons;
- A water right is a right to use a portion of the public's water resources - an usufructory right;
- Water rights owners may build facilities on the lands of others, by agreement or with just compensation, to divert, extract, or move water from a stream or aquifer to its place of use; and
- Water rights owners may use streams and aquifers for the transportation and storage of water.

After this constitutional establishment of the prior appropriation system, the Water Right Determination and Administration Act of 1969, which applies to surface water and tributary groundwater,⁵ further codified the procedure for adjudication and administration of water rights in Colorado. The 1969 Act stated that all water in the state meant for public use was subject to appropriation and administration to "maximize the beneficial use of all of the waters of the state."⁶

As Colorado Supreme Court Justice Gregory Hobbs described in his 1999 law review article⁷:

Major accomplishments of the 1969 Act include: (1) integration of surface water and tributary groundwater into a unitary adjudication and administration system; (2) specialized water court jurisdiction and engineer administration on a watershed basis; (3) resume notice procedure for obtaining jurisdiction for adjudication of rights; (4) case-by-case decrees and appeals in the context of an ongoing and comprehensive adjudication; (5) authorization of augmentation plans to enable otherwise out-of-priority water use through the provision of replacement water; (6) effective rulemaking and enforcement authority in the state and division engineer for the protection of state, federal, and interstate rights; and (7) explicit procedures for filing and pursuing applications and objections to applications for water rights, conditional water rights, changes of water rights, and augmentation plans.

Colorado allocates and administers water according to five classifications: (1) water of the natural stream, which includes surface water and tributary groundwater (groundwater that is hydrologically connected to a surface stream); (2) designated groundwater (within a designation groundwater basin); (3) nontributary groundwater outside of designated groundwater basins; (4) Denver Basin groundwater; and (5) geothermal groundwater. All these types of water are owned by the public, but only tributary waters of the natural stream are subject to allocation by the doctrine of prior appropriation under Article XVI, Sections 5 and 6, of the Colorado Constitution and the 1969 Act. The other types of groundwater are subject to different allocation and administration systems according to statutes of the Colorado General Assembly.

Under the prior appropriation system, a downstream water user who has a senior priority right adjudicated by the water court may divert and use water before upstream users with less senior water rights (i.e. junior rights) on the same stream. This becomes particularly vital during a water shortage when water rights are more highly valued. A “call” on a stream may cause an upstream user with junior rights to reduce diversions or curtail water usage completely so that the calling downstream user with more senior rights may receive the quantity of water to which they are entitled.

“Beneficial use,” defined as a level beyond which waste may occur, serves as both the measure and limit of the water.⁸ This term is used to both determine and to administer water rights. In the early territorial days, beneficial use extended primarily to domestic and agricultural use. As the state’s population has grown and water values have evolved and changed, the definition of “beneficial use” has likewise evolved and expanded to include municipal, industrial, recreational and wildlife uses, among others. Instream flow water rights held exclusively by the CWCB to preserve or improve the environment to a reasonable degree,⁹ are codified in the statutory definition of beneficial use.¹⁰ The statutory definition of beneficial use has more recently been amended to recognize in-channel uses for recreational purposes.¹¹

Water Rights and Adjudication

The prior appropriation system today is a product of our constitution, legislation, and the judicial system. Colorado's seven water courts, established in each of the seven major watersheds of the state, issue decrees confirming water use rights. Water rights may be confirmed for use on a direct flow basis, by storage, or by exchange. With a direct flow right, the water user applies the water from the stream or tributary aquifer directly to use for irrigation, domestic, industrial, or other uses. A storage right is typically accomplished by placing water into a vessel, such as a reservoir or tank, or under certain conditions into an aquifer, for beneficial use at a later time. An exchange is generally effectuated by diverting water at an upstream location, while providing a substitute supply of water at a downstream location that is suitable in quantity and quality to satisfy downstream senior priorities, so long as existing intervening water uses within the exchange reach are not impacted. Water court decrees generally quantify direct flow and exchange water rights in terms of flow, measured in cubic feet per second, while storage water rights are generally measured volumetrically in acre-feet.

In Colorado, a water right is appropriated when a user demonstrates intent and takes steps to put water to beneficial use, and is made absolute by storing water or applying water directly to beneficial use. A water user may then receive protection under the priority system by adjudicating that right through the water court process. A user can also obtain a conditional water right by showing an intent to place water to beneficial use and proving that the user "can and will" put the water to beneficial use under Colorado's anti-speculation doctrine. To become an enforceable perfected water right, the owner must apply to the water court and receive an absolute water right decree. As the prior appropriation system has evolved, more water rights have been adjudicated than can be satisfied in dry years in some river basins. When this occurs, that basin is described as over-appropriated, which means that the opportunity to develop new junior water rights in that basin is limited. In over-appropriated basins, new water uses are created by changing existing water rights or by developing augmentation plans.

Changes of Water Rights

The right to use water in Colorado is usufructory. As such, it is limited to the location of diversion, place of use, manner of use, and type of use allowed by a water court decree. A water right may be conveyed to another water user or, with appropriate water court approval, changed to another location of diversion, place of use, manner of use, or type of use while retaining its priority. However, changes of water rights are subject to terms and conditions that prevent injury to existing water rights.¹³

The engineering analysis in a change of water right proceeding establishes the time, place, and amount of decreed and historical consumptive use, which serves as the volumetric limitation on any new consumptive use. In addition to establishing historical consumptive use, an analysis must establish the timing, location, and amount of historical return flows (the non-consumed portion of the diversion), which must be replaced in the stream so that water users senior to the date of the change in use may continue to enjoy stream conditions in place

Usufructory Rights

A term used in civil law referring to the right of enjoying a thing, the property of which is vested in another (in this case the state) and to draw from the same all the profit, utility, and advantage which it may produce providing it be without altering the substance of the thing.¹²

at the time of their appropriation.¹⁴ A full analysis considering time, place and amount of historical use on a stream is generally referred to as a “net stream depletion” analysis.

The goal of the net stream depletion assessment, including historical beneficial consumptive use, is to ensure that the amount of water removed from the stream system and consumptively used is equal to the amount returned to the stream at a particular time and place. Maintaining flows after a change of water right ensures that water users who established their rights prior to the date of the change in use receive the water that they are entitled to, and do not suffer an injury to their water rights as a result of the change.

Augmentation Plans

Colorado water law allows users to divert water out-of-priority if they replace any injurious depletions under what is called a “plan for augmentation.”¹⁵ A typical plan for augmentation allows a user with a junior water right to divert out-of-priority, (thus cutting in line so to speak), so long as that junior water user can replace or remedy its injurious depletions to the user with senior calling water rights and not injure other water users in the process. A common scenario is that a water user pumps a well out of priority and then replaces stream depletions caused by the pumping with other senior surface water or nontributary groundwater. Under an augmentation plan, the replacement water must generally be available in the same quality and quantity including the same time, location, and amount as the stream depletions caused by out-of-priority pumping or diversions.¹⁶ Permanent or long-term plans for augmentation and changes of water rights require water court approval, but the State Engineer has statutory authority to approve temporary substitute water supply plans and interruptible water supply agreements for similar purposes.

State Administration of Water Rights

Water rights are administered by the Colorado Division of Water Resources (DWR), a division of the Department of Natural Resources. Also referred to as the State Engineer’s Office, DWR evaluates well permits, inspects dams and wells, and oversees the work of water commissioners in the field who physically allocate the water and enforce compacts, water court decrees, and well permits.

The State Engineer’s Office is headquartered in Denver, with seven field offices spread across the state in each major river basin. Every field office has a Division Engineer, who serves as the lead, managing the administration of that particular water division. Water commissioners not only monitor diversion structures and streams in the field for immediate administration of water rights, but also gather important data for use in water planning studies and decision support systems.

The water commissioners also administer calls on the river system to ensure the holder of a senior priority receives up to a full allocation. Other duties of the Division Engineers include regulating headgates, measuring devices, and administering and enforcing storage water rights, plans for augmentation, exchanges, and transmountain water diversions. DWR also oversees the well permitting process for all types of groundwater. Well permits are required for extraction of tributary groundwater, designated groundwater, non-tributary groundwater, Denver Basin groundwater and geothermal groundwater.¹⁷

In its management of water records statewide, DWR maintains decrees, permits, maps, historical streamflow and diversion measurements, real-time streamflow and major diversions, groundwater levels, and also maintains a repository of policy documents, planning material, rules, and regulations.

DWR has collected data for many years and placed it into Colorado's Decision Support Systems, a water management system designed to analyze and model pertinent information for water users and organizations. The Decision Support Systems generate maps, tables, and graphs that show information such as streamflow, historical diversions, and detailed well information. The Decision Support Systems provide a variety of resources for water management organizations and other interested parties.

Moving Forward

The evolution of Colorado water law through the courtroom and the legislative process present both challenges and opportunities for Colorado's Water Plan. The institution of the prior appropriation system is difficult to navigate because of the planning and costs associated with the necessary judicial and administrative approvals. The Alternatives to Agricultural Transfer Grant Program, new legislation, water court rule changes, and ongoing studies and processes on water banking have helped increase the flexibility within this landscape and demonstrate how the complex Colorado water administration system can adjust.

Recent agreements between multiple stakeholders, such as the Colorado River Cooperative Agreement between Denver Water and over two dozen western slope entities, illustrate the ability of Colorado's water administration system to achieve maximum use of the state's water resources for the greatest benefit.

2.2 Interstate Compacts and Equitable Apportionment Decrees

Colorado is a headwaters state where the major rivers flow to downstream states on both sides of the Continental Divide. As Colorado and other downstream states developed those rivers in the late nineteenth and early twentieth centuries, disputes arose regarding the authority of one state to control the use of an interstate stream that originates in another state.¹⁸ Initially, downstream states sought to resolve water disputes through litigation before the United States Supreme Court.¹⁹

Two cases decided by that Court persuaded Colorado water leaders that negotiated interstate water agreements were preferable to litigation.²⁰ Colorado is a party to nine formal interstate water agreements, called compacts, and these compacts place limits on Colorado's ability to use all of the water supplies that originate in Colorado (see Table 2-1).

Table 2-1: Colorado's Interstate Compacts

Colorado River Compact, 1922
La Plata River Compact, 1922
South Platte River Compact, 1923
Rio Grande River Compact, 1938
Republican River Compact, 1942
Upper Colorado River Compact, 1948
Arkansas River Compact, 1948
Costilla Creek Compact, 1963
Animas La-Plata Compact, 1969

In the 1907 case of *Kansas v. Colorado*, which arose from the contention that water users in Colorado were depriving users in Kansas their fair share of Arkansas River flows, the U.S. Supreme Court announced the doctrine of equitable apportionment.²¹ This doctrine provides that the

principle of “equality of right” should be applied when determining how states should share rivers, to ensure each state receives equal benefit.²² The court dismissed Kansas’ claim because it could not show sufficient injury from Colorado’s diversions, but allowed Kansas to bring a new action in the event of a “material increase in the depletion of the waters of the Arkansas by Colorado.”²³ *Kansas v. Colorado* left future disagreements about river use to the uncertain and expensive process of protracted, Supreme Court litigation. A similar dispute over Colorado’s proposed diversions from the Laramie River to the detriment of downstream senior appropriators in Wyoming led to the case of *Wyoming v. Colorado*.²⁴ Resolving the dispute in Wyoming’s favor, the Supreme Court ruled in 1922 that when two states each use the prior appropriation doctrine, the doctrine should be applied to determine relative priorities on an interstate basis.²⁵ Thus, this decision required junior water users in Colorado to honor senior water rights in Wyoming.²⁶

One of the attorneys representing Colorado in the Wyoming litigation was a visionary who recognized that the law resulting from the *Kansas* and *Wyoming* decisions put Colorado’s future at great risk.²⁷ Delph Carpenter of Greeley, an experienced irrigation litigator as well as a rancher and former state senator, was appointed interstate streams commissioner in 1913.²⁸ As an attorney for the state, he worked on negotiations with Nebraska regarding the South Platte River.²⁹ During this time, he formulated the leading theory on the rights and authorities for entering into interstate compacts that guided the creation of the nine water compacts ultimately signed by Colorado.³⁰

Carpenter became especially concerned about the Colorado River. California, a prior appropriation state, was growing rapidly.³¹ Carpenter feared that without an agreed apportionment between the states, California farmers and municipalities would appropriate the river to the point that Colorado could not provide for future development.³² To protect Colorado, Carpenter was the principal force in the negotiation of the Colorado River Compact and went on to negotiate additional compacts on behalf of Colorado.^{33, 34} Carpenter’s model guided other negotiators of interstate water compacts, which provided certainty to water users in all participating states.¹

Interstate water compacts are formal agreements among the participating states, authorized by the United States Constitution, and ratified by state legislatures and the United States Congress. Under this framework, compacts are considered federal law, state law, and legally binding contracts among the signatory states. These compacts help the states negotiate, rather than litigate interstate waters. The nine water compacts, along with two court decrees, are fundamental elements of Colorado’s Water Plan

Table 2-2: Colorado’s Interstate Decrees
Laramie River Decree, 1957
North Platte Decree, 2001

¹ Carpenter also negotiated the South Platte River Compact and the La Plata River Compact. Other negotiators of interstate water compacts include: Clifford H. Stone (Upper Colorado River Compact and original Costilla Creek Compact); M.C. Hinderlider (Rio Grande River Compact and Republican River Compact); J.E. Whitten (amended Costilla Creek Compact); Henry C. Vidal, Gail L. Ireland and Harry B. Mendenhall (Arkansas River Compact); and multiple negotiators (Animas La-Plata Compact).

because they dictate how water is shared among states and therefore identify and impose the rights to, and limitations of, use and future development of every stream in Colorado.

Overview of Colorado's Interstate Compacts and Interstate Equitable Apportionment Decrees

Colorado River Compact

The Colorado River Compact is the foundation for a complicated set of legal requirements regarding use and management of the Colorado River, known as the “Law of the River.”² The negotiators of this compact signed it on November 24, 1922, and the U.S. Congress approved it by passage of the Boulder Canyon Project Act in 1929.³⁵

Generally, the compact apportions the right to consume water for beneficial use from the Colorado River System among the upper basin states (Colorado, Utah, Wyoming, and New Mexico) and the lower basin states (California, Arizona, and Nevada).³⁶ The dividing point between the basins is Lee's Ferry, Arizona.³⁷ The compact recognizes each basin's right to the beneficial consumptive use of 7.5 million acre-feet of water per year in perpetuity.³⁸ The lower basin states may increase their beneficial consumptive use by one million acre-feet per year.³⁹ The compact also obligates the upper division states to “not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75 million acre-feet for any period of ten consecutive years.”⁴⁰ Anticipating a potential treaty between the United States and Mexico, the compact further specifies that the states are to address any obligation to deliver water to Mexico under a future treaty by using water surplus to the apportionments between the basins.⁴¹ If no surplus exists, the upper and lower basins are to share equally in meeting any such deficiency.⁴² In addition to the apportionment provisions, the Colorado River Compact asserts that present perfected rights are not affected by the compact and recognizes the states' respective authority to regulate and control the appropriation, use, and distribution of water within their boundaries.⁴³ Present perfected rights are defined as “perfected rights, as here defined, existing as of June 25, 1929, the effective date of the Boulder Canyon Act.”⁴⁴ Complete text of the compact can be found [here](#).

Upper Colorado River Basin Compact

The Upper Colorado River Basin Compact apportions the right to beneficial consumptive use of the Colorado River among the Upper basin states (Colorado, Wyoming, Utah, New Mexico, and Arizona).⁴⁵ The compact was signed by these states on October 11, 1948 and ratified by Congress in 1949.⁴⁶ The compact allocates the consumptive use as follows: Colorado 51.75 percent, New Mexico 11.25 percent, Utah 23 percent, Wyoming 14 percent, and Arizona 50,000 acre-feet per year.⁴⁷ In addition to the allocation provisions, the compact outlines parameters for the upper division states to assure compliance with the flow obligation at Lee's Ferry under the Colorado River Compact, and establishes a Commission to implement and administer the compact.⁴⁸ Each of the four upper division states and the federal government may appoint a Commissioner to the Commission.⁴⁹

²The “law of the river” is a colloquial phrase that generally refers to the collective body of compacts, decrees, statutes, regulations, contracts, treaty, and other legal documents and agreements applicable to the allocation, appropriation, development, exportation, and management of the waters of the Colorado River.

The Upper Colorado River Basin Compact also sets forth specific terms for apportioning the use among the states of interstate tributaries to the Colorado River, including the Yampa, San Juan, Little Snake, and Henry's Fork.⁵⁰ The compact also recognizes water use according to the La Plata River Compact and accounts for such uses as part of the Upper Colorado River Compact.⁵¹ Complete text of the compact can be found [here](#).

Arkansas River Compact

Recognizing the value of settling uncertainties associated with the equitable apportionment decree from *Kansas v. Colorado*, the two states signed the Arkansas River Compact on December 14, 1948, which Congress ratified in 1949.⁵² This compact does not impose any fixed delivery obligation.⁵³ Instead, it protects water uses in existence in 1949, and limits future development in either Colorado or Kansas to the extent it would cause any material depletion of useable stateline flow.⁵⁴ The compact also addresses allocation of benefits from use of storage at John Martin Reservoir, which was completed the same year the compact was approved.⁵⁵ Specifically, the compact directs that John Martin Reservoir be operated for the benefit of both states and provides specific terms for operation.⁵⁶ Based on the compact, storage periods are divided between winter (November 1 to March 31) when all inflows are stored, and summer (April 1 to October 31), when generally only large flood flows are stored.⁵⁷ The compact also establishes the Arkansas River Compact Administration with designated roles and responsibilities.⁵⁸

Based on its authority and obligations, the Administration adopted the 1980 Operating Plan for John Martin Reservoir, which substantially modified the storage and release of water from the reservoir to improve the efficiency of water delivery to users in both states.⁵⁹ Recent litigation in *Kansas v. Colorado* provides more specific guidance for administration of the river, within the framework established in the compact and Operating Plan.⁶⁰ Complete text of the compact can be found [here](#).

Animas-La Plata Project Compact

Signed on June 7, 1969, this compact between Colorado and New Mexico is designed to inform the operation of the Animas-La Plata Project.⁶¹ This compact recognizes New Mexico's right to divert and store water from the Animas and La Plata Rivers with the same priority as those diversions under the Animas La Plata Project for Colorado users.⁶² The compact further clarifies that any use by New Mexico of these waters is counted toward its allocation under the Upper Colorado River Basin Compact.⁶³ Complete text of the compact can be found [here](#).

La Plata River Compact

Following on the heels of the Colorado River Compact, the La Plata River Compact was signed by New Mexico and Colorado on November 27, 1922, and approved by Congress in 1925.⁶⁴ The La Plata River Compact designates the location and operation of two gages on the river and defines the calculation for determining La Plata River flows.⁶⁵ This compact allows both states unrestricted use of the river between December 1 and February 15 of each year.⁶⁶ During the rest of the year, each state is entitled to unrestricted water when the Interstate gage station is greater than 100 cubic feet per second.⁶⁷ When the interstate gage station is less than 100 cubic feet per second, Colorado must deliver half of the mean flow measured at the Hesperus gage Station to New Mexico.⁶⁸ Additionally,

the compact allows for alternating periods of use between the two states in times of low flow and specifies that minor deviations from the required water deliveries will not be considered a violation.⁶⁹ Complete text of the compact can be found [here](#).

Republican River Compact

Colorado, Kansas, and Nebraska signed the Republican River Compact on December 31, 1942, which Congress ratified in 1943.⁷⁰ The compact quantifies the average annual “Virgin Water Supply” (defined as water within the basin “undepleted by the activities of man”) within the basin and its tributaries as 478,900 acre-feet of water per year.⁷¹ For beneficial consumptive use each year, the compact allocates 54,100 acre-feet of water to Colorado, 190,300 acre-feet of water to Kansas, and 234,500 acre-feet of water to Nebraska.⁷² In addition, the entire water supply originating in the basin downstream from the lowest crossing of the river at the Nebraska-Kansas state line is allocated for beneficial consumptive use in Kansas.⁷³ If the water supply of any sub-basin varies by greater than 10 percent relative to the period of record used as a basin compact, as a basis for the compact, the allocations also change by the same percentage.⁷⁴

Instead of establishing principles for dispute resolution, the compact calls for each state to administer the compact through its respective water administration officials, and acknowledges that those three officials may, by unanimous action, adopt rules and regulations consistent with the compact.⁷⁵ Consequently, in 1959 the states established the Republican River Compact Administration (RRCA).⁷⁶ Each year, by unanimous action, the three RRCA members compute the Virgin Water Supply within the basin and the beneficial consumptive use of each state.⁷⁷ Under the accounting procedures established by the RRCA, Colorado’s allocation for beneficial consumptive use in the Republican River sub-basins under normal conditions includes 10,000 acre-feet from the North Fork of the Republican, 15,400 acre-feet from the Arikaree River, 25,400 acre-feet from the South Fork of the Republican, and 3,300 acre-feet from the Beaver Creek. Kansas and Nebraska may each consume 190,300 acre-feet and 234,500 acre-feet of water, respectively.⁷⁸

Despite efforts to avoid litigation and promote interstate comity by entering into the Republican River Compact, the states have been involved in formal disputes regarding compact compliance and interpretation since 1999. Currently, the lack of unanimity regarding accounting procedures and compact compliance has formed the basis of several non-binding arbitrations and litigation before the U.S. Supreme Court. Complete text of the compact can be found [here](#).

Rio Grande Compact

The Rio Grande Compact allocates beneficial use of water from the Rio Grande among Colorado, New Mexico, and Texas. These states signed the Rio Grande Compact on March 18, 1938, and it was approved by Congress the following year.⁷⁹ The compact defines the boundaries of the Rio Grande River Basin and establishes the operation of six gage stations and recorders near reservoirs built after 1929.⁸⁰ It requires that Colorado deliver a certain amount of water at the New Mexico and Colorado state line annually based on an index schedule, and includes provisions for New Mexico to deliver certain amounts to Elephant Butte Reservoir based on a similar, though separate, index schedule.⁸¹ The compact assumes a normal release of 790,000 acre-feet from Elephant Butte to irrigate lands in southern New Mexico and Texas and provide water to Mexico consistent with the

1906 Treaty.⁸² Additionally, the compact creates a system of water credits and debits, storage, spills, and releases from the Rio Grande Project at Elephant Butte and places further restrictions on storage within Colorado and New Mexico.⁸³ The compact also establishes a commission for compact administration purposes. Colorado's State Engineer serves as Colorado's Commissioner.⁸⁴ Complete text of the compact can be found [here](#).

South Platte River Compact

Colorado signed the South Platte River Compact shortly after the La Plata River Compact on April 27, 1923; however Congress did not fully ratify the compact until 1926.⁸⁵ This compact allocates the waters of the South Platte River between Colorado and Nebraska.⁸⁶ It relies on the west boundary of Washington County to separate the upper and lower sections of the South Platte River within Colorado and establishes a gage at Julesburg to measure flow.⁸⁷ The South Platte Compact provides Colorado unrestricted use of water in the lower section between October 15 and April 1 and includes several provisions relating to Nebraska's canals. Between April 1 and October 15, the compact stipulates that Colorado curtail diversions in the lower section by appropriators with decrees junior to June 14, 1897 when the mean flow (as measured at the Julesburg gage) is less than 120 cubic feet per second.⁸⁸ Like the La Plata Compact, the South Platte Compact specifies that minor irregularities in water delivery will not constitute a violation of the compact.⁸⁹ Complete text of the compact can be found [here](#).

Amended Costilla Creek Compact

Colorado and New Mexico signed the Costilla Creek Compact on September 30, 1944, and amended the compact in 1963.⁹⁰ The Costilla Creek Compact is intended to establish integrated operations between Colorado and New Mexico for existing and prospective irrigation facilities and to equalize the benefits of the water and its beneficial use between the two states.⁹¹ The compact defines May 16 to September 30 as the irrigation season, designates October 1 to May 15 as the storage season, and prohibits direct flow diversions during the storage season.⁹² The compact further sets forth the amount of water to be delivered among the water users within both states, and provides for allocation of surplus flows and storage in reservoirs constructed after the compact took effect.⁹³ Deliveries to water users in Colorado are to be made from flows of Costilla Creek downstream of where it leaves the mountains.⁹⁴ Moreover, the compact allocates 36.5 percent of the usable capacity of the Costilla Reservoir to Colorado and 63.5 percent to New Mexico.⁹⁵ The 1963 amendment to the compact allows for a change in point of diversion for the Cerro Ditch, where delivery from Costilla Reservoir is made.⁹⁶ A commission comprised of the State Engineers for both Colorado and New Mexico oversees the compact.⁹⁷ Complete text of the compact can be found [here](#).

Laramie River Decree

The decree in *Wyoming v. Colorado*, 353 U.S. 953 (1957), permits Colorado to divert 49,375 acre-feet of water per calendar year from the Laramie River and its tributaries provided that no more than 19,875 acre-feet per calendar year of that total amount of water may be diverted by Colorado outside the Laramie River Basin.⁹⁸ Further, no more than 1800 acre-feet may be diverted by Colorado after July 31 of each year for use within the basin. All waters diverted for use within the Laramie River Basin in Colorado are restricted to irrigation use on those lands designated by

the court at the time of the decree, while waters diverted for use outside the basin are not subject to that restriction. The waters of Sand Creek are specifically excluded from the operation of this decree.⁹⁹ Complete text of the decree can be found [here](#).

North Platte Decree

The amended decree in *Nebraska v. Wyoming*, 534 U.S. 40 (2001), equitably apportions water in the North Platte River among Colorado, Nebraska, and Wyoming.¹⁰⁰ The decree limits Colorado's diversion of water from the North Platte River in Jackson County for irrigation of no more than 145,000 acres during one irrigation season (May 1 to September 30) and limits storage to storing no more than 17,000 acre-feet of water for irrigation purposes between October 1 of any year and September 30 of the following year. The decree also limits total water exports from the North Platte River Basin in Colorado to no more than 60,000 acre-feet during any 10-year period. The decree does not affect or restrict the use or diversion of water for ordinary and usual domestic, municipal, and stock watering purposes.¹⁰¹ Complete text of the decree can be found [here](#).

Other Institutional Interstate and Federal Agreements

In addition to the compacts and interstate equitable apportionment decrees described above, Colorado has entered into many interstate agreements (rather than more formalized compacts) to manage water resources. Two such agreements, which are described below, are Memoranda of Understandings between Colorado and neighboring states involving Pot Creek (Utah) and Sand Creek (Wyoming). In addition, Colorado has remained actively involved in interstate and federal water matters to protect the State's rights and interests in water resources. Recognizing that formal disagreements or disputes among states regarding enforcement, interpretation or implementation of the interstate compacts or reconsideration of equitable apportionment decisions rise directly to the U.S. Supreme Court as state to state controversies, and inevitably result in expensive, protracted litigation, the last two decades have seen an unprecedented amount of cooperation and interstate consensus among the State of Colorado, the federal government, and downstream states. The result of this cooperation is that many disputes have ultimately resolved through interstate agreements.

Pot Creek Agreement

Colorado and Utah used a Memorandum of Understanding (MOU) to define their relationship regarding Pot Creek, rather than an interstate compact.¹⁰² Originating in the Uinta Mountains in Utah, Pot Creek flows for eight miles within Colorado before joining the Green River. The Pot Creek MOU was signed on April 1, 1958 and sought to establish an equitable and workable division of water between the two states. This MOU stipulated that both Colorado and Utah believed that a compact would eventually be necessary to appropriate the water between the two states, but that the MOU would help develop a functioning system prior to the formulation of an interstate compact. One aspect of the Pot Creek MOU was to define the parameters for appointing a water commissioner with the authority to administer water in both Colorado and Utah, the expenses to be apportioned with Utah bearing 80 percent of the costs and Colorado 20 percent. Additionally, this MOU states that direct flow diversions may not be exercised before May 1 of each year and establishes a schedule of priorities for use in the two states.¹⁰³

Sand Creek Agreement

Sand Creek originates in the Laramie Mountains of Colorado and flows into Wyoming where it joins the Laramie River.¹⁰⁴ To equitably apportion Sand Creek, Colorado and Wyoming signed an MOU on March 13, 1939. The Sand Creek MOU allocated waters according to the priority water rights in Colorado and Wyoming, recognizing that Wyoming was entitled to 50.68 cubic feet per second prior to any Colorado diversions. This provision was later revised on August 7, 1997 to require the delivery of 40 cubic feet per second by Colorado over a seven day period at the beginning of the irrigation season, after which Colorado was required to deliver 35 cubic feet per second. Finally, the Sand Creek MOU limited diversions of the Sand Creek Ditch and the Wilson Supply Ditch to amounts of water in excess of the water allocated to Wyoming.¹⁰⁵

Colorado River

Within the Colorado River Basin, there have been extraordinary strides toward cooperation in the last several decades. For example, the Upper Colorado River Recovery Program and the San Juan River Recovery Implementation Program enable Colorado to fully use its compact entitlements, while striving to support the recovery of endangered fish species. These programs are further described in this plan.

In 2006, Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming also signed the Range-Wide Conservation Agreement and Strategy for Roundtail Chub, Bluehead Sucker, and Flannelmouth Sucker (Three Species Agreement).¹⁰⁶ The states created this agreement to expedite the implementation of conservation measures for the three species through a collaborative and cooperative interstate effort. The Three Species Agreement sought to minimize the potential threats to the species that could result in a federal listing using coordinated State-driven preventative measures.¹⁰⁷

In 2007, the states navigated substantial disagreement to collectively support the Bureau of Reclamation's (BOR's) Record of Decision on Interim Guidelines for Lower Basin Shortages and Coordinated Operation of Lakes Powell and Mead through 2026.¹⁰⁸ Among other things, these guidelines: 1) set forth coordinated, operational protocols between Lakes Mead and Powell to allow the system to operate more efficiently during drought; 2) establish shortage guidelines in the lower basin; and 3) implement the Intentionally Created Surplus mechanism for banking water in Lake Mead.¹⁰⁹

Continued cooperative efforts have helped lower basin interest to use water more efficiently. Such efforts include the creation of Intentionally Created Surplus, the pilot operation of the Yuma Desalting Plant, and the construction and operation of Brock Reservoir.

The states and federal government have also continued to develop a working relationship with Mexico, resulting in Minutes 316-319 to the 1944 Water Treaty.¹¹⁰ These Minutes identify and implement voluntary options for creating a larger quantity of water in the system, enhancing environmental values, providing Mexico access to storage in the United States, providing improved water management during drought in both countries, and establishing the foundation for

developing and implementing cooperative projects mutually beneficial to both countries consistent with the 1944 Water Treaty and the Law of the River.

In response to the basin-wide drought beginning in 2000, there has also been increased interstate activity in the field of weather modification. Weather modification, or cloud seeding, is designed to increase winter precipitation through aerial and ground-based techniques. The Colorado Basin States are pursuing winter cloud seeding efforts in Colorado, Wyoming, and Utah. Additionally, New Mexico helps fund Colorado's weather modification program in southwest Colorado to increase run-off and flow in the Colorado River.¹¹¹

Most recently, the Colorado River Basin States have turned their attention to collaborating on contingency planning to protect certain reservoir thresholds in the event of continued drought conditions, protecting power generation, and ensuring the continued use and development of existing water supplies.

Platte River

On the South and North Platte Rivers, Colorado, Wyoming, and Nebraska are currently working with the Department of the Interior to collectively manage the river with the dual goals of endangered species recovery and water development protection. The Platte River Recovery Implementation Program, established in 1997, seeks to restore habitat, provide for increased stream flows, and encourage an adaptive management approach to river operations.¹¹² This program is further described in Chapter 6.

Republican River

Within the Republican River Basin, the state of Colorado continues to be involved with Colorado water users, as well as Nebraska and Kansas, to identify reasonable methods for future compact compliance by all parties. The Compact Compliance Pipeline (CCP) was recently constructed to facilitate Colorado's ongoing and future compact compliance while mitigating impacts to Colorado water users. Before the pipeline can become fully operational, Nebraska, Kansas, and Colorado must agree on how to account for the water under the compact. This includes negotiating, and in some instances arbitrating, appropriate changes to compact accounting procedures and implementing new operations in the basin. Once a final agreement or decision is implemented water delivery from the CCP will be counted towards Colorado's compact obligation to Nebraska and Kansas.

Rio Grande River

On the Rio Grande, the state continues to work with intrastate and interstate issues related to groundwater administration and compliance with the compact compliance and the Endangered Species Act (ESA). Groundwater issues are being addressed in the San Luis Valley through the establishment of basin sub-districts and ongoing efforts to end groundwater administration rules for the Rio Grande Basin in Colorado. Additionally, the state continues to work with the federal government and stakeholders to address survival and recovery efforts of endangered and threatened species in a manner that respects and complies with existing Colorado water rights as well as interstate compact rights and authorities. The state is also involved in an interstate lawsuit

before the U.S. Supreme Court concerning groundwater pumping and usage between Texas and New Mexico below Elephant Butte Reservoir. Because interpretation and enforcement of the Compact may form the basis for part of the controversy between Texas and New Mexico, Colorado, as a signatory to the Compact, is a named party to the lawsuit.¹¹³

[San Juan/Dolores River](#)

In the San Juan/Dolores Basin, a major project is underway to assist Colorado in meeting its compact obligations to New Mexico. The Long Hollow Reservoir is being constructed to both supplement the irrigation needs for the region and to assist in fulfilling compact requirements. This reservoir will allocate 300 acre-feet of annual storage to be used for deliveries to New Mexico during summer low-flow months. In addition, the Animas La-Plata Project was recently completed. The water purchased by CWCW for this project will be important to the state in the future.

2.3 Colorado's Local Control Structure

Colorado's local governments have considerable authority in making water development and management decisions. The state's 64 counties and 271 municipalities exercise a broad range of powers to address the needs of respective constituents that are explicitly delegated to them by state law.

Generally, counties have discretionary powers to provide services, including water and sewer, and to operate districts for irrigation and recreation, among others. Cities and towns have the ability to address the needs of their denser populations through self-government, including administrative, police and financial powers. Furthermore, the state constitution authorizes municipalities and counties to adopt home rule charters, which provide even greater autonomy and flexibility to address local problems.¹¹⁴ Municipal home rule is intended to ensure that cities can make decisions on expending funds, incurring debt, building and maintaining public facilities, and undertaking other activities to meet their needs. County home rule charters are authorized to establish the organization and structure of county government, but do not provide the "functional" home rule powers of municipal charters.¹¹⁵

[Land and Water Use Planning Authority](#)

State law also provides local governments with authority specific to land use and water planning. The Local Government Land Use Control Enabling Act broadly allows counties and municipalities to balance environmental protection with the need to provide for the planned and orderly use of land.¹¹⁶ The act allows a local government to provide for the phased development of services and to regulate the location of activities and development that may cause significant changes in population density. The act also requires a local government to make a determination as to whether an applicant for larger developments (in excess of 50 units or single-family equivalents) has demonstrated that the proposed water supply is adequate to serve the proposed development.¹¹⁷

Counties and municipalities are also required to adopt master plans for the development of their jurisdictions, which may include a water supply component.¹¹⁸ State law encourages water efficiency and conservation through public project landscaping guidelines.¹¹⁹

Counties and municipalities have the authority to impose an impact fee as a condition of a development permit in order to pay for certain costs associated with growth. These fees can only be used to offset the impacts of new development on existing infrastructure and capital improvements and cannot be used for ongoing expenses and maintenance.¹²⁰ Nearly half of Colorado's cities have implemented impact fees, and the most commonly used fees are for water and sewer.¹²¹ Although the developer pays the fee, the costs are typically borne collectively by residents of the new development through increased housing prices, when the market can sustain the full price increase needed to cover the fee.¹²²

In addition to providing a tool for offsetting impacts to existing infrastructure, state law allows a municipality to construct or authorize the construction of new waterworks, if approved by voters. The municipality is also authorized to protect the waterworks and water supply from pollution for up to five miles above the point from which the water is taken.¹²³

Finally, HB-74-1041 powers (further explained in section 2.4) allow local governments, primarily counties, to identify, designate, and regulate 21 statutorily defined "areas and activities of state interest," including the site selection, construction or extensions of major new water and sewage treatment systems. This is intended to ensure that local governments can consider and mitigate the impacts of new developments.¹²⁴

Special Districts

Colorado law allows voters to create many types of local special districts,¹²⁵ which are governing entities that oversee specific services, such as fire protection, water, and sewer. Special districts have the autonomy to solve local problems using local funds to devise local solutions. Districts do this by dividing the costs of services among all property owners and residents. They are also able to finance larger infrastructure and public facility projects and repay these costs over time as development occurs and property values increase.¹²⁶ There are a number of special districts related to water use and water planning, including:

- Water Districts— supply water for domestic and other public and private purposes by any available means and provide all necessary or proper reservoirs, treatment works and facilities.¹²⁷
- Sanitation Districts— provide for storm or sanitary sewers, or both; flood and surface drainage; treatment and disposal works and facilities; or solid waste disposal facilities or waste services; and all necessary or proper equipment.¹²⁸
- Water and Sanitation districts— provide both water and wastewater services.¹²⁹
- Metropolitan Districts— provide two or more of a variety of services including parks and recreation, wastewater and water.¹³⁰
- Park and Recreation Districts— provide park or recreational facilities or programs.¹³¹
- Irrigation districts— provide for the irrigation of lands in the district and the drainage work necessary to maintain irrigation.¹³²
- Water Conservancy Districts and Water Conservation Districts— transmit information and coordinate efforts among agencies, political subdivisions, and private citizens and businesses concerning the conservation, protection, and development of Colorado's water resources.¹³³

- Urban Drainage and Flood Control— assist local governments with multijurisdictional drainage and flood control challenges and provide funding or levy property taxes to fund programs and projects.¹³⁴
- Groundwater Management Districts— adopt rules and regulations to help administer groundwater within the district.¹³⁵

Department of Local Affairs (DOLA) Overview

DOLA is responsible for supporting Colorado's local communities and augmenting local government capacity by providing training, technical and financial assistance to localities. The department's divisions serve several purposes, including: provision of affordable housing, property tax assessment and collection, training for local government issues, and distribution of state and federal funds for community projects. Within DOLA, the Division of Local Government (DLG) provides local governments with demographic data, technical assistance for local governments on common issues (such as budgeting and planning), technical resources, and financial assistance programs. Specifically within DLG, the Community Development Office provides technical and financial assistance to local governments on land use planning and general community development, including training for planners and planning commissioners. DLG often funds county and municipal comprehensive plans and encourages water supply and conservation elements.

2.4 Local, State, and Federal Water Planning, Approval, & Permitting Institutions

Introduction

To implement a water project in Colorado approvals from numerous local, state, and federal entities are required. These approvals and partnerships are critical to ensure the right checks and balances are in place for a project to move forward. Traditionally, these organizations include the entities listed below.

Local entities:

- *Project proponents* include a wide array of water users and water providers including, but not limited to, local governments that run a utility, private water companies that act as a local utility, special districts, ditch companies, or regional water conservancy and conservation districts that sell water to local water providers. These entities are responsible for coordinating with state and federal permitting entities to successfully permit their water project.
- *Local governments* have jurisdiction and authority over parts of development projects and can request mitigation for any impacts resulting from proposed water projects because of their 1041 powers, which are detailed below under the state planning section.¹³⁶
- *Cooperating agencies* are entities interested in a water project that request cooperating agency status under the National Environmental Policy Act (NEPA) process.¹³⁷

State entities:

- *Colorado Water Conservation Board (CWCB)* is a division within the Colorado Department of Natural Resources. CWCB sets water policy and planning in Colorado.¹³⁸

- *Colorado Water Quality Control Division (CWQC)* is housed within the Colorado Department of Public Health and Environment (CDPHE). The agency reviews water quality certifications under Section 401 of the federal Clean Water Act (CWA).
- *Division of Water Resources (DWR)* is housed in the Colorado Department of Natural Resources and is responsible for water administration. DWR ensures that a project can be administered. New water rights and well permits must be filed with DWR.
- *Colorado Attorney General's Office* is the legal authority regarding matters of law, including whether or not a particular project or agreement is legal under Colorado law.
- *Colorado Parks and Wildlife (CPW)* is a division within the Colorado Department of Natural Resources. CPW reviews state wildlife mitigation plans under Colorado's state statutes, known as 122.2 plans.¹³⁹

Federal entities:

The following can all act as lead agencies responsible for National Environmental Policy Act (NEPA) compliance and oversight.

- *Environmental Protection Agency (EPA)* is the federal agency responsible for oversight of permitting related to wetland mitigation, described under section 404 of the CWA.
- *U.S. Army Corps of Engineers (Corps)* is responsible for 404 permitting under the CWA.
- *U.S. Forest Service (USFS)* manages United States forests and has substantial land holdings in Colorado (role related to water rights described in Section 2.5).
- *U.S. Fish and Wildlife Service (USFWS)* manages threatened and endangered species recovery programs and regulates actions impacting threatened or endangered species under the ESA). This agency is responsible for determining if a project exceeds the bounds of any programmatic opinions regarding further water development. Under the Fish and Wildlife Coordination Act, federal agencies responsible for coordinating NEPA compliance must consult with the USFWS regarding the project's potential impacts to threatened and endangered fish and wildlife species.
- *Bureau of Reclamation (BOR)* is the agency that built, and now manages, several water projects, such as Blue Mesa Reservoir and the Fry-Ark project. BOR is responsible for contracting water out of these federal projects.
- *U.S. Bureau of Land Management (BLM)* has substantial land holdings within Colorado.
- *U.S. National Park Service (NPS)* has substantial land holdings within Colorado (see Section 2.5 for NPS).
- *Federal Energy Regulatory Commission (FERC)* is responsible for FERC licensing associated with hydropower projects.

State Planning

The CWCB is the primary state agency responsible for statewide water planning. Water planning determines the types of water projects and quantity of water needed in the future to support Colorado's growing population. The basin roundtables and the Interbasin Compact Committee (IBCC) were created in 2005 and are participants in CWCB's statewide water planning efforts.

The IBCC is made up of two representatives from each basin roundtable, six governor appointees, and two appointees from the state legislature. Their charge is to develop agreements among basins and to develop statewide policy issues.

Both the basin roundtables and the IBCC provide critical input to the Statewide Water Supply Initiative (SWSI) and Colorado's Water Plan. SWSI creates a technical foundation and a common technical platform that stakeholders and Colorado's Water Plan use and build upon. The report is periodically updated with the latest technical information and tracks Colorado's changing water supply and demand. In addition, the basin roundtables and CWCB have developed a forum where project proponents can find technical and financial support.

Section 122.2

C.R.S. § 37-60-122.2 is the Fish and Wildlife Resources Fund and Authorization that declares fish and wildlife resources are a matter of statewide concern and requires that impacts to such resources should be reasonably mitigated by applicants proposing water diversion, delivery, or storage projects.¹⁴⁰ A section 122.2 plan is generally required when an applicant seeks a permit or license from the federal government for the specified types of water projects, with some exceptions as noted in the statute. Applicants must submit a mitigation proposal to the CPW commission for review and approval.¹⁴¹ Once the applicant and the commission agree on the plan, it is forwarded to the CWCB for Board adoption as the official state position on the plan.¹⁴² A plan is generally required when an applicant seeks a permit or license from the federal government for specified types of water projects, with some exceptions, as noted in the statute. Grants to help implement the mitigation plans are available for applicants. Examples of completed plans or those section 122.2 plans still in process are: Southern Delivery System (SDS), Windy Gap firming project, Moffat Collection project, and Chatfield Reservoir Reallocation project.

401 Water Quality Certification

The WQCD is an agency under the CDPHE. The WQCD reviews water quality certifications under Section 401 of the federal CWA and issues permits accordingly.¹⁴³ The WQCD also examines actions or projects that fall under the Colorado 401 Certification Regulation. Any federal license or permit issued to construct or operate a facility, which may result in any fill or discharge into navigable waters of the United States is required to obtain a CWA 401 certification.¹⁴⁴ The certification process includes a preliminary review of the proposed project, a 30-day public notice, review of public comments, and a final certification decision for the proposed project.¹⁴⁵ Permitting is discussed further in Section 9.4.

1041 Local Permits

In 1974, the Colorado General Assembly enacted measures to further define state and local government's authority to make planning decisions for matters of statewide interest. House Bill 74-1041 establishes local powers over certain activities of state interest.¹⁴⁶ These are commonly referred to as 1041 powers which allow local governments to identify, designate, and regulate areas and activities of state interest through a local permitting process.¹⁴⁷ The 1041 powers enable local governments to maintain control over particular aspects of development projects, even when

the development project has statewide impacts.¹⁴⁸ For a development project to proceed, it needs to be consistent with the environmental and developmental goals of the local communities, as outlined in their 1041 regulations.

The mitigating impacts from the construction and operation of large-scale water projects are particularly important to many local governments. House Bill 74-1041 authorizes local governments to designate activities of state interest as follows: 1) site selection and construction of major new domestic water and sewage treatment systems; 2) major extension of existing domestic water and sewage treatment systems; 3) site selection and development of new communities; and, 4) efficient use of municipal and industrial water projects.¹⁴⁹ Local governments may not pass regulations that prohibit the construction of municipal water facilities and the expansion of existing projects. House Bill 74-1041 outlines that a locality must have a permit, and designate conditions of the permit before construction of a project with state interest.¹⁵⁰

Cooperating Agency Status

Federal agencies actively consider designation of cooperating agencies in the preparation of analyses and documentation required by NEPA and they participate as cooperating agencies in other agency's NEPA processes.¹⁵¹ The Council on Environmental Quality (CEQ) regulations addressing cooperating governing agencies NEPA state that federal agencies responsible for preparing NEPA analyses and documentation do so "in cooperation with State and local governments" and other agencies with jurisdiction by law or special expertise.¹⁵²

Stakeholder involvement is important in ensuring that decision makers have the environmental information necessary to make informed and timely decisions. Cooperating agency status is a major component of agency stakeholder involvement in the NEPA process. The benefits of early cooperating agency participation in the preparation of NEPA analyses include: disclosing relevant information early in the analytical process; applying available technical expertise and staff support; avoiding duplication with other federal, state, tribal and local procedures; and establishing a mechanism for addressing intergovernmental issues, and other benefits. The state of Colorado participates as both a non-federal project sponsor and as a Cooperating Technical Agency on a case-by-case basis for water projects in the state.

NEPA, Section 404 Permitting, and the ESA

NEPA establishes the broad national legal framework for protecting the environment.¹⁵³ NEPA's basic policy is to ensure that all branches of government give proper consideration before undertaking any major federal action that substantially affects the environment.¹⁵⁴ NEPA requirements are invoked when significant projects are proposed that have a federal nexus. A federal nexus includes use of federal funds, crossing federal lands, and use of federal facilities. The primary NEPA requirements are Environmental Assessments (EA) and Environmental Impact Statements (EIS), which are required from all federal agencies to assess the likelihood of impacts from the proposed project and alternative courses of action.¹⁵⁵ Depending on the various aspects of a given project, a variety of federal agencies can serve as the "lead agency" for NEPA purposes, as mentioned above.¹⁵⁶

In 1972, Section 404 of the CWA established a program to regulate the discharge of dredged or fill material into waters of the United States.¹⁵⁷ The program is jointly administered by the Corps and the EPA. The Corps is responsible for day-to-day administration and permit review, and EPA provides program oversight. The goal of the program is to ensure that no discharge of dredged or fill material is permitted if there is an alternative that would be less damaging to the aquatic resources, or if substantial degradation would occur to the nation's waters. The permit review process is sequential and encourages avoiding impacts, then minimizing impacts and, finally, requiring mitigation for unavoidable impacts to aquatic environment.¹⁵⁸ In addition, the U.S. Congress enacted the ESA of 1973.¹⁵⁹ ESA requires federal agencies to consult with the USFWS when any action the agency carries out, funds, or authorizes may affect a listed endangered or threatened species. These consultations can be very resource intensive, and they ultimately are completed with a Biological Opinion (BO) from the USFWS. This BO can, in extreme cases, result in a "jeopardy opinion" and can result in the federal agency not taking action. The State of Colorado is involved in NEPA processes, ESA consultations, and 404 permitting processes at various levels on a case-by-case basis. The State may review agency action, participate as a cooperating agency, a non-federal sponsor, or participate in some other way.

2.5 Tribal and Federal Reserved Water Right Issues within Colorado

Introduction

In addition to the patchwork of local, state, and federal agencies involved in water planning, described in Section 2.4, many federal agencies and Native American tribes hold water rights that serve as part of the existing institutional setting for water planning. Colorado is home to a substantial amount of tribal and federally held lands. Of the 66, 485,760 acres that form the state of Colorado, the federal government holds title to approximately one-third of this land (24,086,075).¹⁶⁰ Specific federal agencies with major federal land holdings in Colorado include: USFS, BLM, NPS, and USFWS. In addition, two different Native American tribes have reservations located within Colorado borders: the Southern Ute Tribe and the Ute Mountain Ute Tribe are both located in Southwestern Colorado (and northwestern New Mexico). The Southern Ute Tribe is governed by its tribal council whose constitution was approved in 1936.¹⁶¹ The Ute Mountain Ute Tribe is governed by its tribal council whose constitution was approved in 1940.¹⁶² Beyond the two tribes, only the USFS, NPS, and USFWS have pursued substantial reserved water rights associated with their landholdings in Colorado.

The history of federal and tribal water rights, as they relate to these land holdings in Colorado, is unique and complicated. Any discussion of federal water rights must begin with a discussion of "the Winters Doctrine."¹⁶³ The Winters Doctrine, established by the U.S. Supreme Court in 1908, generally provides that when the United States sets aside an Indian Reservation, it also reserves the minimum amount of water necessary to fulfill the purposes of the reservation, with the priority date established as of the date of the reservation.¹⁶⁴ The Winters Doctrine was a landmark case for it was the first time the federal government deviated from the established convention that water law was purely a state matter.^{165, 166} The Court subsequently expanded application of the Winters Doctrine beyond tribal reservations to also apply to federal lands withdrawn from the public

domain to the extent that water is deemed either expressly or impliedly necessary to satisfy the primary purposes of the federal reservation.¹⁶⁷ This expanded version of the judicially created Winters Doctrine resulted in what is generally referred to as “federal reserved water rights.”

Federal reserved rights differ from rights acquired under state law in that reserved rights rest on the date a reservation was created—not when the water was first put to beneficial use—and cannot be lost through non-use. Moreover, before 1952, the United States avoided, and was not required to have, its federal claims to water either formally listed or made the subject of any decree or permit within the state water administration system. Rather, federal reserved water rights existed outside of (and separate from) the orderly procedure for administering all other water rights within the states. The ability, therefore, of the state systems to function to avoid conflict and create affirm water supply through a comprehensive and cohesive water administration system was threatened by the judicially created federal water right under the Winters Doctrine.

As a direct response to this unintended ambiguity, Congress adopted the McCarran Amendment in 1952 to rectify the fact that “the extent and priority of federal water rights, including federal reserved rights, were unknown and not the subject to adjudication or determination in state courts.” To overcome this complication, the Amendment provides a limited waiver of the United States’ sovereign immunity for purposes of including the United States (on its own behalf or on behalf of the tribes) in state stream adjudications and water administration suits.¹⁶⁸ Since then, Colorado has settled and adjudicated tribal reserved rights claims asserted on behalf of the Southern Ute and Ute Mountain Ute Tribes in Colorado as well as claims for federal reserved water rights by federal agencies throughout the state. The state administers the reserved rights recognized by these proceedings in priority in conjunction with state-based water rights.

Federal Agencies

Water rights held by the USFS, the USFWS, and the NPS enjoy complicated histories.¹⁶⁹ Each agency has sought substantial federal reserved water rights in a variety of locations throughout the western United States. In Colorado, the USFS has filed for reserved water rights in all seven water divisions. In Water Divisions 1 and 2, the USFS claims for non-consumptive reserved rights were denied by the water court and withdrawn with prejudice.^{170 171 172} In Water Division 3, the USFS reached a stipulated decree settlement for both consumptive and non-consumptive reserved rights in 2000.¹⁷³ Stemming from the Colorado Supreme Court decision in *U.S. v. Denver*, the USFS may not claim federal reserved water rights for instream flow purposes in Water Divisions 4, 5 or 6.^{174, 175, 176} The USFS’s applications for federal water rights are still pending in Water Division 7.^{177, 178}

The USFWS has several large wildlife refuges in Colorado. The NPS has obtained federal reserved water rights for Rocky Mountain National Park, the Great Sand Dunes National Park and National Monument, the Black Canyon of the Gunnison, and the Mesa Verde National Park.^{179, 180, 181, 182, 183} The federal government also maintains a wild and scenic river designation for the upper reaches of the Cache La Poudre under the Wild and Scenic Rivers Act that includes a federal reserved water right.¹⁸⁴

Tribes

The Southern Ute and Ute Mountain Ute tribes filed water claims through the United States in 1976 in over twenty-five streams in southwest Colorado. Rather than litigate each of these claims, the Tribes, the State of Colorado, the United States, and other parties negotiated settlements for each river, which were combined and incorporated into the Colorado Ute Indian Water Rights Final Settlement Agreement dated December 6, 1986 (1986 Settlement Agreement).¹⁸⁵

The Final Settlement Agreement quantifies the entitlements of the tribes to reserved water rights in the state of Colorado and provides for administration of those reserved rights. A critical component of the 1986 Settlement Agreement is provision of water to the tribes from the Animas-La Plata Project, a participating project of the Colorado River Storage Project Act, authorized by the Colorado River Basin Project Act to fulfill the Tribes' reserved rights claims from the Animas and La Plata Rivers.¹⁸⁶

The United States Congress authorized the 1986 Settlement Agreement in the Colorado Ute Indian Water Rights Settlement Act of 1988, Pub. L. No.100-585 (102 Stat. 2973) (1988 Settlement Act), and Colorado's District Court, Water Division 7, entered stipulated Consent Decrees for the Tribes' water on December 19, 1991. However, complications with endangered species, water quality and other concerns prevented implementation of the 1986 Settlement Agreement, 1988 Settlement Act, and 1991 consent decrees on the Animas and La Plata Rivers. To address these concerns, Congress modified its authorization of the Animas La Plata Project, and amended the 1988 Settlement Act in the Colorado Ute Settlement Act Amendments of 2000, Pub. L. No. 106-554, 114 Stat. 2763A 258 (2001), (2000 Amendments).¹⁸⁷ According to these amendments, water use from the Animas La Plata Project is limited to municipal and industrial (M&I) uses. Moreover, the U.S. Attorney General is required to have the Colorado District Court amend the Consent Decrees to incorporate the modifications in the 2000 Amendments. Under this framework, construction of the Animas-La Plata Project began in 2001. The Colorado District Court's amendments to the 1991 Consent Decrees were effectuated in 2006 to reflect the changes in the 2000 Amendments, and the reservoir for the Animas-La Plata Project filled in 2011.¹⁸⁸

The purposes of this Final Settlement Agreement were to: (1) determine finally all rights of the Southern Ute and Ute Mountain Ute Indian Tribes, and of the persons claiming under the tribes, to beneficially use water for, or to beneficially use water on, under, adjacent to or otherwise appurtenant to, the Southern Ute and Ute Mountain Ute Indian Reservations within the state of Colorado; (2) settle existing disputes and remove causes of future controversy among the tribes and the State, among the tribes and the United States, and among Indians of the reservations or their successors and other persons, concerning the rights to beneficially use water in southwestern Colorado; (3) settle all claims by the tribes and by the United States on behalf of the tribes in the water adjudication proceedings pending in the Colorado District Court for Water Division No. 7; (4) secure for the tribes an opportunity to derive an economic benefit or generate revenue from the use of the project and non-project reserved water rights secured in this agreement; (5) to enhance the tribe's ability to meet their repayment obligations under this agreement; and (6) to authorize the tribes to sell, exchange, lease or otherwise temporarily dispose of their water.¹⁸⁹

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- ³ *Comstock v. Ramsay*, 55 Colo. 244, 254, 133 P. 1107, 1110 (1913).
- ⁴ Colo. Const. of 1876, art. XVI, § 6.
- ⁵ Water Right Determination Act, 37-92-101 et. seq. (C.R.S.).
- ⁶ §37-92-102 (1)(a), C.R.S.
- ⁷ *Colorado’s 1969 Adjudication and Administration Act: Settling in*, University of Denver Water Law Review Volume 3 1999.
- ⁸ § 37-92-103 (4), C.R.S.
- ⁹ §37-92-102 (3), C.R.S.
- ¹⁰ §37-92-103 (4), C.R.S.
- ¹¹ §37-92-102 (5), C.R.S.
- ¹² Radosevich, George E., *Western Water Laws and Irrigation Return Flow*. U.S. EPA: 1978. *Black’s Law Dictionary*, 4th ed. revised, 1968.
- ¹³ §§ 37-92-305 (3), (4) C.R.S.
- ¹⁴ *Colorado Water Conservation Board v. City of Central*, 125 P.3d 424 (Colo. 2005)
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- ²⁴ *Wyoming v. Colorado*, 259 U.S. 419 (1922).
- ²⁵ *Wyoming v. Colorado*, 259 U.S. 419 (1922).
- ²⁶ *Wyoming v. Colorado*, 259 U.S. 419 (1922).
- ²⁷ Tyler, *Silver Fox of the Rockies*, 104-105.
- ²⁸ Tyler, *Silver Fox of the Rockies*, 100.
- ²⁹ Tyler, *Silver Fox of the Rockies*, 104-105.
- ³⁰ Tyler, *Silver Fox of the Rockies*, 119.
- ³¹ Tyler, *Silver Fox of the Rockies*, 115.
- ³² Tyler, *Silver Fox of the Rockies*, 115.
- ³³ Tyler, *Silver Fox of the Rockies*, 88-122.
- ³⁴ Norris Hundley, *Water and the West: The Colorado River Compact and the Politics of Water in the American West* (Berkeley: University of California Press), 83-137
- ³⁵ C.R.S. § 37-61-101 et seq. and approved by Congress by the Boulder Canyon Project Act, Chapter 42, § 4, page 45 (1928)(codified at 42 U.S.C.A. § 617c).
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- ³⁷ C.R.S. § 37-61-101 et seq.
- ³⁸ C.R.S. § 37-61-101 et seq.
- ³⁹ C.R.S. § 37-61-101 et seq.
- ⁴⁰ C.R.S. § 37-61-101 et seq.
- ⁴¹ C.R.S. § 37-61-101 et seq.
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- ⁴⁶ C.R.S. § 37-61-101 et seq. and approved by Congress by the Colorado River Storage Project Act, ch. 203, 70 Stat 105 (1956) (codified at 43 U.S.C. § 620-620 (o))

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⁵² C.R.S. § 37-69-101 et seq. and approved by Congress by Act on May 31, 1949, ch.155 (codified at 63 Stat. 145).
⁵³ C.R.S. § 37-69-101 et seq.
⁵⁴ C.R.S. § 37-69-101 et seq.
⁵⁵ C.R.S. § 37-69-101 et seq.
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⁶³ C.R.S. § 37-64-101.
⁶⁴ C.R.S. § 37-63-101 et seq. and approved by Congress by Act on January 29, 1925, ch. 110 (codified at 43 Stat. 796).
⁶⁵ C.R.S. § 37-63-101 et seq.
⁶⁶ C.R.S. § 37-63-101 et seq.
⁶⁷ C.R.S. § 37-63-101 et seq.
⁶⁸ C.R.S. § 37-63-101 et seq.
⁶⁹ C.R.S. § 37-63-101 et seq.
⁷⁰ C.R.S. § 37-67-101 et seq. and approved by Congress by Act on May 26, 1943, ch. 104 (codified at 57 Stat. 86).
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⁷² C.R.S. § 37-67-101 et seq.
⁷³ C.R.S. § 37-67-101 et seq.
⁷⁴ C.R.S. § 37-67-101 et seq.
⁷⁵ C.R.S. § 37-67-101 et seq.
⁷⁶ "Republican River Compact Synopsis," Republican River Water Conservation District, accessed October 8, 2014. <http://www.republicanriver.com/CompactInfo/tabid/93/Default.aspx>.
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⁹⁰ C.R.S. § 37-68-101 et seq. and approved by Congress by Act on December 12, 1963, Public Law No. 88-198 (codified at 77 Stat. 350).
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- ⁹⁸ *Wyoming v. Colorado*, 353 U.S. 953 (1957).
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- ¹⁰⁰ *Nebraska v. Wyoming*, 534 U.S. 40 (2001).
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¹⁷¹ U.S. v. Jesse, 744 P.2d 491 (Colo. 1987)

¹⁷² Remanded case name: In the Matter of the Application for Water Rights of the United States of America in Water Division No. 2 (Dist. Ct., Water Div. No. 2, Colo. 1998) (Nos. 79-CW176, 81-CW-220, 81-CW-221, 81-CW-222, 81-CW-223, 82-CW-18-, 82-CW-19, 82-CW-20, 82-CW-27-34).

¹⁷³ Concerning the Application for Water Rights of the United States of America in Alamosa, Archuleta, Hinsdale, Mineral, Rio Grande, Saguache, Costilla, and San Juan Counties, Colorado (Dist. Ct., Water Div. No. 3 1998) (decreed in 2000) (No. 81-CW-183 consolidated).

¹⁷⁴ In the Matter of Application for Water Rights of the United States of America (Dist. Ct., Water Div. No. 4, Colo.)(Nos. W-425-W-438).

¹⁷⁵ In the Matter of the Application for Water Rights of the United States of America (Dist. Ct. Water Div. No. 5, Colo.)(Nos. W-467 and W-69).

¹⁷⁶ In the Matter of the Application for Water Rights of the United States of America (Dist. Ct. Water Div. No. 6, Colo.)(Nos. W-85 and W-86).

¹⁷⁷ In the Matter of the Application for Reserved and Appropriative Water Rights of the United States of America in Archuleta, Hinsdale, La Plata, Mineral and San Juan Counties (Dist. Ct., Water Div. No. 7, Colo. 1976)(No.w-1605-76B)

¹⁷⁸ In the Matter of the Application for Reserved Water Rights of the United States of American to Water on, in and under the San Juan National Forest (Dist. Ct., Water Div. No. 7, Colo. 1973)(Nos. 1146-73, 1148-73).

¹⁷⁹ Memorandum of Decision Concerning the Application for Water rights of the United States of America for Reserved Rights in Rocky Mountain National Park in Boulder and Laramie Counties (Dist. Ct., Water Div. No. 1, Colo. 1993) (No. W-8439-76 and W-8788-77).

¹⁸⁰ In the Matter of the Application of the United States of America for Water Rights in the Rio Grande River Drainage in Alamosa and Saguache Counties (Dist. Ct., Water Div. No. 3, Colo. 1981) (No. 81-CW-164).

¹⁸¹ In the Matter of the Application for Water Rights of the United States of America in Alamosa and Saguache Counties (Dist. Ct., Water Div. No. 3, Colo. 2004)(2004CW35) (decided 2008).

¹⁸² Concerning the Application for Water Rights of the United States of America in Montrose County (Dist. Ct., Water Div. No. 4, Colo. 2001)(2001CW05) (decided 2008)

¹⁸³ Concerning the Application of Water Rights for the United States of American in the County of Montezuma (Reserved Water Rights for Mesa Verde National Park), Findings of Fact, Conclusions of Law and Decree (Dist. Ct., Water Div. No. 7, Colo. 1997)(No. W-1633-76).

¹⁸⁴ Revised Findings of Fact, Conclusions of Law, and Decree Concerning the Application of the United States of America for Reserved Water Rights for the Cache La Poudre Wild and Scenic River in Larimer County (Rocky Mountain National Park and Roosevelt National Forest) (Dist. Ct., Water Div. No. 1, Colo. 1986)(No.86-CW-67).

¹⁸⁵ Colorado Ute Indian Water Rights Settlement Act of 1988, Pub. L. No.100-585 (102. Stat. 2973)

¹⁸⁶ Colorado Ute Indian Water Rights Settlement Act of 1988, Pub. L. No.100-585 (102. Stat. 2973)

¹⁸⁷ 1988 Settlement Act in the Colorado Ute Settlement Act Amendments of 2000, Pub. L. No. 106-554, 114 Stat. 2763A 258 (2001)

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3. Overview of Each Basin

3.1 Introduction

This section examines the river basins in the context of the larger river systems which they form. An understanding and recognition of each basin's particular landscape, historical context, and current issues provide the necessary basis to explore Colorado's complete water picture.

The following descriptions were provided by basin residents. Members of the basin roundtables and Colorado Water Conservation Board (CWCB) members were asked to update descriptions, working from the Statewide Water Supply Initiative (SWSI) update released by the CWCB in 2011. Basin descriptions, concerns, and challenges have been updated with this most recent request for feedback.

3.2 Arkansas Basin

Basin Description: The Arkansas River begins in the central mountains of the state 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, dropping over 10,000 feet to an elevation of 3,340 feet at the Colorado-Kansas line. Several tributaries flow from the high southern mountains toward the mainstem of the Arkansas and drainage from the higher plains to the north also contributes to the flows. The Arkansas River Basin is spatially the largest river basin in Colorado, covering slightly less than one-third of the state's land area (28,268 square miles or 27 percent of the state's total surface area).

Grassland and forest cover approximately 67 percent and 13 percent of the basin, respectively. Over 20 percent of the land is publicly owned. A large amount of the grassland is devoted to agriculture with one-third of agricultural lands requiring irrigation. Increasing urbanization is occurring throughout portions of the Arkansas River Basin. Over the last few years, persistent drought has impacted the basin heavily.

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 compact is "not intended to impede or prevent future beneficial development... as well as the improved or prolonged functioning of existing works: Provided, that the waters of the Arkansas river... shall not be materially depleted in usable quantity or availability..."¹ The primary tool for administering the Arkansas River Compact is the 1980 Operating Principles, which provide for storage accounts in John Martin Reservoir and the release of water from those accounts for Colorado and Kansas water users.

Colorado and Kansas have litigated claims concerning Arkansas River water since the early 20th century, which led to the negotiation of the Compact. In 1995, Colorado was found to have depleted stateline flows in violation of the Compact through the use of tributary groundwater. As a result, the Colorado State Engineer promulgated well administration rules to bring Colorado into compliance with the compact, and Colorado compensated Kansas for damage claims (approximately \$34 million). Recently, the Colorado State Engineer promulgated irrigation efficiency rules, which require augmentation for any upgrades to water delivery systems, such as drip irrigation or sprinkler systems.



Arkansas River

Basin Challenges:The Arkansas Basin will face several key concerns and challenges with respect to water management issues and needs over the next 40 years, identified as follows:

- Arkansas River Compact requirements, existing uses and water rights result in little to no water availability for new uses. All new uses, and many irrigation efficiency improvements, require augmentation.
- Growth in the headwaters region will present challenges to securing augmentation water for new demands.
- Concerns over agricultural transfers and the impacts to rural economies are significant in the lower portion of the basin downstream of Pueblo Reservoir.
- Recreational in-channel diversions or water rights for recreation will have an impact on the development of augmentation plans for agricultural transfers. The Arkansas River has been called the most rafted river in the world, but those recreational flows could be threatened unless there is continued, thoughtful collaboration on water resources.
- Concerns over water quality and suitable drinking water exist in the lower basin.
- Possible federal listing of the Arkansas darter fish as a threatened or endangered species could affect water management in the basin.
- Replacement of existing municipal supplies, plus growth in urban areas will result in an increase in the demand for municipal water supplies.

Specific projects and methods identified for meeting the future water needs of the Arkansas Basin are identified in the Arkansas Basin Implementation Plan (BIP).

3.3. Basins of the Colorado River System

The Colorado River system (including tributary basins) drains over one-third of the state's area. Originating in the north central mountains, the main stem of the Colorado River flows southwesterly and is met at Grand Junction by the Gunnison River before flowing west into Utah. The Yampa River and the White River move westward across the northwest quadrant of the state to the Utah border where they join the Green River, another tributary of the Colorado. The San Miguel River and the Dolores River begin near the southwestern corner of Colorado and travel north along the western border into Utah. The San Juan River and its tributaries collect the water in the southernmost regions west of the Continental Divide and flow into New Mexico.

Less than 20 percent of the entire Colorado River Basin lies inside Colorado; however, about 75 percent of the water in the entire river basin originates in the state. In the State of Colorado, transbasin diversions account for about 5 percent of the total water supply, or about 500,000 acre-feet per year. Most of these transbasin diversions move water from west to east, supplying water to the Front Range.

Mainstem Colorado River Basin

Basin Description: The Colorado River Basin in Colorado encompasses approximately 9,830 square miles. Elevations in the basin range from greater than 14,000 feet in the headwaters areas, to about 4,300 feet at the Colorado-Utah state line. The basin's mountainous upper reaches



Colorado River

gradually give way to a series of canyons and gentler terrain, as the river flows along the Interstate 70 corridor toward Grand Junction and the Utah border.

Snowpack in the elevations above 9,000 feet is an important water source for human use on both sides of the Continental Divide in Colorado. This water is also important for compliance with legal obligations: as much as 70 percent of the river flows out of state.

A substantial portion of the basin is composed of federally-owned land. Rangeland and forest are the predominant land uses in the Upper Colorado River Basin (about 85 percent). Forested land is present throughout many parts of the basin. Livestock grazing, recreational use, timber harvesting, and gas drilling are the leading uses of the federal lands. Active and inactive mines can be found within the basin.

Basin Challenges: The Colorado River Basin will face several key challenges with respect to water management issues and supply needs over the next 40 years, some of which are as follows:

- Recreational use and the environment are major drivers in the basin and are important for economic health and quality of life. There is some concern that many of these areas are vulnerable for various reasons, including competition with other water needs.
- Agriculture is important in the basin, especially in the lower basin (Grand Valley). Despite its importance, agricultural lands continue to be urbanized as communities expand, which could impact twenty percent of irrigated lands in the basin.
- The success of the Upper Colorado River Endangered Fish Recovery Program is vital to the future of the river. The Program is designed to address the recovery needs of the endangered fish in the Colorado River while protecting existing water uses and allowing for the future use of Colorado River water in compliance with interstate compacts, treaties, and applicable federal and state law.
- There is concern over a potential compact shortage during severe and sustained drought and the potential impacts to in-basin supplies.

- The development of water rights associated with transbasin projects are a concern, and their effect on in-basin supplies must be considered.
- Water quality is a concern, particularly related to selenium and salinity issues.

Gunnison River Basin

Basin Description: The Gunnison River Basin stretches over 8,000 square miles of western Colorado, extending from the Continental Divide to the confluence of the Gunnison and Colorado Rivers near Grand Junction. The Gunnison River Basin is defined by the Elk Range to the north, the Sawatch Range to the east, the San Juan Mountains to the south, and the Uncompahgre Plateau to the southwest. Water traveling from the headwaters to Grand Junction experiences more than 9,500 feet of elevation change.

The Gunnison River Basin is largely forested. Forest area is distributed throughout the basin and covers approximately 52 percent of the total basin area. About 5.5 percent of the land in the basin is classified as planted/cultivated land and is primarily concentrated in the Uncompahgre River Valley between Montrose and Delta, with additional pockets near Gunnison and Hotchkiss.



Gunnison River

Basin Challenges: Several water management issues have been identified that will present challenges to Gunnison River Basin water users over the next 40 years, summarized as follows:

- Growth in the headwaters will require additional water management strategies.
- Addressing agricultural water shortages in the upper portion of the basin is an important goal of the community; lack of financial resources is an impediment.
- There is concern over possible future transbasin diversions and the potential effect this might have on existing uses within the basin.
- The area between Ouray and Montrose is rapidly growing. Tourism is important in the headwaters areas, but agriculture is dominant in the Uncompahgre Valley. A rapid influx of retirees and growth in the Uncompahgre Valley may dramatically change the agricultural uses and other land uses in the area.

Yampa River, White River, and Green River Basins

Basin Description: The Yampa River, White River, and Green River Basins cover roughly 10,500 square miles in northwest Colorado and south-central Wyoming. The basin is defined, in part, by the Continental Divide on the east. The elevation in the basin ranges from 12,200 feet (Mount Zirkel) in the Park Range, to about 5,100 feet at the confluence of the Yampa and Green Rivers at Echo Park within Dinosaur National Monument. The basin contains diverse landforms including steep mountain slopes, high plateaus, rolling hills, incised sandstone canyons, and broad alluvial valleys and floodplains.

Large portions of land in the basin are federally-owned. Livestock, grazing, and recreation are the predominant land uses. Near the towns of Craig, Hayden, Steamboat Springs, Yampa, and Meeker, much of the land is dedicated to agricultural use. The mountains are densely covered by forest. The valleys and plateaus are mostly covered by shrubland with some forested areas. The Steamboat Springs area, featuring a destination ski resort, is likely to experience continued and rapid population growth.



Yampa River

Basin Challenges: For the Yampa River, White River, and Green River Basins, key water management issues for the next 40 years include:

- The emerging development of gas and oil shale resources is impacting water demand both for direct production and the associated increase in municipal use.
- Agriculture, tourism, and recreation are vital components of this basin's economy. As the needs of communities and industry grow, competition between sectors could increase.
- Industrial uses, especially power production, are a major water use. Future energy development is less certain.
- While rapidly growing in some areas (Yampa River/Steamboat Springs area), the basin as a whole, is not developing as rapidly as other portions of the state. This has led to concern that the basin will not get a "fair share" of water use afforded to Colorado under the Colorado River Compact in the event of a compact call.
- Implementation of a successful Upper Colorado River Endangered Fish Recovery Program is vital to ensuring protection of existing and future water uses.
- Agricultural producers in the basin would like to increase the amount of irrigated land by 14,000 to 18,000 acres, but the lack of financial resources is an impediment.

[Dolores River, San Juan River, and San Miguel River Basins](#)

Basin Description: The San Juan River, Dolores River, and San Miguel River Basins are located in the southwest corner of Colorado and cover an area of approximately 10,169 square miles. The Upper San Juan River and its tributaries flow through two Native American reservations—the Ute Mountain Ute Reservation and the Southern Ute Indian Reservation, in the southern portion of the basin. What is also known as the Southwest Basin is actually a series of nine sub-basins, eight of which flow out of state before they join the San Juan River in New Mexico or the Colorado River in Utah. The water history of the Southwest Basin has been shaped by the Colorado River Compact issues, the Colorado Ute Indian Water Rights Settlement and a



Dolores River

number of U.S. Bureau of Reclamation (BOR) storage projects.

Basin Challenges: In addition to the three compacts governing water use across the broader Colorado River Basin, there are other compacts, settlements and species issues specific to the San Juan/Dolores/San Miguel region:

- The Colorado Ute Indian Water Rights Settlement Act of 1988 – Settles the reserved water right claims of the Southern Ute and Ute Mountain Tribes on all streams that cross the reservations of the two tribes, with respect to quantity, priority, and administration.
- The Dolores Project was integral to the Ute Mountain Ute portion of the Indian Water Rights Settlement. Construction of the Dolores Project was allowed to proceed in 1977, by order of the Secretary of Interior, because it provided potable water for the first time to the Ute Mountain Ute community of Towaoc and irrigation water for a highly productive 7,600 acre Tribal farm in exchange for subordinating senior Tribal water rights claims that could have dried up the Mancos River Valley.
- Tribal water allocations out of the Animas-La Plata Project (ALP) component of the Settlement provided the Tribes with an M&I water source to supply and augment future depletions of the San Juan River system which are constrained by the San Juan Recovery Program for Endangered Native Fish. The ALP also provided the City of Durango and surrounding areas with a long term M&I supply.
- The Southwest Basin also includes numerous instream flow segments. Instream flows have served as a tool to balance valued agricultural uses with in-stream water to support recreational and environmental values, all of which combine to support the economic and aesthetic values that drive settlement and commerce in the Southwest Basin.
- The Southwest Basin is also characterized by extensive U.S. Forest Service (USFS) and Bureau of Land Management (BLM) land ownership. Most Southwest Basin headwaters originate on federal land. These federal agencies have worked with the CWCB Instream Flow Program to secure substantial flow protection at high elevations throughout the basin. As stream flow protections have increasingly focused on lower elevation streams, below stored water and communities, instream flow appropriations have become more complex and challenging.

Agriculture and ranching prevail in the lower elevations of La Plata, Montezuma, Dolores, San Miguel, and Montrose Counties as they have for many generations. Tourism and recreation have become more established in the region as the Animas, Piedra, Dolores, and San Miguel Rivers offer both fishing and rafting opportunities along with flat water recreation on the region's many reservoirs.

This multiple-basin area of the state is extremely diverse and is experiencing changing demographics:

- The Pagosa Springs-Bayfield-Durango corridor is rapidly growing while experiencing areas of localized water shortages. This area is transitioning from oil and gas, mining and agricultural use to tourism, recreation, and a retirement or second home area.
- The Cortez and Dove Creek area remains strongly agricultural, supplemented by energy production, but is also seeing growth with retirees moving to the area.

- The San Miguel area is a mix of recreation and tourism along with a strong desire to maintain agriculture in the western part of the county.

Overall, water supply is available in the Southwest Basin as a result of numerous storage projects built primarily to supply irrigation water. Several of these storage projects have been able to allocate or carve out small amounts of M&I water to supply domestic growth. Resulting revenues from M&I sales are being re-invested in delivery system efficiencies that will yield the water necessary to meet future M&I needs without diminishing agricultural deliveries. The remaining challenge is the development of sufficient infrastructure to get M&I water to where it is needed. There is also a need for new storage to meet long-term supply needs in the Pagosa Springs area, as well as in Montrose County.

The Southwest Basin Roundtable takes very seriously the need to reconcile a strong commitment to maintaining a balance between a vibrant agricultural sector and healthy streams to support environmental and recreational values. In keeping with this philosophy the Southwest Basin is organizing identified projects and processes (IPPs) by sub-basin with one IPP list that addresses agricultural, municipal, industrial, environmental and recreational values and needs. This approach is intended to reveal opportunities for multi-benefit projects to address water supply gaps.

3.4. South Platte River, Republican River, and North Platte River Basins

South Platte River Basin

Basin Description: The South Platte River Basin is the most populous basin in the State. Per SWSI 2010, the South Platte Basin population is expected to double from approximately 3.5 million people to 6 million people by 2050. Approximately 85% of Colorado's population resides in the South Platte Basin, and the Front Range area of the basin is Colorado's economic and social engine. The South Platte River Basin also has the greatest concentration of irrigated agricultural lands in Colorado.

The topographic characteristics of the South Platte River Basin are diverse. Its waters originate in the mountain streams along the Continental Divide in the northern portion of the Front Range. The river emerges from the mountains southwest of Denver and travels north through the Denver area where numerous tributaries such as Cherry Creek, Clear Creek, Coal Creek, Boulder Creek, St. Vrain Creek, Big Thompson River, and the Cache La Poudre River join the South Platte; then traverse northeast across the High Plains. The western portions of the basin and its montane and subalpine areas are mostly forested, while the High Plains region is mainly grassland and planted/ cultivated land. Approximately one-third of the South Platte Basin land area is publicly owned, with the majority of these lands in the forested mountains. The South



South Platte River

Platte River crosses the Colorado-Nebraska state line near Julesburg and merges with the North Platte River in southwestern Nebraska to form the Platte River.

The hydrology of the South Platte Basin is highly variable, with an approximate average annual native flow volume of 1.4 million acre-feet. Water supply in the South Platte Basin is supplemented by approximately 400,000 acre feet of trans-basin diversions from the Colorado River Basin and by approximately 100,000 acre feet from the Arkansas, North Platte and Laramie River Basins. In addition, over 30,000 acre feet are pumped from non-tributary groundwater aquifers to supplement supplies. However, surface water diversions in the South Platte Basin average approximately 4.0 million acre-feet annually, with an additional average annual 500,000 acre-feet of groundwater withdrawals. The amount of diversion in excess of native flow highlights the return flow-dependent nature of the basin's hydrology, and the basin-wide efficient use and reuse of water supplies. On average, only 400,000 acre feet of water leave the basin.

The South Platte River Compact of 1923 establishes a legal framework within which the water of the South Platte River is allocated to water users in both Colorado and Nebraska. Specifically, the Compact requires the Colorado State Engineer to curtail diversions east of the Washington County line that are junior to June 14, 1897 when flow in the river is less than 120 cubic feet per second from April 1 through October 15.

The Platte River Recovery Implementation Program (PRRIP) and the Upper Colorado River Endangered Fish Recovery Program provide limited Endangered Species Act (ESA) coverage for Program participants. Participation in these programs protects existing uses and allows continued water development.

Basin Challenges: The South Platte Basin is Colorado's most economically diverse basin. Urban sector businesses and industries within the South Platte Basin provide for a majority of the state's overall economy, and agricultural production is the highest among basins across the State of Colorado. The basin also supports a wide range of ecological systems and important water-dependent ecological and recreational attributes. Coloradans and tourists regularly take advantage of the South Platte's recreational opportunities provided by the basin's many environmental features. Willing water transfers from the agricultural sector to the M&I sector have proven reliable, though viewed as unsustainable if the South Platte, and the State of Colorado, are to continue to have a high quality of life and diverse economy, as the population continues to grow. The challenge of preserving the municipal/industrial (M&I), agricultural, and recreational economies, as well as preserving the basin's environmental features, makes water management in the South Platte Basin especially complex. These complexities include:

- Agriculture is the dominant water use in the basin, accounting for 85% of total water diversions. Conversion of agricultural water to M&I uses (agricultural transfers) will continue to be a significant option for meeting future M&I needs, especially in those areas where agricultural land will be urbanized. These agricultural transfers are likely to have negative impacts to rural communities, as well as to open spaces, wetlands and recreation that are tied to irrigated lands. Loss of irrigated agricultural lands will negatively impact the local economy and the state's economy, as well as the state's food security.

- Competition for additional M&I water supplies is significant, and in some cases, multiple M&I suppliers have identified the same water supplies as future water supplies. Competition increases the costs to M&I customers, and competition for the same water supplies could result in some M&I suppliers lacking enough water in the future.
- A substantial amount of the basin's water supply originates in the Colorado River Basin. As such, compliance with the Colorado River Compact, and avoiding a compact curtailment, is critical to the South Platte Basin.
- The lack of new major water storage in recent decades (aside from the recent construction of Reuter-Hess Reservoir) has led to reliance on nonrenewable groundwater in Douglas and Arapahoe Counties. Strong economic and population growth in these counties, coupled with the lack of surface water supplies, led the need to develop renewable surface water supplies and additional water storage for the South Metro area.
- Conjunctive use of surface water and alluvial groundwater, and use of alluvial aquifers for storage, offer opportunities to expand sustainable water use. Aquifer storage is generally considered to have fewer environmental impacts, and water stored in alluvial aquifers is not subject to evaporation losses. Aquifer storage poses control and administrative issues that will need to be addressed to ensure that other water rights are not injured.
- Water quality will continue to be a challenge as more water is diverted for use, and point and non-point sources discharge to the basin's waters. Salt content of soil and water in the South Platte River valley, and sedimentation/erosion in parts of the basin, are likely to continue to increase over time, which will negatively impact the ability to use this water for agricultural and M&I purposes. Technological solutions are expensive and non-sustainable because of high energy demands and issues associated with disposal of concentrated treatment residuals. The South Platte Basin is leading the state with regard to M&I water use efficiency. Efficient use of the basin's resources, through water reuse and conservation, is a critical component to meet future water needs. Increased M&I water use efficiency will reduce the quantity of water availability for agriculture, ecological resources, and other uses, because M&I return flows will be diminished.
- The urban environment is an important component of quality of life for many South Platte Basin residents. Judgments about the value of the urban environment, including the need to provide water for irrigated landscape, make discussions about water supply development needs all the more difficult. The environmental and recreational features within the basin including amenities such as mountain streams and rivers used for fishing and rafting, city green ways, flatwater reservoirs, wetlands and open space, are all extremely important to Colorado's tourism economy and quality of life for its residents.

Specific projects and methods identified for meeting the future water needs of the South Platte Basin are identified in the joint BIP, completed with the Metro Basin roundtable.

Republican River Basin

Basin Description: The Republican River Basin in Colorado is located on the Northeastern High Plains. The headwaters of the North Fork and South Fork of the Republican River, and the Arikaree River, originate in the Northeastern High Plains of Colorado near Wray, Cope, and Seibert,

respectively. The Republican River is formed by the confluence of the North Fork of the Republican River and the Arikaree River just north of Haigler Nebraska, with the South Fork of the Republican joining just southeast of Benkelman, Nebraska. Other major drainages within the Republican River Basin include Frenchman Creek, Beaver Creek, and Red Willow Creek. The Republican River Basin in Colorado encompasses approximately 7,760 square miles, which represents 31 percent of the total Republican River Basin located in Colorado, Nebraska, and Kansas.

The topographic characteristics of the Republican River Basin, which are similar to the High Plains region of the South Platte River Basin, consisting mainly of grassland and planted/ cultivated land. The Republican River Basin in Colorado is underlain by the High Plains or Ogallala aquifer, which is one of the largest water bodies in the United States, and extends from South Dakota to Texas.

The Republican River Compact of 1942 apportions the waters of the Republican River Basin between Colorado, Nebraska, and Kansas. The compact defined the Republican Basin, for purposes of the compact, as “all the area in Colorado, Kansas, and Nebraska, which is naturally drained by the Republican River, and its tributaries, to its junction with the Smoky Hill River in Kansas”. It also states that beneficial consumptive use is the basis and principle upon which the allocations made in the compact are predicated.



Republican River

The Compact quantified the average virgin water supply (defined as the water supply that is “undepleted by the activities of man”) originating in the Republican River Basin upstream of the Nebraska-Kansas state line as 478,900 acre-feet per year. Based on this quantification, the Compact dictates allocations for beneficial consumptive use in each State. Colorado was allocated 54,100 acre-feet, which was further allocated as follows: North Fork of the Republican River drainage basin – 10,000 acre-feet; Arikaree River drainage basin – 15,400 acre-feet; South Fork of the Republican River drainage basin – 25,400 acre-feet; and Beaver Creek drainage basin – 3,300 acre-feet. In addition, Colorado is allocated the entire water supply of the Frenchman Creek and Red Willow Creek drainage basins in Colorado.

In 2004 the Republican River Water Conservation District was established for the purpose of cooperating with and assisting the State of Colorado with compact compliance. The Republican River Water Conservation District recently completed the construction of the Republican River Compliance Pipeline to assist in compact compliance.

Administration of surface water in the Republican River Basin is separate from groundwater administration. The Water Courts have judicial authority regarding surface water rights, whereas the Colorado Ground Water Commission has regulatory and an adjudicatory authority regarding the management and control of Designated Ground Water. The Colorado Ground Water Commission is responsible for adjudicating groundwater rights and issuing large capacity well

permits. Much of the groundwater located within the basin has been authorized as being in a Designated Groundwater Basin. The Colorado Groundwater Commission has established eight designated basins and 13 Groundwater Management Districts within such basins. Groundwater Management Districts are local districts that have additional administrative authority. Much of the Republican River Basin lies within the Northern High Plains Groundwater Management District.

Basin Challenges: The Republican River Basin will face several key issues and challenges with respect to water management issues over the next 40 years, identified as follows:

- Republican River Compact compliance.
- Depletions to the Ogallala Aquifer continue to reduce the amount of readily available water supplies for the agricultural economy in the basin; in some cases presenting a feasibility issue of providing adequate water supplies for crop irrigation or in some cases no water supply.
- Continued detailed coordination and communication between multiple water rights and administrative authorities (e.g. Colorado Ground Water Commission, Department of Water Resources, Ground Water Management Division, Water Court, etc.).

North Platte River Basin



North Platte River

Basin Description: The North Platte River Basin, also known as North Park, is a high altitude valley covering about 2,000 square miles in north central Colorado, adjacent to Wyoming. The basin includes all of Jackson County and the small portion of Larimer County that contains the Larimie River Watershed.

Both the North Platte and Laramie Rivers flow north into Wyoming, and are subject to use limitations stemming from Supreme Court decrees. Water use in the basin is dominated by irrigated pastures

associated with ranching operations, with over 400 irrigation ditches diverting water from the mainstem, and the numerous tributary streams throughout the basin. Total irrigated acreage in the basin, based on 2001 estimates, is approximately 116,000 acres. A portion of North Platte water is exported to the Front Range via the Michigan Ditch and Cameron Pass Ditch, which combined divert approximately 4,500 acre-feet per year out of the basin. The basin also contains a major wildlife refuge along with numerous public lands and the recreational opportunities they offer.

Water use in the basin is also governed by the Three State Agreement of the Platte River Recovery Implementation Program, related to endangered species recovery efforts on the Platte River in Central Nebraska. The agreement employs a “one-bucket concept” for the North Platte Basin of Colorado that currently limits water use in the basin to depletions associated with the irrigation of up to 134,467 acres, while allowing for flexibility in the type of water use.

Basin Challenges: The North Platte River Basin will face several key issues and challenges with respect to water management over the next 40 years, identified as follows:

- Maintain compliance with the equitable apportionment decrees on the North Platte and Laramie Rivers that quantify the amount of available water and lands that can be irrigated.
- Increase economic development and diversification through strategic water use and development.
- Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies.
- Gain knowledge of the basin's consumptive uses and high-altitude crop coefficients.
- Understand and use the North Platte Decision Support System to quantify historical consumptive use, agricultural shortages, water availability and water storage opportunities.
- Quantify and strategically develop available unappropriated waters within the basin.
- Successfully resolve endangered species issues on the Platte River in Central Nebraska through the Platte River Recovery Implementation Program in a manner that does not put pressure on water users to reduce existing uses.
- Maintain healthy rivers through the strategic implementation of projects that meet prioritized nonconsumptive needs.
- Promote water rights protection and management through improved streamflow gaging data.
- Enhance forest health and management efforts for wildfire protection and beetle kill impacts.

3.5. Rio Grande Basin

Basin Description: The Colorado portion of the Rio Grande drainage basin is located in south central Colorado and encompasses less than 10 percent of the State's land area (approximately 7,700 square miles). The San Juan Mountains to the west, the Sangre de Cristo range to the north and east, the Culebra range to the southeast, and the Colorado-New Mexico state line to the south define the boundaries of the Rio Grande Basin within Colorado. Between the San Juan Mountains and the Sangre de Cristo Mountains lies the San Luis Valley, a principal feature of the Rio Grande Basin, with an average elevation of 7,500 feet, and precipitation of less than 8 inches per year.

Basinwide, land is evenly divided between public and private ownership. However, the majority of the land in the San Luis Valley is privately owned. The primary use of more than 600,000 acres of irrigated land is agricultural operation in the central portion of the basin, which accounts for the second largest provider of fresh potatoes in the United States. Areas in the valley which are not irrigated are mostly classified as shrubland (24 percent) and grassland (31 percent). The San Juan and the Sangre de Cristo mountain ranges are largely forested. The northern one-third of the basin is considered to be a "closed basin" and does not contribute any surface flows to the Rio Grande.



Rio Grande River

Interstate compacts and international treaties affecting water use in the Rio Grande Basin include the Rio Grande, Colorado, and Tijuana Treaty of 1945 between the U.S. and Mexico, the Rio Grande Compact of 1938, and the Amended Costilla Creek Compact of 1963. In particular, the Rio Grande Compact establishes Colorado's obligations to ensure deliveries of water at the New Mexico state line and New Mexico's obligation to ensure deliveries of water at the Elephant Butte Reservoir, with some allowance for credit and debit accounts. The obligations are calculated based on the amount of flow at indexed stations, which then, as dictated in the compact, determine the amount of flow that must be delivered to the downstream states during that year. The Rio Grande Compact established the Rio Grande Compact Commission to administer the terms of the agreement. The Commission consists of one representative from each state and a non-voting federal representative.

Basin Challenges: The Rio Grande Basin will face several key issues and challenges with respect to water management issues and needs over the next 40 years, identified as follows:

- The Rio Grande Compact and the effects of sustained drought make the objective of sustainability difficult.
- Groundwater use for agriculture is currently at unsustainable levels.
- Economic impacts of reducing irrigation use of groundwater supplies will be difficult, but working on community-based solutions offers the best hope of minimizing the impacts.
- Residential growth, primarily in the form of second and vacation homes, especially in the South Fork area, is creating a need for augmenting water supplies.
- Groundwater is a key component of water use in the basin for both M&I and agriculture. Groundwater management presents an ongoing challenge.

3.6. Basin Implementation Plan Themes

Throughout the BIP process, roundtables engaged in public outreach, targeted technical outreach with basin entities, and a series of discussions regarding the priorities and values within the respective basins. While the BIPs identify projects and methods by which water supply needs may be met, they also serve as an up-to-date summary of the issues of concern and greater water policy management themes within each basin. In the following section, some of the major themes identified in each BIP will be presented, by basin. The goals and measurable outcomes generated by each roundtable are discussed in more detail in Chapter 6, along with projects and methods identified in the respective BIPs. The discussion in this chapter is limited to major themes and points of consideration that guide the work of the BIPs.

Arkansas Basin

A major emphasis of the Arkansas Basin roundtable was a public outreach program that aspired to reach all corners of the basin. A series of public meetings were held, with information about Colorado's Water Plan and the BIP process presented by roundtable members. In addition to these public meetings, the annual Arkansas River Basin Water Forum served as a point for receiving major input into the BIP.²

The roundtable identified several important points of consideration which underpin the BIP document. These points represent the major challenges and opportunities which the roundtable

faces, in planning for the water supply future of the Arkansas basin. The roundtable first identifies “the interdependence of all water usage types,” recognizing the connections between agricultural use, environmental and recreational uses, and the impacts of municipal and industrial supplies.³ As an importing and exporting basin, the roundtable faces complex hydrology, and the complicated administration of water mandated under the *Kansas v. Colorado* lawsuit. Moving forward, declining levels of groundwater will represent a major challenge to basin users, in addition to the demand for augmentation water.⁴

The BIP process has also continued the robust discussion regarding conservation within the basin, recognizing the variety of needs and abilities of water providers and municipalities. Another emphasis of the roundtable, coming on the heels of a year in which Colorado saw record wildfires, drought, and floods, was the Watershed Health Working Group, which brought together stakeholders to discuss the ways that agencies and impacted parties can collaborate before, during, and after such a natural disaster.⁵

The next steps for the Arkansas Basin roundtable represent the path to implementation, with these challenges and basin concerns in mind. During the public outreach process, the roundtable solicited input forms, to gather ideas and project or method concepts from basin residents.⁶ Moving forward, the roundtable will identify additional projects and methods in the basin, culled from these input forms or from water providers. The roundtable is also moving forward on a basinwide hydrologic model to inform implementation decisions, and assess water supply gaps at the regional and local levels.⁷

Colorado Basin

In the creation of the BIP, the Colorado Basin roundtable looked within the basin’s boundaries to enumerate the projects and processes by which stakeholders plan to meet future water needs. Interviews were conducted with water providers, and roundtable members were asked to provide information about identified projects or methods.⁸ This process resulted in a comprehensive list of ongoing and planned efforts within the basin: the first aggregation of its kind. Projects and methods, as well as overarching concerns and challenges, were organized by subregion within the BIP.

The roundtable also articulated a set of prevailing basin themes, reflecting the concerns of stakeholders around the basin, as well as roundtable members. Within the Colorado Basin, a major concern is the development of a new transmountain diversion, beyond those addressed within the Colorado River Cooperative Agreement.⁹ This theme is driven by concerns regarding the Colorado River Compact, as well as issues of environmental health within the mainstem and tributaries. The BIP identifies the relationship between various water uses, and the potential negative impacts to uses from overdevelopment of the river.

The roundtable identified six themes, which represent the overarching messaging of basin stakeholders, gathered through the public input process and roundtable discussion. The themes are as follows:

1. Protect and Restore Healthy Streams, Rivers, Lakes, and Riparian Areas
2. Sustain Agriculture

3. Secure Safe Drinking Water
4. Develop Local Water Conscious Land Use Strategies
5. Assure Dependable Basin Administration
6. Encourage a High Level of Basinwide Conservation¹⁰

Within each theme, the roundtable identifies potential actions and strategies to accomplish these areas of importance. For example, a Stream Management Plan is suggested as a path forward to achieving the first theme, and major water rights such as the Shoshone Hydroelectric Plant are identified as crucial to meeting the fifth theme.¹¹

The BIP is divided into several sections, each focusing on a different subregion within the greater basin. Within each subregion, concerns and challenges were identified, in the greater context of the basinwide themes. Also, projects and methods identified by stakeholders and water providers are listed, with some project information available, as provided.¹² Moving forward, the roundtable plans to refine project and method information, to gain a clearer picture of the future of water management strategies within the basin.

Gunnison Basin

The Gunnison Basin roundtable began with one primary goal: “Protect existing water uses in the Gunnison Basin.”¹³ From this foundation, the roundtable established eight additional complementary goals, and seven statewide principles.¹⁴ The roundtable completed targeted technical outreach activities throughout the basin, with the goal of identifying ongoing and planned projects and methods. Additionally, the roundtable built upon previous public outreach and education efforts, ensuring that the established goals and principles reflected the concerns of basin citizens and stakeholders.

The roundtable chose to analyze identified projects and methods by highlighting those that met basin goals. These projects and methods were identified as reflecting the concerns and priorities in these Goals, and were further sorted by their schedule for implementation. Projects and methods which were “likely feasible by 2020” and represented an “excellent job of meeting basin goals” were classified as Tier 1 projects.¹⁵ The identified projects and methods are intended to provide solutions to basin water needs, as enumerated within the BIP: agricultural shortages; municipal and industrial needs; and environmental and recreational needs.

The Statewide Principles identified in the BIP are intended to provide the roundtable’s position on interbasin issues in Colorado, for the reference of other roundtables and Colorado’s Water Plan. As part of the Colorado River system, the statewide principles include a few points regarding the development of water supply from that system. The Gunnison roundtable primarily emphasizes the variability of Colorado River supply, as well as the importance of the prior appropriation system to protecting existing uses from adverse impacts.¹⁶ Additionally, the statewide principles advocate for local solutions to water needs, equitable application of conservation strategies, and the utilization of scenario planning in water management.¹⁷

The Gunnison BIP also includes several basin evaluations: hydrologic modeling and mapping of potential projects and methods, as well some case studies in water management.¹⁸ This modeling

exercise enabled an assessment of water availability under current hydrology and legal administration. The major emphasis of this BIP is the identification of projects and methods, and the relationships between these proposed projects and basin goals. To that end, the roundtable recommends a path to implementation that takes under consideration “securing project acceptance and demonstrating project feasibility.”¹⁹

North Platte Basin

The North Platte Basin roundtable BIP identified eight basin goals, which reflected the unique water management challenges and values within the basin. The projects and methods identified by this roundtable must operate within two major legal frameworks, as expressed in the basin goals: “Maintain and maximize the consumptive use of water permitted in the Equitable Apportionment Decree and the baseline depletion allowance of the Three State Agreement.”²⁰ Within these boundaries, the roundtable goes on to identify further Goals, informed by ongoing public outreach and education efforts.

Of primary importance in the North Platte BIP is the maintenance of agricultural uses within the basin. Basin goals reflect this concern, identifying the need to strategically develop water, while maintaining and upgrading existing critical infrastructure. Additionally, the roundtable recognizes the importance of environmental and recreational attributes, analyzing the benefits to these attributes provided by agricultural uses, as well as aspiring to healthy rivers and wetlands.²¹ The BIP also speaks to statewide issues, advocating for the management of forest health through wildfire and beetle kill efforts, and the “equitable statewide application of municipal water conservation.”²²

The North Platte Basin roundtable also used hydrologic modeling and mapping to provide a technical assessment of the effect of projects and methods within the greater basin. Through these basin evaluations, roundtable members were able to gauge the feasibility of particular identified projects and methods, and identify situations where implementation of multiple projects or methods would present a challenge.²³

The North Platte roundtable chose to address their basin goals through the identification of projects and methods which meet those identified needs and concerns. In their analysis of projects, the roundtable determines which specific basin goals each project may address, and generally outlines potential challenges to implementation. The roundtable also provides a list of planned environmental and recreational projects, which address specific attributes that the roundtable has identified as important to basin citizens and stakeholders.

Rio Grande Basin

The Rio Grande Basin Water Plan provides an in-depth look at the basin’s issues and proposed solutions, beginning with a comprehensive overview of the basin itself. The processes for Colorado’s Water Plan and the Basin Water Plan are discussed, along with a statement on the statewide issue of transmountain diversions. The basin overview includes an analysis of factors within the basin which affect water management, including geography, the history of development, and legal frameworks such as the Rio Grande Compact and the administration of

water rights.²⁴ This overview provides a backdrop for the parts of the Plan to follow, and describes the landscape in which the Plan intends to establish solutions for water management challenges. The Plan goes on to define goals and measurable outcomes, which were informed by the public outreach process which the roundtable undertook, as well as discussions at the roundtable level. The goals seek to address the key attributes of the basin: “a resilient agricultural economy, watershed and ecosystem health, sustainable groundwater resources, the encouragement of projects with multiple benefits, and the preservation of recreational activities.”²⁵ The goals and accompanying measurable outcomes are supported by modeling efforts and scenario planning, with the idea of preventing “harm to existing water rights while maximizing Colorado’s entitlement under the Rio Grande and Costilla Creek compacts.”²⁶ Goals are further explored, by identifying the particular water needs which each goal meets, be it agricultural, municipal and industrial, environmental and recreational, or related to water administration.²⁷ The Plan discusses these various needs, analyzes how these needs interrelate, and looks to the future of each sector.

After setting the stage with the basin overview and the goals, which look to the future of the basin, the plan explores solutions: projects and methods are examined, and compared to the list of basin goals. Certain projects, which meet multiple basin goals, are selected for review in a project fact sheet.²⁸ The sheets provide a closer look at the project, with information such as project proponent, estimated budget, and an indication of the basin goals which the project meets. The Plan also provides an estimate of funding needs for these identified projects, and includes a list of projects which meet environmental and recreational information gaps, paving the way for more informed project identification in the future.²⁹

After project and method identification, the Plan examines the means by which implementation may be possible. First, the outreach and educational efforts of the roundtable are summarized, with a plan for future efforts. Then, strategies for implementation are discussed.³⁰ These strategies include stakeholder involvement, future modeling improvements, and cooperative in-basin water management efforts.³¹ The Rio Grande Plan is intended to remain a living document, with updates and additions by the roundtable providing meaningful input into the water management future of the basin.

South Platte Basin (including Metro)

Recognizing the common geography and pertinent issues, the South Platte and Metro roundtables chose to work together on a BIP. In preparing this BIP, both roundtables seek to provide a reference for other basin roundtables, as well as stakeholders statewide, regarding the challenges and opportunities present in the South Platte Basin. Facing future population growth, a wide variety of needs, and numerous constraints, the roundtables plan to find solutions which balance these various factors. Challenges identified for the water supply future include: limited native supply, groundwater and aquifer administration and management, interstate water commitments, project permitting concerns, environmental and recreational values, and water quality issues.³²

With this host of challenges, the roundtables recognize that solutions must be carefully crafted and selected to maximize benefits and use. To that end, the roundtables have identified three major guidelines for assessing solutions:

1. Minimize adverse impacts to agricultural economies;
2. Develop new multipurpose projects that either offset transfers from agricultural uses or provide additional water to reduce current agricultural shortages;
3. Proactively identify and implement methods to protect and enhance environmental and recreational water uses.³³

Additionally, in preparing for future needs, the roundtables have incorporated the “four legs of the stool” approach posed by the IBCC, consisting of: conservation and reuse; identified projects and processes; agricultural transfers; and new Colorado River supplies.³⁴ Specifically, ten implementation strategies are listed within the BIP. These strategies mostly follow the “four legs of the stool” discussion, focusing on maximum implementation of identified projects and processes, as well as advancing conservation and reuse efforts.³⁵ Other strategies address maximizing native basin supplies, while minimizing traditional buy-and-dry of agricultural lands for municipal supply, through use of alternative transfer methods.³⁶ Regarding transmountain diversions, the roundtable advocates the following action: “Simultaneously advance the consideration and preservation of new Colorado River supply options.”³⁷

The roundtables believe that this suite of strategies are the best approach to meet the varied needs within the basin, while addressing the identified challenges presented. Moving forward, the roundtables plan to continue technical work to better understand potential solutions, and identify projects and methods which meet the three guidelines above.

Southwest Basin

Through the BIP process, the Southwest Basin roundtable sought to address the many complexities of that basin: nine sub-basins, various compacts and treaties, and the disparate interests of stakeholders within that corner of Colorado.³⁸ Agricultural, municipal and industrial, environmental, and recreational needs all play a role in the Southwest landscape, and the roundtable seeks to address them with equal attention through the BIP process.

As a Colorado River system basin, the Southwest roundtable expresses concern regarding new development from that system as part of a new transmountain diversion.³⁹ Compact concerns, as well as potential future needs within the Southwest basin itself underpin this issue. To this end, the roundtable has set forth seven factors to be considered prior to development, as well as a commitment to remain involved in statewide discussions on the matter. Interwoven with these transmountain diversion policies is a commitment to greater conservation practices, proposing a 70/30 ratio (indoor use to outdoor use) for water providers receiving any new diversion.⁴⁰

Interaction between state and federal entities is also identified as a key concern and opportunity by the roundtable. In the BIP, with respect to federal policies and actions, as well as the issue of tribal water rights, “the roundtable encourages and supports creative solutions sought through collaborative efforts.”⁴¹ Recognizing the importance of environmental and recreational attributes to the basin, the roundtable has placed an emphasis on a greater understanding of the water needs for maintaining these values, identifying two methods to address the need for data and assessment.⁴²

The Southwest roundtable also undertook an ambitious public outreach process, soliciting input from basin stakeholders. From this public outreach and roundtable discussions, 21 goals and 30 measurable outcomes were adopted.⁴³ The basin took an aggressive approach to listing new identified projects and processes, identifying 75 new projects and methods through the input process, bring the total list of identified projects and processes for all sub-basins to 130 proposals for meeting future water needs.⁴⁴

Yampa/White/Green Basin

The Yampa/White/Green Basin roundtable views the BIP process as an opportunity to articulate stakeholder viewpoints from northwest Colorado, informing ongoing statewide discussions and the Colorado's Water Plan process.⁴⁵ To that end, the roundtable encouraged dialogue at the roundtable level and in the public outreach process, to set a vision for the basin moving forward. This basin vision includes an assessment of meeting in-basin future needs at the municipal and industrial, agricultural, and environmental and recreational levels. Also, the roundtable examines the Yampa/White/Green Basin's role within Colorado, and establishes statements of policy on interbasin and interstate concerns.

Of key concern to the roundtable is the basin's role in the Colorado River system. The roundtable emphasizes the role of the Colorado River Compact, and the issue of a new transmountain diversion. Regarding any new supply project from the Colorado River, the roundtable states that such a project should be thoroughly studied to define potential impacts to the Colorado River system, and additionally, advocates for a "negotiated equitable apportionment among Colorado River tributary basins."⁴⁶ This concept is discussed in more detail in Chapter 8.

The primary goal of the roundtable is to ensure that existing in-basin needs are met, including "consumptive, environmental, and recreational uses."⁴⁷ Looking to future uses, the roundtable recognizes that energy needs may play a major role in the basin. Within basin goals, the roundtable seeks to address potential shortages, and improve the current infrastructure, with an emphasis on water quality and non-consumptive uses.⁴⁸

The roundtable integrated ongoing studies into the BIP process, using their 2014 Projects and Methods Study to analyze potential water supply solutions under various hydrologic scenarios. This study, along with the BIP outreach process, resulted in a list of potential projects and methods within the basin, and an analysis of water availability, with implementation of identified projects and processes and their effect on nonconsumptive values.⁴⁹ Moving forward, the roundtable will continue to refine ongoing studies, seek additional projects and methods, and continue the outreach and education efforts initiated within the basin.⁵⁰

Conclusion

As demonstrated in this brief overview, each basin features its own remarkable opportunities, as well as distinct challenges that make planning for Colorado's water future difficult. Solutions will impact not only one basin, but basins throughout Colorado. Though each area is characterized by unique issues and concerns, our water future is connected statewide. Every basin grapples with drought, interstate compacts and agreements, growing populations, important environmental and

recreational values, and sustaining agriculture. Because of so many shared interests, we need to continue working together to collectively solve our water supply gaps, so that the Colorado we value can continue to flourish.

¹ Arkansas River Compact, Art. IV, para D, 1948.

² WestWater Research, CDM Smith, CH2MHILL, Peak Facilitation, *Draft Arkansas Basin Implementation Plan* (Colorado Springs: WestWater Research, 2014) Executive Summary.

³ *Id.*

⁴ *Id.*

⁵ *Id.*

⁶ *Id.*

⁷ *Id.*

⁸ SGM, *Draft Colorado Basin Implementation Plan* (Glenwood Springs: SGM, 2014) 1.

⁹ *Id.*

¹⁰ *Id.* 3-5.

¹¹ *Id.*

¹² *Id.*

¹³ Wilson Water Group, *Draft Gunnison Basin Implementation Plan* (Denver: Wilson Water Group, 2014) Executive Summary.

¹⁴ *Id.*

¹⁵ *Id.*

¹⁶ *Id.*

¹⁷ *Id.*

¹⁸ *Id.*

¹⁹ *Id.* 8.

²⁰ Wilson Water Group, *Draft North Platte Basin Implementation Plan* (Denver: Wilson Water Group, 2014) 2.

²¹ *Id.*

²² *Id.*

²³ *Id.*

²⁴ DiNatale Water Consultants, *Draft Rio Grande Basin Water Plan* (Boulder: DiNatale Water Consultants, 2014) 121.

²⁵ *Id.* 121.

²⁶ *Id.*

²⁷ *Id.*

²⁸ *Id.* 252.

²⁹ *Id.* 277.

³⁰ *Id.* 292.

³¹ *Id.* 292.

³² HDR, WestSage Water Consultants, *Draft South Platte Basin Implementation Plan* (Denver: HDR, West Sage Water Consultants, 2014) Executive Summary.

³³ *Id.*

³⁴ *Id.*

³⁵ *Id.*

³⁶ *Id.*

³⁷ *Id.*

³⁸ Harris Water Engineering, *Draft Southwest Basin Implementation Plan* (Durango: Harris Water Engineering, 2014) w.

³⁹ *Id.*

⁴⁰ *Id.*

⁴¹ *Id.*

⁴² *Id.*

⁴³ *Id.*

⁴⁴ *Id.*

⁴⁵ AMEC, *Draft Yampa/White/Green Basin Implementation Plan* (Denver: AMEC, 2014) i.

⁴⁶ *Id.*

⁴⁷ *Id.*

⁴⁸ *Id.*

⁴⁹ *Id.*

⁵⁰ *Id.*

4. Water Supply

Introduction

Colorado's water supply consists of both surface water and groundwater sources. Surface water and groundwater supplies are dependent on complex interactions between geography, weather, and legal constraints, all influencing how much water is available for beneficial uses. Groundwater accounts for approximately 17 percent of water use, while surface water supplies the remaining 83 percent. Colorado's rivers and streams, which are highly variable both seasonally and annually, provide surface water and replenish alluvial groundwater supplies. Groundwater and surface water are subject to different management institutions, which are further described in section 2.1. The quality of surface water and groundwater also influences the amount available for different types of uses.

4.1 Waters of Colorado

Colorado's geography is diverse, with terrain that ranges from the low-lying plains of Holly (3,392 feet) to the high peak of Mt. Elbert (14,439 feet), the highest peak in the contiguous Rocky Mountains states. All of the state resides above 3,300 feet, with a mean elevation of 6,800 feet, the highest of any state.¹ This variability influences precipitation amounts and patterns experienced across the state.

Many major rivers originate in the high Rocky Mountains and collectively account for 70 percent of Colorado's surface water. They flow through the mountains onto the plains and out of the state toward the Pacific Ocean west of the Continental Divide and toward the Gulf of Mexico east of the divide, passing into 18 downstream states and Mexico along the way. All Colorado rivers flow out of the state. Four major river systems begin in Colorado: the Arkansas, the Colorado, the Platte and the Rio Grande.²

Colorado has eight primary river basins that span this terrain: South Platte; North Platte; Arkansas; Rio Grande; Gunnison; Colorado; the Northwest Basin composed of the Yampa, White, and Green Rivers; and the Southwest Basin composed of the Dolores, San Juan, and San Miguel Rivers. The Republican River also begins in Colorado. These basins are dependent upon winter snowpack and spring runoff to replenish and sustain their flow which, on average, produces approximately 15 million acre-feet of water annually. Of that, we consume roughly 5 million acre-feet and approximately 10 million acre-feet flow out of Colorado to neighboring states.

The western side of the Continental Divide contains 70 percent of the surface water³ and 11 percent of the population. The eastern side of the Continental Divide consumes 70 percent of the state's

water.⁴ As a result, many reservoirs on the western slope service communities and demands along the Front Range and eastern plains.¹ Water managers rely on networks of reservoirs, pumps, tunnels, and ditches to store and move water and to meet demands at peak times. They also need to comply with relevant environmental mitigation requirements to maintain ecosystem health. Demand-management strategies can help to alleviate stress on the system under both normal operating conditions and during shortages, as further discussed in chapter 6.3.

Groundwater plays a major role in the statewide water supply. Colorado has seven principal aquifers, or aquifer systems, both alluvial and bedrock.⁵ Nineteen of Colorado's sixty four counties and approximately 20 percent of the state's population rely heavily on groundwater.⁶ Certain areas of the state have superior access to groundwater (e.g. the San Luis Valley and the various designated groundwater basins and alluvial systems on the eastern plains) than other areas (Figure 4.1-1). Groundwater aquifers are beneficial because they offer natural infrastructure and protection from evaporation; however relying upon groundwater aquifers is challenging because of the uncertain and varied natural recharge rates. In some cases, the total amount of water is finite, so it is a non-renewable resource.

Both alluvial and bedrock aquifers offer potentially significant groundwater storage capability. Total capacity potentially available statewide is approximately 10 million acre-feet of alluvial aquifer storage and over 150 million acre-feet of bedrock aquifer storage. Many potential storage sites are located far away from significant recharge water sources, and there are only a few applications of managed groundwater storage in Colorado, mostly located in the Denver Basin aquifers. Colorado developed rules allowing for recharge and long-term storage in the non-tributary Denver Basin aquifers, but there are currently no comparable rules for storage in alluvial

Figure 4.1-1: Designated Groundwater⁵



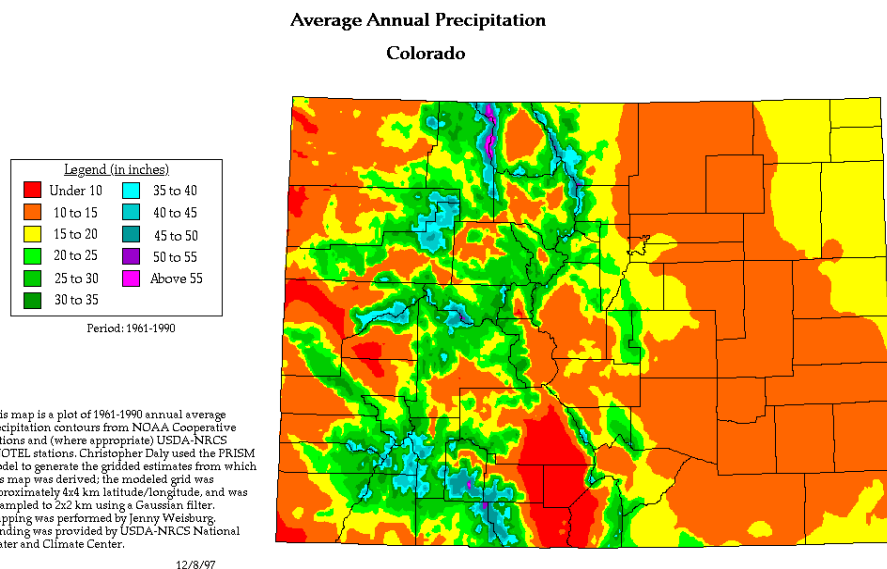
¹ The western slope includes the Gunnison, Colorado, Yampa/White/Green river basins, and the basin of the Southwest, composed of the Dolores, San Juan, and San Miguel Rivers. The Rio Grande, North and South Platte, Arkansas and the Republican river basins are included in the calculations for the eastern slope. If the Rio Grande Basin is included in the western slope, then western slope water increases closer to 80%, which is the figure traditionally used. However since the Rio Grande is not truly west of the continental divide, 70% is a more accurate figure.

aquifers. Groundwater recharge for augmentation purposes is differentiated from groundwater recharge for storage purposes. Recharge in shallower unconfined alluvial aquifers is physically easier than in the deeper confined bedrock aquifers (i.e. surface spreading vs. injection). However, in contrast to recharge for augmentation, storage in alluvial aquifers can be more difficult to manage because of the transient nature of groundwater flow in tributary alluvial aquifers, making storage in alluvial aquifers more short-term. Thus, our understanding of recharge for storage in alluvial aquifers relies on sophisticated groundwater modeling. While groundwater storage has its advantages (e.g. lack of evaporation), it also has its challenges, including slow recharge rates and difficulty controlling the recharged water, retrieving the water, and delivering to the customer. It is also limited in that surface water supplies are renewable, but two major sources of groundwater in eastern Colorado—the Denver Basin and the Ogallala aquifers—are not.

4.2 Variability in Water Supplies

Precipitation varies in both amount and distribution across the state and is influenced by the elevation and the orientation of the mountains and valleys (4.2-1). While portions of the state such as the San Luis Valley receive just seven inches of precipitation annually, other portions, for example Wolf Creek Pass, average over 60 inches. Colorado receives 17 inches of precipitation, on average each year. In general, the mountains receive more precipitation than the eastern plains, and winters are typically wetter than summers. Despite high precipitation during the winter months, demand for water is highest in the summer months and the growing season.⁷

Figure 4.2-1: Average Precipitation In Colorado 1961-1990 (inches)



Source: NOAA, 1997

Our state's variable precipitation patterns have resulted in considerable hydrologic fluctuation with floods and drought possible within the same year. In 2011 and 2013, Colorado experienced both extreme flooding and severe droughts during the same periods. These variations from basin to basin can differ by thousands of acre-feet.⁸ Furthermore, basin streamflow is not equally distributed across the state, so a low flow in one basin may be greater than a high flow in another, as is the case with the Colorado River and the Southwestern Basins, (Table 4.2-2).

For the purposes of this report, hydrologic classifications are assigned based on percentile ranking: drought, dry, average, wet and flood (Table 4.2-1). Drought and dry periods have significant and lasting impacts on water supplies and availability for years, while wet years offer relief with as much as six times the amount of annual water supplies compared to dry years (e.g. lower South Platte). Both extremes can affect water supplies and availability throughout the state for years (Figure 4.2-3).

Table 4.2-1: Hydrologic Classification Criteria ²	
Percentile Range	Hydrologic Classification
0.00 - 0.05	Drought (much below normal)
0.06 - 0.24	Dry
0.25 - 0.75	Average (normal)
0.76 - 0.94	Wet
0.95 - 1.00	Flood (much above normal)

They also have other consequences, such as wildfires and negative economic impacts. For example, in 2002, the driest single year on record, Colorado suffered a number of severe wildfires. The largest of these fires, the Hayman Fire, elevated levels of nitrate and turbidity in streams located in the burn area, and remained elevated for five years after the event.^{9 10} Another example, in 2013, the West Fork Complex fire damaged watersheds in the Rio Grande Basin. Further, the Colorado Water Conservation Board coordinated field data and assisted in the developing reports on the substantial hillside and stream erosion that takes place following medium and high intensity wildfires.¹¹ In addition, water providers have reported increased levels of debris in reservoirs, which affect not only water quality, but also the operations of water supply and treatment infrastructure.¹²

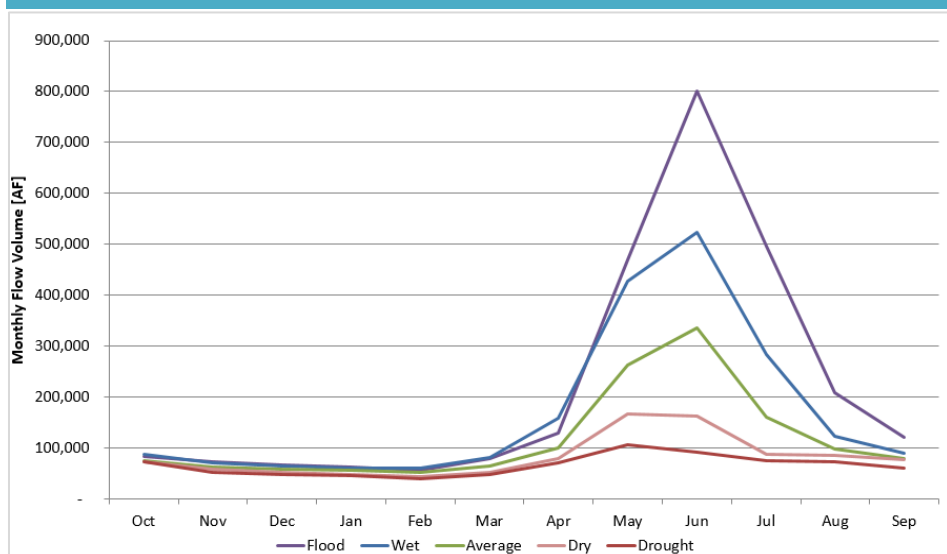
Wildfires can impact Colorado's economy and can cost the state millions of dollars in response and recovery efforts alone. They can also impact water provider's budgets as well. The 1996 Buffalo Creek and 2002 Hayman fires cost Denver Water \$20 million in wildfire related dredging and maintenance at their Strontia Springs reservoir, without full resolution of the problem.¹³ In 2012, another year of statewide drought, Colorado Springs Utilities, and the City of Fort Collins also incurred costs from separate wildfires in the watersheds that supply their municipal water. These naturally-occurring events can greatly affect the amount of water supplies that are available for use.

² Table 4.2-1 shows the upper-most threshold of the percentile range for each of the selected gages. As this was an independent analysis, values may differ slightly from volumes reported in the individual basin implementation plans.

Drought, independent of wildfire, can also carry substantial impacts from decreased water availability. In 2012, it is estimated that lost revenues resulting from the drought in the agricultural sector alone exceeded \$409 million statewide.¹⁴ When secondary and tertiary economic impacts to local communities are factored in, the loss increases to \$726 million statewide.¹⁵ Drought can also negatively influence air quality, water delivery infrastructure, wildlife, the environment, recreation, and tourism. Drought is unique in that it can last for weeks, months, or years; and the longer a drought persists, the larger its impact. For instance, a municipality may be able to weather a single-year drought by using reservoir storage and drought response measures, but if the storage is not replenished, subsequent years become increasingly more difficult to manage. The same is true in the agricultural sector; ranchers forced to cull herds in response to drought may need decades to recover their stock, or may never recover at all. Both the Rio Grande and the Arkansas Basins have been dry most of the past decade with only three above-average precipitation years since 2000.¹⁶ The Colorado River Basin has experienced the driest 14-year period since 1963 with above-average flows in only 3 of the last 14 years.¹⁷

On the other end of the variability spectrum are floods- too much moisture can result in overflowing reservoirs and extensive damage. In the fall of 2013, widespread flooding occurred in some regions of the state after receiving as much as 19 inches of rain in a few days or less. In these areas, the events were equivalent to nearly a full year of precipitation. As many as 88 weather stations exceeded 24-hour precipitation records and the hardest hit areas received over 600 percent of average precipitation for the month.¹⁸ Entire communities were inundated with water. The September 2013 floods resulted in loss of life, power, homes, businesses, and roads. Initial estimates of economic losses have reached \$2.9 billion.¹⁹ This event caused Halligan Reservoir to rise 30 feet, capturing nearly 6000 acre-feet of water in just over 24 hours. Halligan Reservoir transformed from nearly an empty vessel to a full supply in a matter of days.²⁰ Unfortunately, flows were so high that many storage facilities lost the infrastructure necessary to store the excess water. Floods not only cause community damage, but also affect agricultural operations and water supply due to damaged delivery systems. Flooding events can leave water supply infrastructure, such as diversions and headgates, completely disconnected from their historical source of water supplies. These impacts can take weeks, months, or years to fully repair, and some damage may be too great to ever repair economically.

Figure 4.2-1: Average Monthly Flows by Hydrologic Classification^a

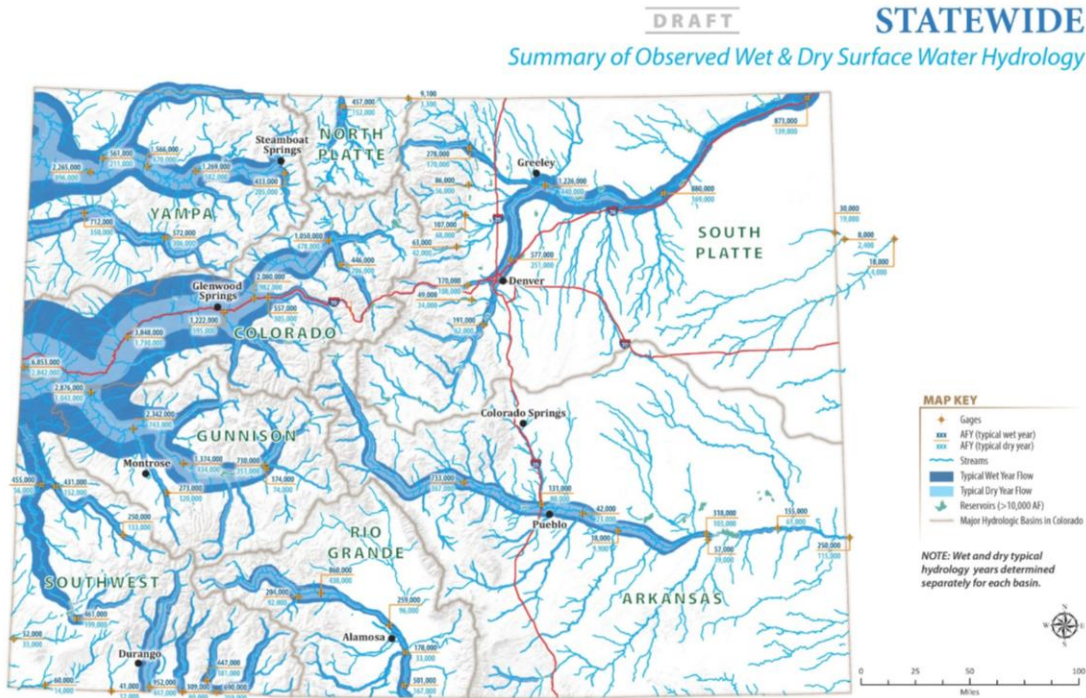


^aFigure 4.2-1 uses the same hydrologic classifications as Table 4.2-1, but shows average monthly flow volumes to illustrate the wide variance that can exist between classifications, especially during the runoff season.

Figure 4.2-2: Annual Flow Values for Varying Conditions as Select Gages (AFY)^b

Basin	Gage Name	Gage ID	Drought	Dry	Average	Wet	Flood
Arkansas	Arkansas River at Canon City	07096000	293,800	404,600	611,000	797,700	940,300
Colorado	Colorado River near Dotsero	09070500	852,000	1,060,500	1,788,400	2,333,000	3,029,600
Southwest	Animas River at the state line	09363500	365,400	443,600	886,400	991,000	1,181,500
Southwest	Dolores River near Dolores	09166500	140,600	195,100	396,700	491,700	515,700
Gunnison	Gunnison River near Grand Junction	09152500	824,300	1,114,700	2,243,100	3,153,100	3,765,700
North Platte	North Platte River near Northgate	06620000	121,600	196,700	390,200	565,600	728,700
Rio Grande	Rio Grande near Del Norte	08220000	325,700	462,500	742,200	965,500	1,030,700
South Platte	South Platte River near Kersey	06754000	248,900	412,300	916,200	1,644,900	2,628,600
Yampa/White/Green	Yampa River near Steamboat Springs	09239500	180,600	244,200	394,800	502,300	599,300
Yampa/White/Green	White River near Meeker	09304500	276,700	353,700	499,500	666,800	758,300

Figure 4.2-3: Wet and Dry Year Flows at Select Gages^c



4.3 Uncertainties Affecting Supply

In addition to the high hydrologic variability we face as a state, climate change and dust on snow events present additional complexities and uncertainties. In recent decades, Colorado has warmed and will likely continue to warm in the future. Average yearly temperature has increased 2°F in the last 30 years, and 2.5°F in the last 50 years across the state. This has affected the timing of snowmelt and peak runoff, which occur earlier, and there has been an increase in heat waves and wildfires.²¹ Climate projections show Colorado warming an additional 2.5°F to 5°F by mid-century, with summer temperatures increasing more than winter. While projections are less clear whether precipitation will increase or decrease, warming temperatures that drive physical processes, such as evapotranspiration, are projected to result in a decrease in annual stream flow, especially in the state's southern basins. Even moderate increases in precipitation will not be sufficient to overcome the drying signal.²² All of these changes are likely to affect water available for beneficial use in Colorado in the coming decades. Figure 4.3-1 illustrates the potential water-related impacts from climate change in different areas and sectors as described in the 2014 Climate Change in Colorado Report.²³

Table 4.3-1: Summary of projected changes and potential impacts to water resources for Colorado²⁴

Element	Projected changes and potential impacts	Studies that have assessed this vulnerability for Colorado
Overall surface water supply	Most projections of future hydrology for Colorado's river basins show decreasing annual runoff and less overall water supply, but some projections show increasing runoff. Warming temperatures could continue the recent trend towards earlier peak runoff and lower late-summer flows.	CWCB (2012); Reclamation (2012); Woodbury et al. (2012)
Water infrastructure operations	Changes in the snowpack and in streamflow timing could affect reservoir operations, including flood control and storage. Changes in the timing and magnitude of runoff could affect the functioning of diversion, storage, and conveyance structures.	CWCB (2012); Reclamation (2012)
Crop water demand, outdoor urban watering	Warming temperatures could increase the loss of water from plants and soil, lengthen growing seasons, and increase overall water demand.	CWCB (2012); Reclamation (2012)
Legal water systems	Earlier and/or lower runoff could complicate the administration of water rights and interstate water compacts, and could affect which rights holders receive water.	CWCB (2012)
Water quality	Warmer water temperatures could cause many indicators of water quality to decline. Lower streamflows could lead to increasing concentrations of pollutants.	EPA (2013)
Groundwater resources	Groundwater usage for agriculture could increase with warmer temperatures. Changes in precipitation could affect groundwater recharge rates.	
Energy demand and operating costs	Warmer temperatures could place higher demands on hydropower facilities for peaking power in summer. Warmer lake and stream temperatures, and earlier runoff, could affect water use for cooling power plants and in other industries.	Macknick et al. (2012)
Forest disturbances in headwaters regions	Warmer temperatures could increase the frequency and severity of wildfire, and make trees more vulnerable to insect infestation. Both have implications for water quality and watershed health.	
Riparian habitats and fisheries	Warmer stream temperatures could have direct and indirect effects on aquatic ecosystems, including the spread of non-native species and diseases to higher elevations. Changes in streamflow timing could also affect riparian ecosystems.	Rieman and Isaak (2010)
Water- and snow-based recreation	Earlier streamflow timing could affect rafting and fishing. Changes in reservoir storage could affect recreation on-site and downstream. Declining snowpacks could impact winter mountain recreation and tourism.	Reclamation (2012); Battaglin et al. (2011); Lazar and Williams (2008)

As the climate of Colorado shifts, past variability of stream flows become a less reliable guide for future variability.²⁵ Table 4.3-2 below illustrates projected depleted flows for 2050 in acre-feet per year at eleven different sites around the state. In some scenarios, projected depleted flows are less than zero. Under those scenarios the negative projection indicates that some established uses would be unable to obtain their historical supply of water.²⁶ Both the Arkansas and the Rio Grande Rivers have projected depleted flows of less than zero under both projected climate scenarios; the South Platte has a negative projected depleted flow under the “hot and dry” climate scenario. Continued monitoring, research, and planning is critical to determining whether future supplies will fulfill future demands and continue to fulfill *current* demands. Addressing these challenges will require collaboration and innovative solutions.

Table 4.3-2: Projected Depleted Flows for 2050 (acre-feet/year)

Basin/ Gauge	Historical ³	Hot & Dry ⁴	Between 20 th Century Observed & Hot/Dry ⁵
Yampa River near Maybell	1,110,000	1,110,000	1,230,000
White River near Meeker	439,000	429,000	549,000
Colorado River near State Line	4,560,000	3,980,000	4,470,000
Gunnison River near Grand Junction	1,780,000	1,620,000	1,740,000
San Juan River near Carracas	446,000	455,000	463,000
Los Pinos River at La Boca	150,000	131,000	140,000
Dolores River near Bedrock	277,000	264,000	277,000
Arkansas at Lamar	136,000	-286,000	-184,000
North Platte River near Northgate	313,000	257,000	299,000
Rio Grande near Lobatos	409,000	-160,000	-39,000
South Platte at South Julesburg	395,000	-294,000	71,000

Dust on Snow Events

So called “Dust-on-snow” events also introduce uncertainty into managing water supplies. Dust-on-snow events occur when wind deposits dust from southwestern deserts, and other loose-soil surfaces that lack vegetation, onto mountain snowpack. This increases the effect of solar radiation, which speeds up snowmelt and leads to earlier spring runoff. Studies have shown that dust events can advance snowmelt timing, enhance snowmelt runoff intensity, and decrease snowmelt yields.²⁷ ²⁸ Dust-on-snow events can result in peak runoff occurring three weeks earlier than normal;²⁹ this shift is independent of climate change which may also result in earlier snowmelt patterns.³⁰ Since

³ Historical or current conditions, which is no change in runoff or crop irrigation requirement (CIR) fall at roughly the 9th and 67th percentiles; this means that 91% of runs show increases in CIR and about two thirds show reductions in runoff.

⁴ Hot and dry is defined as the 75th percentile for CIR which represents water use, and the 25th percentile for natural flows, meaning only 25% of projections have lower natural flows and 25% of projections have a higher crop irrigation requirements. All projections are based on an approach using 209 climate projections.

⁵ Between 20th century observed and hot & dry is defined at the 50th percentile for both natural flows and crop irrigation requirements. This scenario is the middle of the range in terms of severity.

2005, when dust tracking began, 91 events have occurred. Ten of these dust-on-snow events occurred in the 2013 water year, when Colorado observed the heaviest deposition to-date.³¹ While the severity of future dust-on-snow events is uncertain, if events continue at recently-observed rates, they will affect Colorado's present and future water supply by decreasing flows by 5 percent, on average. On the Colorado River, this reduction would result in a decrease of 750,000 acre-feet of water, or twice the amount of water the City of Denver uses annually.^{32 33}

4.4 The Role of Storage

While our snowpack is our greatest storage "facility," in order to meet the year-round needs of agriculture, municipalities, recreation, and the environment, we have constructed numerous reservoirs to hold water during plentiful times and release water during heightened demand or periods of drought. Nearly half of the state's storage capacity is located on the western slope in the Colorado River Basin and its tributaries.³⁴ Colorado's total storage capacity is approximately 7.5 million acre-feet within 1953 reservoirs (Figure 4.4-2). Approximately 4.2 million acre-feet of the state's total storage is in 113 federally-owned reservoirs.

Colorado's water infrastructure, including water storage, is critical to maintaining stable water supplies. Proper infrastructure allows Colorado to use its legal entitlements before water flows out of the state. In addition, infrastructure is essential in assisting with flood control, supporting all types of use (agricultural, environmental, municipal, and industrial) in periods of drought, complying with interstate compacts, and augmenting systems in order to maintain compliance with water administration. Most storage projects were developed in the middle of last century. Both construction of new infrastructure and storage have remained relatively static over the last 30 years (Figure 4.4-2). In fact, construction of storage has declined so much that our current rate of building storage capacity resembles that of the Great Depression.

Figure 4.4-1: Colorado Dam and Reservoir Construction History and Volume by decade⁶

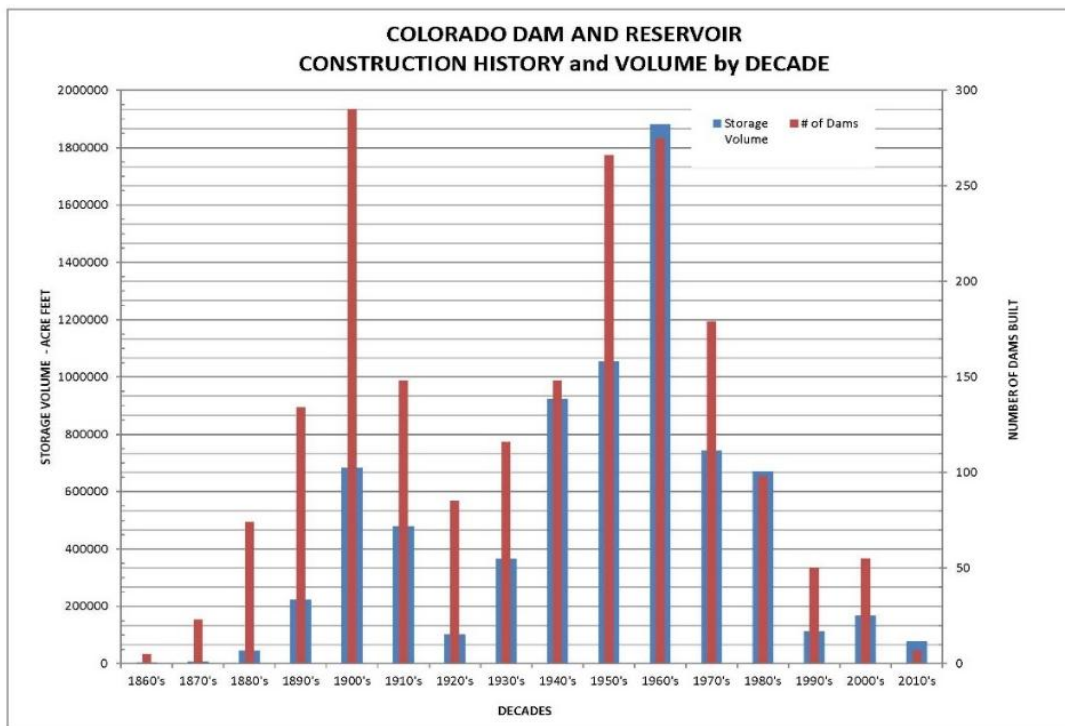
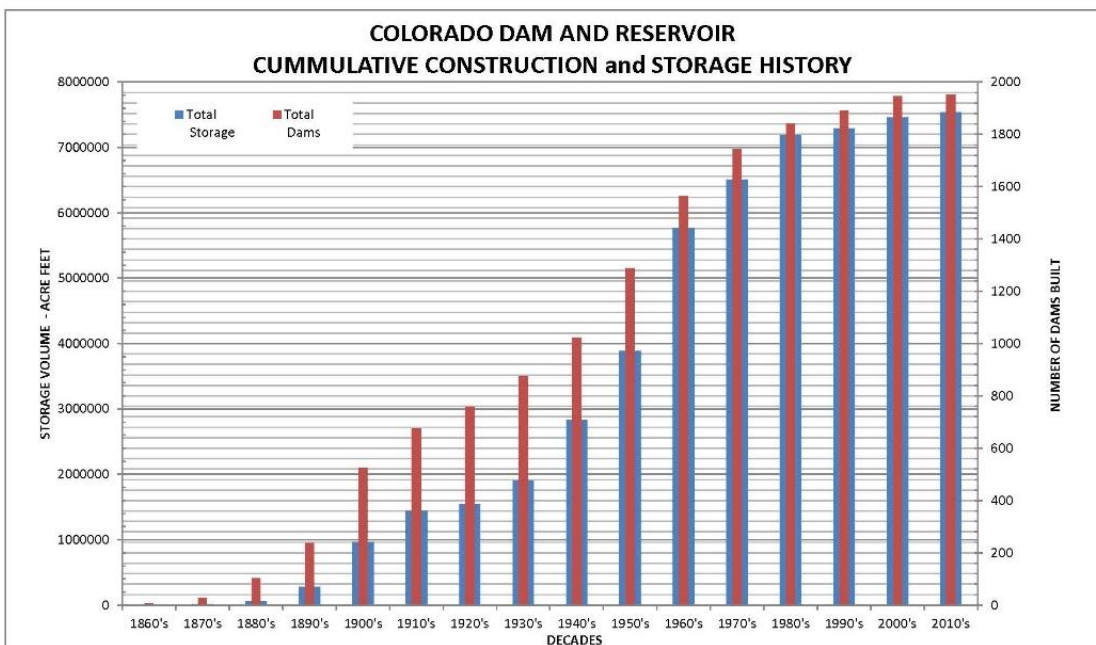


Figure 4.4-2: Colorado Dam and Reservoir Cumulative Construction and Storage (cumulative)



⁶ Figure 4.4-1 does not include storage capacity associated with flood control reservoirs because it can only be used on a limited basis for water supply storage.

While storage is a critical element for managing Colorado's future water supplies, new storage projects can be contentious and face numerous hurdles, including permitting and funding. In many cases, it may be more practical and efficient to reallocate or enlarge an existing dam and reservoir than to build a completely new structure. In determining whether a reservoir is suitable for enlargement, we use the following factors: the ability to capture excess yield, the potential for exchange, the reservoir location relative to more senior water rights, the engineering characteristics of existing facilities, interstate compact considerations, and environmental benefits and impacts.

The Colorado Division of Water Resources uses information contained in the dams database to examine enlargement potential for existing reservoirs and dams. The database of dams in Colorado contains information on the volume of water at the spillway, or normal high-water line, and the volume of water that would be present if the reservoir filled to the dam crest. The difference between the volume of normal storage and of maximum storage is called the storage delta. The storage delta is typically needed for routing floods so the dam does not overflow. Advances in meteorology, hydrology, and dam engineering make it possible to reassess reservoirs and potentially capture excess flood storage for use as active storage. The storage delta section of the reservoir basin has the largest surface area; therefore, a relatively small increase in the vertical height of the reservoir will result in a large increase in water storage capacity.⁷

Table 4.4-1: 15 Largest Potential Reservoir Storage Increase by Storage Delta Factor

Name	Division	Max Storage	Normal Storage	Storage Delta	Surface Area	Managing Organization
JOHN MARTIN	2	805,440	232,942	572,498	8,955	U.S. ARMY CORPS OF ENGINEERS
CHATFIELD	1	355,000	26,600	328,400	1,200	U.S. ARMY CORPS OF ENGINEERS
BONNY	1	348,390	41,342	307,048	2,000	U.S. BUREAU OF RECLAMATION
CHERRY CREEK	1	265,770	13,226	252,544	852	U.S. ARMY CORPS OF ENGINEERS
GRANBY	5	752,048	539,800	212,248	7,260	U.S. BUREAU OF RECLAMATION
PUEBLO	2	535,507	357,678	177,829	4,646	U.S. BUREAU OF RECLAMATION
ANTERO	1	115,000	26,500	88,500	2,600	DENVER BOARD OF WATER COMMISSIONERS
BEAR CREEK	1	81,075	2,000	79,075	110	U.S. ARMY CORPS OF ENGINEERS
BLUE MESA	4	1,019,748	940,800	78,948	9,180	U.S. BUREAU OF RECLAMATION
GREEN MOUNTAIN	5	222,645	154,600	68,045	2,130	U.S. BUREAU OF RECLAMATION
MCPHEE RESERVOIR	7	440,000	381,100	58,900	4,300	U.S. BUREAU OF RECLAMATION
CUCHARAS #5	2	64,820	7,414	57,406	915	TWO RIVERS WATER COMPANY
TWIN LAKES	2	141,000	86,000	55,000	2,805	U.S. BUREAU OF RECLAMATION
DILLON	5	305,000	254,036	50,964	3,300	DENVER BOARD OF WATER COMMISSIONERS
TRINIDAD	2	169,370	119,877	49,493	2,018	U.S. ARMY CORPS OF ENGINEERS

Table 4.4-1 shows the factors of maximum storage, normal storage, and surface area for the top 15 dams on our potential enlargement list. As an example, at John Martin Reservoir, an increase of one foot in the normal high-water line of the reservoir results in an increased storage capacity of nearly 9000 acre-feet. While it is certainly not the only indicator regarding the potential for enlargement, a large storage delta is a threshold criteria. A reservoir with a large storage delta can expand its additional storage capacity without increasing the area potentially inundated by the dam, which

⁷ This does not take into account compact entitlements or other constraints that may exist.

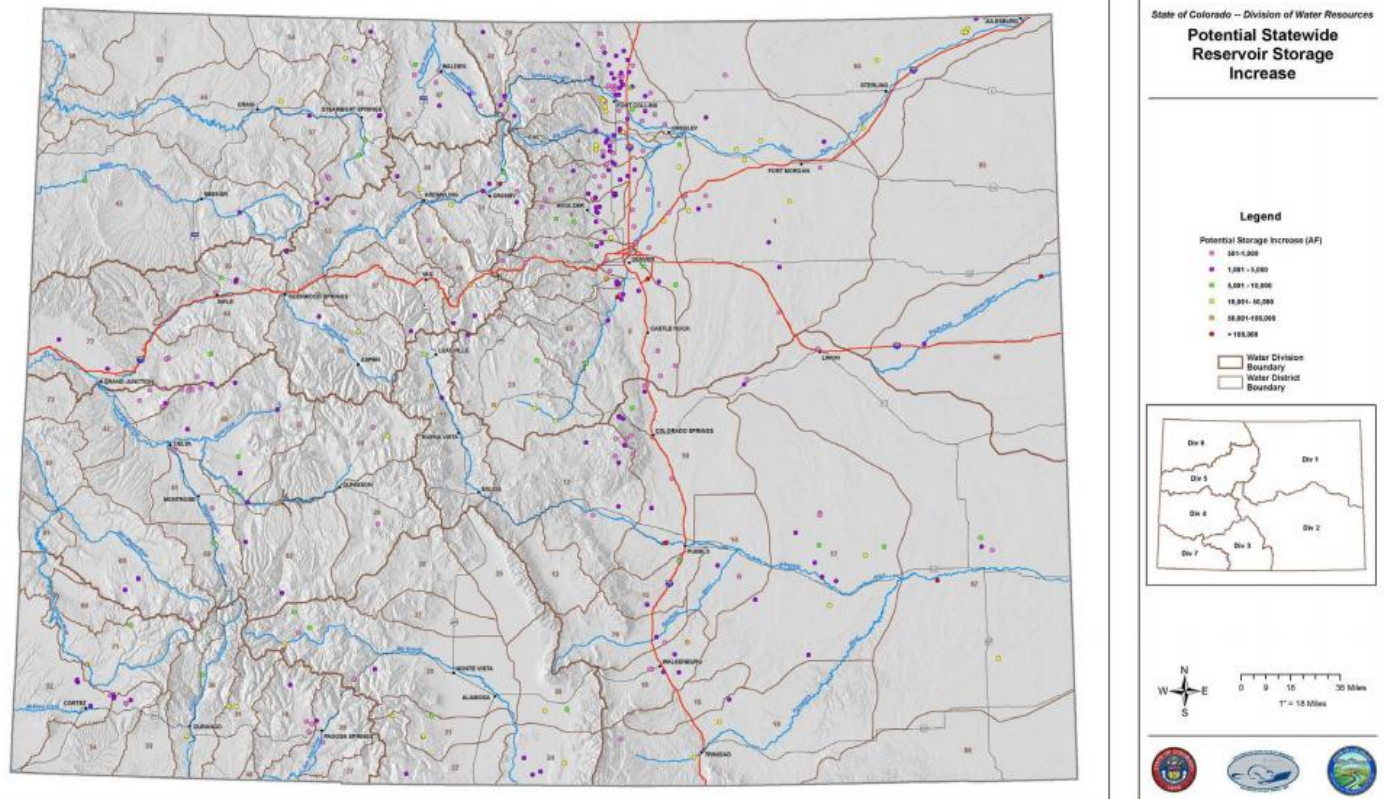
minimizes the associated environmental impacts. The most efficient way to generate a list of dams and reservoirs that can be enlarged is to use the database to evaluate the storage delta. Table 4.4.-2 shows the results of the query from all 1900 jurisdictional dams in the database. The table shows 323 candidate dams that meet the criteria of a storage delta greater than 500 acre-feet. Figure 4.4-3 shows the geographical distribution of the dams by the range of potential storage that exists.

Table 4.4-2: Number of dams by water division that fall into the various ranges of Storage Delta

Water Division	STORAGE_DELTA Range (acre-feet)						Division Totals
	501-1,000	1,001-5,000	5,001-10,000	10,001-50,000	50,001-100,000	>100,000	
1	53	61	10	16	2	3	145
2	19	23	5	5	2	2	56
3	2	5	4	5	0	0	16
4	16	10	3	1	1	0	31
5	9	15	3	3	2	1	33
6	8	9	4	2	0	0	23
7	6	7	2	3	1	0	19
	113	130	31	35	8	6	323

In general, the reservoirs with the largest storage delta are those owned by the federal Bureau of Reclamation (BOR) and the U.S. Army Corps of Engineers (Corps). BOR reservoirs are primarily for storage of project waters, not for flood storage. Conversely, Corps dams are dual purpose and have the largest storage deltas because they include dedicated flood storage capacity.³⁵

Figure 4.4-3: Potential Statewide Reservoir Storage Increase based on Storage Delta factor only



4.5 Weather Modification

Weather modification, also known as cloud seeding, is used to increase available water supplies. The World Meteorological Organization states that weather modification programs that are well designed and well executed have demonstrable results³⁶ with no documented negative environmental effects from using silver iodide for cloud seeding.³⁷ Colorado is a leading state for weather modification activities with seven permitted ground-based wintertime cloud seeding programs. The goal of these programs is to increase snowpack and streamflow. In comparison to other sources of new water, cloud seeding is a relatively low-cost means of increasing system supplies. The recreation sector, especially the ski industry, relies heavily on cloud seeding. In 2006, because of prolonged water supply shortages in the Colorado River Basin, the Colorado Water Conservation Board signed agreements with the New Mexico Interstate Stream Commission, California Six Agency Committee, Southern Nevada Water Authority, and Central Arizona Water Conservation District to collaborate and financially support cloud seeding in Colorado. For additional information on weather modification efforts within the state, please refer to the Weather Modification Program pages on the Colorado Water Conservation Board website.³⁸

4.6 Water Quality

Water quality and quantity are inextricably connected. Understanding water supply and demand alone is an incomplete picture. There must be enough water available for use with suitable quality for irrigation, drinking water, recreational uses, and the protection of aquatic life.

Based on the 2012 Integrated Report (reporting period 2010-2011):

- 65 percent of river and stream miles and 28 percent of lake and reservoir acreages evaluated statewide attain water quality standards.
- 25 percent of river and stream miles and 49 percent of lake and reservoir acreages statewide do not have enough data to determine if water quality standards are being met.
- 10 percent of river and stream miles and 23 percent of lake and reservoir acreages evaluated statewide are not meeting water quality standards for one or more pollutant (i.e., they are impaired waterbodies).³⁹

Over the past 40 years Colorado water quality management programs have ensured clean water for uses such as growing crops, providing drinking water, and enjoying water-based recreation. These programs benefit all Coloradans because clean water is essential to the state's healthy environment, diverse economy, and quality of life. This is why both protecting and restoring water quality are fundamental to supporting Colorado's Water Values and implementing Colorado's Water Plan.

The legislative declaration of the Colorado Water Quality Control Act includes the following goals:

- Achieve the maximum practical degree of water quality in the waters of the state.
- Provide that no pollutant be released into any state waters without first receiving the treatment or other corrective action necessary to reasonably protect the legitimate and beneficial uses of such waters; to provide for the prevention, abatement and control of new or existing water pollution; and to cooperate with other states and the federal government in carrying out these objectives.⁴⁰

In addition, there are several Colorado Water Quality Control Act provisions that are related to water quantity and water rights:

- A primary goal of the Water Quality Control Act is to protect, maintain and improve the quality of statewide waters for beneficial uses including domestic, wildlife, and aquatic life; and agricultural, industrial, and recreational uses.
- Dischargers of pollutants may be required to meet a high degree of treatment in order to protect water rights.
- The Water Quality Control Commission and Water Quality Control Division must consult with the Colorado Water Conservation Board before making any decision or adopting any rule or policy that has the potential to cause material injury to water rights.
- Nothing in the Act is to be construed or applied so as to cause or result in material injury to water rights.
- The Water Quality Control Commission and Water Quality Control Division shall not require an instream flow water right for any purpose.

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- ¹ US Census Bureau, "Statistical Abstract of the United States; Table 366. Extreme and Mean Elevations by State and Other Areas," 2012. [Online]. Available: <https://www.census.gov/compendia/statab/2012/tables/12s0366.pdf>.
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- ³ B. Harding, *Analysis for CWCB*, 2014.
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- ¹¹ David L. Rosgen, *The Trail Creek Watershed Master Plan for Stream Restoration & Sediment Reduction* (Fort Collins: Wildland Hydrology, 2013).
- ¹² Denver Water, *2010 Comprehensive Annual Financial Report* (Denver: Denver Water, 2011), pg #1-17.
- ¹³ Denver Water, *2010 Comprehensive Annual Financial Report*, pg#1-17.
- ¹⁴ James Pritchett, Chris Goemans, and Ron Nelson, *Estimating the Short and Long - term Economic & Social Impacts of the 2012 Drought in Colorado* (Denver: Colorado Water Conservation Board, 2013), pg #9-10.
- ¹⁵ James Pritchett, Chris Goemans, and Ron Nelson, *Estimating the Short and Long - term Economic & Social Impacts of the 2012 Drought in Colorado* (Denver: Colorado Water Conservation Board, 2013), pg #9-10.
- ¹⁶ National Climatic Data Center, "Climate at a Glance - Time Series," August 2014. [Online]. Available: <http://www.ncdc.noaa.gov/cag/time-series/us>.
- ¹⁷ US Bureau of Reclamation, "US Bureau of Reclamation Upper Colorado Region," 11 July 2014. [Online]. Available: <http://www.usbr.gov/uc/water/crsp/cs/gcd.html>.
- ¹⁸ "Colorado Flood Website," Colorado Climate Center, Accessed 2014, <http://coflood2013.colostate.edu/>.
- ¹⁹ Colorado Department of Local Affairs, *Action Plan Amendment#1, Substantial Amendment for the Second Allocation of CDBG-Disaster Recovery* (Colorado Department of Local Affairs, 2014), pg #3.
- ²⁰ Division of Water Resources, "Halligan Reservoir Diversion Records," 2013.
- ²¹ J. Lukas, "Climate Change in Colorado," State of Colorado, 2014. Pg11-35.
- ²² J. Lukas, "Climate Change in Colorado," State of Colorado, 2014.pg 65.
- ²³ J. Lukas, "Climate Change in Colorado," State of Colorado, 2014.pg 84.
- ²⁴ J. Lukas, "Climate Change in Colorado," State of Colorado, 2014.pg 84.
- ²⁵ Colorado Water Conservation Board, "Colorado Drought Mitigation and Response Plan," 2013.
- ²⁶ B. Harding, "DRAFT Technical Memo: SWSI Climate Impact Support, Development of Projected Gauged Flows," October 8, 2014.
- ²⁷ Painter,T. et al, "Impact of disturbed desert soils on duration of mountain snow cover," *Geophysical Research Letters*, 2007.
- ²⁸ Painter,T. et al, "Response of Colorado River Runoff to Dust Radiative Forcing in Snow," *Proceedings of the National Academy of Sciences*, 2010.

- ²⁹ Painter, T. et al, "Response of Colorado River Runoff to Dust Radiative Forcing in Snow," *Proceedings of the National Academy of Sciences*, 2010.
- ³⁰ J. Lukas, "Climate Change in Colorado," State of Colorado, 2014. Pg 84
- ³¹ Center for Snow and Avalanche Studies, "Colorado Dust-on-Snow Program WY2013 Summary," 2013. [Online]. Available: http://snowstudies.org/dust/SBBSA/summary_2013.html.
- ³² Painter, T. Et al. "Response of Colorado River Runoff to Dust Radiative Forcing in Snow," *Proceedings of the National Academy of Sciences*, 2010.
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- ³⁵ Colorado Division of Water Resources, Office of the State Engineer, Dam Safety Branch, "DAMS applications portion of the Colorado Decision Support System (CDSS) water information database," 2014.
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- ³⁷ Weather Modification Association, "Position Statement on the Environmental Impact of Using Silver Iodide as a Cloud Seeding Agent," July 2009.
- ³⁸ <http://cwcb.state.co.us/water-management/water-projects-programs/pages/%C2%ADweathermodificationprogram.aspx>
- ³⁹
- 40

5. Water Demands

Introduction

This chapter provides an overview of Colorado's current and projected municipal, industrial, agricultural, environmental, and recreational uses. Colorado's Water Plan identifies our water resource challenges. To assess the road ahead, it is essential to understand the many ways that water is used throughout the state and how these uses are connected. As municipal and industrial needs expand, pressure on agriculture, the environment, and water-based recreation rises. As the state grows, associated municipal supply needs will likely increase, more people will seek the outdoor opportunities that Colorado offers, and Coloradans will continue to increase their consumption of a variety of locally grown agricultural products provided by ranches and farms across the state.

5.1 Overview

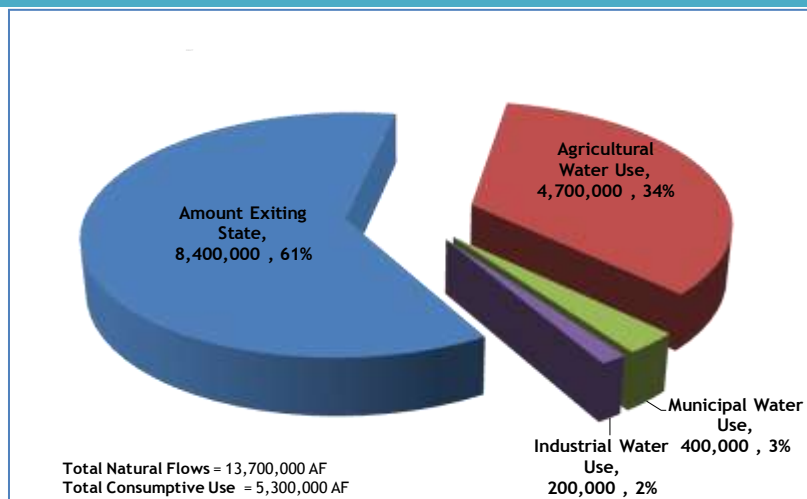
Water use in Colorado is calculated in acre-feet, which is the amount of water that it takes to cover one acre to a depth of one foot. An acre is about the size of a football field, including both end zones.

Water in Colorado is often used multiple times, as this sequence demonstrates: 1) water is diverted for a given use, 2) the plant, person, or process consumes a portion of the water, 3) the portion of water that is not consumed makes its way back to the river (referred to as "return flows"), 4) the return flows are subsequently used by other water users

downstream, and the cycle repeats. Colorado diverts approximately 15.3 million acre-feet of water annually for uses around the state, but consumes an average of only 5.3 million acre-feet.³ In Colorado 34% of use is agricultural, followed by municipalities at 3 percent and large industries at 2 percent (Figure 5.1-1).⁴

In addition to meeting the requirements of communities and food production, water is necessary to support aquatic and riparian dependent species, boating, fishing, camping, and other water-based recreational activities.

Figure 5.1-1: Statewide Consumptive Water Use^{1 2}



5.2 Overview of Municipal and Industrial Needs

To determine the amount of water needed by a municipality, factors such as population, jobs, economic trends and recreational use are used. Colorado's population growth is tied to economic growth. In 2012 water dependent sectors, including agriculture, mining and utilities contributed nearly \$17 billion dollars to Colorado's GDP and represented over 58,000 jobs and \$4.7 billion in annual wages. These sectors, coupled with numerous others, contribute to a vibrant economy which leads to more jobs, and to more people moving to and residing in Colorado.⁵ This growth, in part, drives municipal and industrial water demands.

Municipal Needs

Water needs for municipalities are determined by multiplying per person water use by the number of new people expected to live in a municipality, then subtracting water conservation demand reductions,^a and finally adding any expected increases because of increased temperatures or commercial activities.

Looking ahead to 2050, the future population within Colorado is difficult to accurately predict. For that reason low, medium, and high population estimates were developed. However, even under slow economic growth conditions, most communities throughout the state are projected to grow.⁶ Current indications show that Colorado has one of the fastest growing state economies nationwide, even receiving the top ranking in some analyses.⁷ Under the high growth scenario, the state's population could nearly double by 2050, with some communities growing moderately while others are expected to triple in size.^{8 9} Such growth will mean additional revenue for education and services and less unemployment, but it will also require increased water demands. Municipal water needs will increase as population increases, although conservation actions and any increases in demands resulting from climate change will determine by how much (explored in Chapter 4 and Section 6.3).

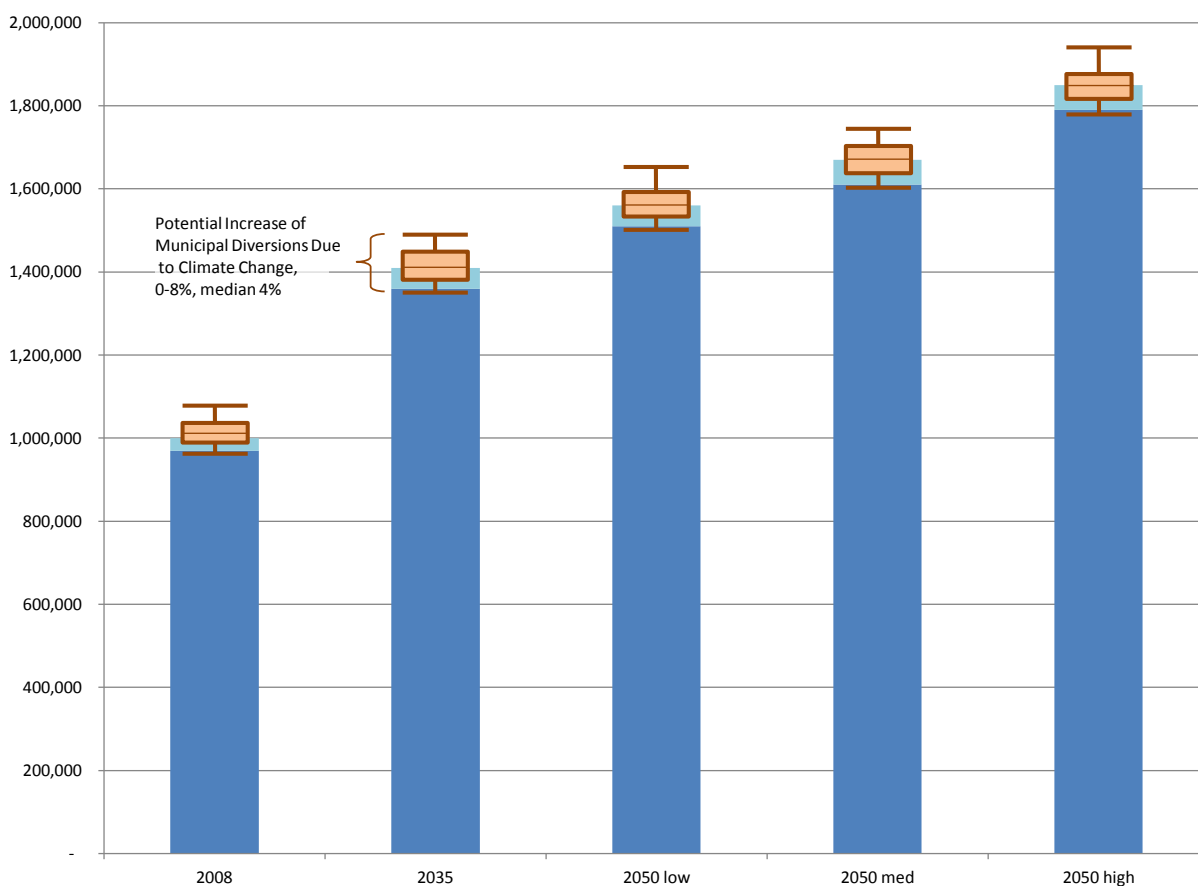
Colorado's growing economy leads to population growth in two primary ways. First, Coloradans are having children who attend college in the state and are able to remain as working adults who start their own families. With the birth rate exceeding the death rate, roughly half of the state's growth comes from residents born in Colorado.¹⁰ Second, Colorado is a desirable place to live. A diverse and healthy economy, combined with vibrant communities, attractive locations, and a high quality of life draw people and businesses to the State and keep them here.¹¹

To continue to employ current and future citizens, Colorado needs to maintain a healthy economy. Furthermore, Colorado does not have the work force needed to keep pace with growth in various employment sectors. For instance, with a growing elderly population, more people will need medical care. To serve this population, the state of Colorado will need additional health workers, some of whom must come from out of state.¹²

^a For the purposes of CWCB's technical work conservation savings were divided into two categories. The first is passive conservation, which was used to reduce demand projections. Passive conservation results from the replacement of old indoor fixtures and appliances with newer, more efficient ones. Active conservation, which takes a concerted effort on the part of water providers and/or property owners, is treated as a method to address the water supply gap. It is incorporated into section 6.3 so that a conscious effort can be made to reduce demands through active conservation.

Population growth for the state is inevitable, but Colorado can influence how the population grows and how much water is needed to support such growth. These strategies are further discussed in Section 6.3. Climate change could also increase municipal needs as outdoor landscapes adapt to longer growing seasons, higher temperatures, and higher rates of evapotranspiration. The effects of climate change on total annual municipal diversions are expected to range from no effect to an increase of much as 8 percent (Figure 5.2-1).¹³ If Colorado experiences a future where population rises while the climate becomes hotter and dryer (a scenario known as hot growth)^{b,14} more than a million acre-feet per year may be needed by 2050 beyond the 2008 demand levels. However, if Colorado experiences weak population growth, matched with historical temperature conditions, the additional annual demand beyond 2008 levels is approximately 600,000 acre-feet.^{15, 16, 17}

Figure 5.2-1: Projected water demands (acre-feet) with range of climate change increases



The degree to which climate change could impact municipal demands varies considerably across the state because of differences in the amount of outdoor irrigation, potential temperature increases, and potential changes in precipitation patterns throughout the state.¹⁸ Increases in demand from climate change do not take into account potential hydrological changes, which could

^b This scenario is also known as the “hot growth” scenario in IBCC scenario planning work, which has hot and dry climate matched with high population growth.

further decrease municipal supply and exacerbate future municipal needs as discussed in Chapter 4.

While climate change has the potential to intensify municipal needs, water conservation, reuse, and land use planning have the potential to attenuate them. As described in section 6.1, no matter what future Colorado faces, a significant amount of conserved water will be needed to ensure that we have enough water to meet Colorado's future needs.

State of Knowledge on Water Conservation

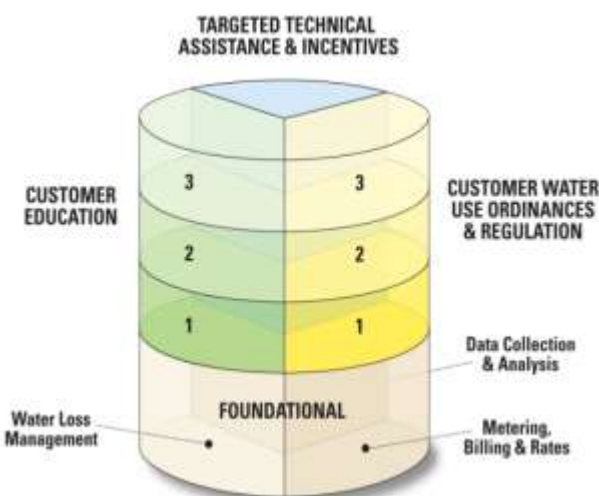
In 2010, the CWCB funded a first ever *Best Practices Guidebook for Municipal Water Conservation in Colorado*. Colorado WaterWise created the Best Practices Guidebook with a large technical and stakeholder group and established fourteen best practices that outline the potential benefits and costs for active water conservation measures, indoor and outdoor, residential and non-residential practices. The Guidebook provides a menu of options that can be selected to add to water providers' water conservation programs. The best practices require financial and human resources to accomplish and implementation varies greatly among water providers.¹⁹

The CWCB created the Levels Analysis Framework prioritizing the best practices a local water provider may undertake to achieve its goals. The Levels Analysis focuses on foundational practices first and then proceeds in varying degrees of difficulty organized by technical assistance and incentives, regulations, and education (Figure 5.2-2). This analysis will help water providers focus both human and financial resources on the most cost efficient activities (most acre-feet saved/resources expended) first and then later expand to attain the more difficult activities.²⁰

Using the Best Practices as a basis, the Statewide Water Supply Initiative (SWSI) 2010 estimated low, medium and high strategies for active water conservation savings. Active water conservation is water conservation that occurs because of the enactment of programs at the local level where financial and human resources are committed to carrying out water efficiency programming. Depending on the level of savings, a varying amount of effort is required to achieve penetration rates consistent with the savings estimates. The SWSI 2010 Municipal and Industrial Water Conservation Strategies report states:

"If water conservation is to be part of Colorado's future water supply portfolio, it must be supported and funded like other supply initiatives. To obtain the savings forecast in this report, the strategies described must be rigorously implemented at the state, regional, local, and customer

Figure 5.2-2-SWSI Levels Analysis Framework



level. Water is saved by municipal customers, but customers can be aided in the effort. State policies that promote conservation-oriented rates, water loss control measures, water efficient landscape and building standards, improved plumbing codes, and education and outreach set the stage for regional and local conservation program measures that target high demand customers and ensure new customers join the water system at a high level of efficiency”.

The total potential savings in SWSI 2010 range from 160,000 to 461,000 acre-feet statewide in 2050 (Table 5.2-1).²¹

Table: 5.2-1

Project	Level	2030 Forecast Savings* (AFY)	2050 Forecast Savings* (AFY)
SWSI 2010	Passive***	131,000	154,000
	Low (active only)	78,000	160,200
	Medium (active only)	133,000	331,200
	High (active only)	197,100	461,300

Even at the highest level of conservation savings, there is still considerable flexibility for individual water utilities. For instance, under high conservation savings, 50 to 80 percent of utilities statewide will need to implement targeted audits for customers that use high amounts of water on their landscapes (Table 5.2-2). While this practice may not make sense for every provider, it may for the majority of providers. By following best practices, water providers can get results while implementing the audits in a way that makes the most sense for the utility. Furthermore, high conservation levels still allow for attractive landscapes that include grass, parks, and trees and therefore maintain property values and continue to help reduce increased urban temperatures. Efforts to address outdoor water conservation need to balance the vital importance of urban landscape and its benefits, including improved air quality, surface water and groundwater quality, increased property values, aesthetics, and general quality of life.

Table 5.2-2: Comparison of 2050 implementation and penetration level for three conservation strategies, and demand reductions used in forecasts

Measure	Implementation or Penetration Level by 2050		
	Low Strategy	Medium Strategy	High Strategy
<i>System-wide conservation measures with potential to impact all customers</i>			
Public information and education	~100%	~100%	~100%
Integrated resources planning	~100%	~100%	~100%
Conservation-oriented water rates	~100%	~100%	~100%
Water budget-based water rates	<=10% of utilities implement	<=30% of utilities implement	<=50% of utilities implement
Conservation-oriented tap fees	0 - 5% of utilities implement	5 - 10% of utilities implement	<= 50% of utilities implement

Smart metering with leak detection	<=10% of pop.	<=50% of pop.	50 - 100% of pop.
<i>Residential indoor savings and measures</i>			
Reduction in Residential Per Capita Indoor Use	Res. Indoor gpcd = 40	Res. Indoor gpcd = 35	Res. Indoor gpcd = 30
Conservation-oriented plumbing and building codes, green building, rules for new residential construction	30-50% of state impacted	50-70% of state impacted	70-100% of state impacted
High efficiency toilets, clothes washers, faucets, and CII equipment	Passive ~100%	Passive ~100%	Passive ~100%
Submetering of new multi-family housing	0%	~50%	~100%
Reduction in customer side leakage	33% savings -passive from toilet replacement	37% savings -passive from toilet replacement and active repairs	43% savings -passive from toilet replacement and active repairs
<i>Non-Residential indoor savings and measures</i>			
Reduction in Non-Residential Per Capita Indoor Use	15% reduction	25% reduction	30% reduction
High efficiency toilets, urinals, clothes washers, faucets, and showers	Passive ~100%	Passive ~100%	Passive ~100%
Conservation-oriented plumbing and building codes, green building, rules for new non-residential construction	30-50% of state impacted	50-70% of state impacted	70-100% of state impacted
Specialized non-residential surveys, audits, and equipment efficiency improvements	0-10% of utilities implement	10-50% of utilities implement	50-80% of utilities implement
<i>*Landscape conservation savings and measures</i>			
Landscape water use reductions (residential and non-residential)	15% reduction	22-25% reduction	27-35% reduction
Targeted audits for high demand landscape customers	0-30% of utilities implement	30-50% of utilities implement	50-80% of utilities implement
Landscape transformation of some high water requirement turf to low water requirement plantings	<=20% of landscapes	20-40% of landscapes	>50% of landscapes
Irrigation efficiency improvements	<=10% of landscapes	<=50% of landscapes	50 - 100% of landscapes
<i>Utility Water Loss Control</i>			
Improved utility water loss control measures	<=7% real losses	<=6% real losses	<=6% real losses
*Landscape water demand reductions include the anticipated impact of urban densification.			

Not all conservation savings can or should be applied to meet future growth. Not every municipality that conserves water will need all of it to meet future growth, and legal barriers restrict water providers from sharing conserved water. Most entities do not have the infrastructure to either share water or re-time conserved water so that it can be used when needed. Additionally, some entities may choose to use conserved water as part of their strategic drought reserve. Initial estimates by the roundtables indicate that between fifty and sixty percent of conserved water could be used to meet future growth. Through the stakeholder engagement process described Chapter 6.3, it was determined that approximately 170,000 acre-feet was the plausible amount that could be applied to meet future needs, no matter what type of future Colorado may face.²² During the latest IBCC discussions, it was determined that Colorado should strive for a high conservation standard that recognizes that each water utility has unique opportunities and capacity for conservation. The IBCC is working to further define what this high conservation standard means.²³

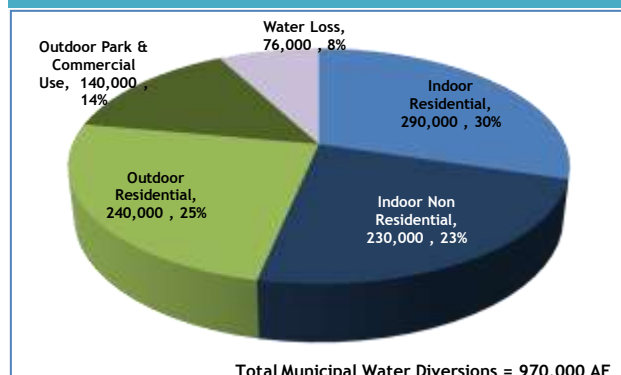
In addition to this amount, another 150,000 of savings will likely accrue by 2050 because of natural replacement rates of fixtures and appliances.^{24 25} These passive water conservation savings occur when home and property owners replace their indoor water fixtures and appliances. Their choices tend to save water compared to old appliances and fixtures because of large-scale regulatory or legislative initiatives such as the Energy Policy Act of 1992 (1992 EPACT). Passive water conservation can be considered a baseline of water savings that will occur naturally and thus is included in demand projections. As customers replace their toilets, dishwashers, clothes washers, showers and the like, many will choose WaterSense or EnergyStar labeled fixtures and appliances, which use less water. Colorado may experience these savings sooner than expected because of the recent legislation, such as SB 14-103, as described further in Chapter 6.3.

Looking forward, additional technical work is needed to better inform the statewide discussion. The Statewide Water Supply Initiative (SWSI) 2010 technical analysis should be updated to take into account the length and severity of the recent economic recession.

Population projections from the Department of Local Affairs, which will be used in future SWSI updates, indicate that even with the recent economic recession, Colorado's population is projected to reach between 8.3 and 9.2 million people by 2050, compared to the current population of 5.2 million.²⁶ The CWCB is in the process of applying new water use data to future population projections for low, medium, and high scenarios. This data will result in updated water demand projections, and will be available by early 2015.

Colorado's current municipal use is approximately 970,000 acre-feet annually.²⁸ This use is split between indoor use, outdoor use, and water loss in distribution systems. These numbers can be further divided between residential, parks, and commercial uses. Statewide, Colorado uses 53 percent indoors, 39 percent outdoors, and 8 percent due to water loss (Figure 5.2-2).^c

Figure 5.2-2: Statewide Municipal Use Patterns²⁷



Municipal Reuse

According to SWSI 2010, the reuse of existing supplies has been projected to provide 43,000 to 61,000 acre-feet per year of water, which accounts for about 10 percent of the total Identified Projects and Processes (IPP) projected yield.²⁹ The full use of reusable water supplies will play an integral role in closing the supply gap by extending the resource through efficient reuse of water.

Colorado water law defines which water supplies can be reused and the extent to which each source can be reused. With limited exceptions, the following sources can legally be reused in Colorado:

- **Nonnative water:** In most cases, water imported into a basin through a transbasin diversion can be reused to extinction. Transbasin diversions account for a substantial quantity of the total reusable supply in Colorado.
- **Agricultural-Municipal Water Transfers:** Agricultural transfers are generally available for reuse; however, reuse is limited to the historic consumptive use of the original agricultural water right decree. This includes water from traditional purchase of agricultural water rights and alternative transfer methods.
- **Nontributary groundwater:** Reuse of nontributary groundwater is allowed.
- **Other Diverted Water:** Any water right with a decreed reuse right may be reused to the extent described in the decree.

These sources can be reused directly, by piping the recycled water from the water reclamation facility to beneficial uses such as nonpotable irrigation sites or industrial uses, or indirectly, by augmenting a surface water or groundwater body with recycled water and diverting an equal amount of flow from a different point of diversion.³⁰

The use of reclaimed domestic wastewater is subject to Regulation 84, which was developed by the Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Commission (WQCC). This regulation currently authorizes the use of reclaimed water for landscape beneficial uses such as nonpotable irrigation (including single-family residential irrigation) and

^c Water loss is defined as the difference between system input volume and authorized consumption, consisting of apparent plus real losses

various commercial and industrial uses such as cooling tower use, dust control, soil compaction, mechanized street cleaning, fire protection, and zoo operations.³¹

Municipal Land Use

Higher density development saves water compared to traditional developments and has other benefits, such as more efficient infrastructure. The 2009 California Water Plan Update showed that a 20 percent increase in density could yield a 10 percent water savings.³² Denser development can also enhance other elements that help define a community, such as transportation, open space, neighborhood design, and walkability. Landscape and irrigation best practices may offer more benefits within a denser land use environment than within a traditional less-dense environment. Urban landscapes will not disappear with a denser environment as healthy urban landscapes enhance the livability of a city or town and are a crucial asset for urban populations.

Demand management strategies such as water conservation, reuse, and land use will play a central role in reducing future demands. As seen in this section, much work has been accomplished by Colorado water providers in the areas of demand management and alternative supplies. Additionally, innovative work is occurring across the United States and points to trends that Colorado may wish to follow. Next steps and future actions will be described in chapter 6.3.

Large Industry

The types of large industries located in Colorado include breweries, snowmaking, energy and mining extraction, power generation, and a multitude of other industries. Collectively, these industries currently require approximately 200,000 acre-feet of water annually. Projections indicate that future large industry needs could increase by 50,000 to 130,000 acre-feet per year by 2050.³³

Additional analyses of industrial needs regarding the use associated with energy and extraction will be incorporated into future water planning efforts. Through statewide and basin-wide planning efforts, existing data will be confirmed and future uses updated. For instance, the Colorado and Yampa/White/Green basin roundtables conducted an Energy Development Water Needs Assessment Update and have asked the CWCB to incorporate this work into future statewide planning efforts.³⁴

5.3 Overview of Agricultural Needs

Statewide, agriculture consumes 34 percent of the total amount of water produced in Colorado, which is 94 percent of the total amount of water consumed. Current agricultural consumptive use is estimated at approximately 4.7 million acre-feet on an average annual basis.³⁵ However, taking into account crop irrigation requirements, current agricultural crops could use an additional 2 million acre-feet if a plentiful supply existed.³⁶ It is important to note, however, that some water shortages are because of management decisions in addition to physically or legally limited water supplies. It is not expected that every agricultural shortage can or should be met in the future.

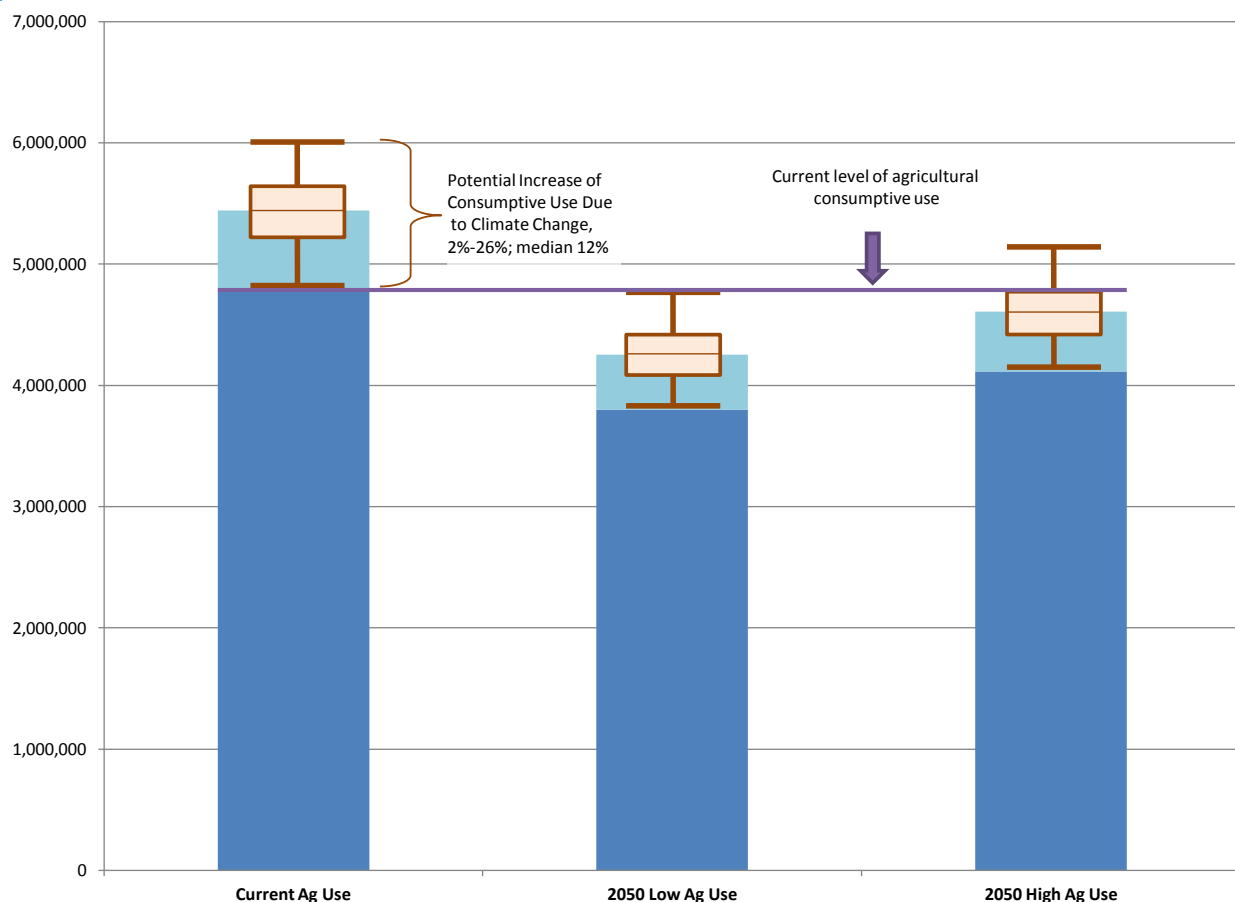
Statewide irrigated acreage is expected to decline for a variety of reasons:

- Many municipalities turn to agricultural water rights as an affordable, reliable source of water and purchase them from willing sellers.
- Urban areas expand onto irrigated farmlands, thus urbanizing those agricultural lands.
- Due to aquifer sustainability and some compact-related issues, the South Platte, Republican, and Rio Grande Basins have reduced, or are in the process of reducing, irrigated acreage.³⁷

Irrigated acres could decrease from 3.5 million irrigated acres to 2.7 million acres statewide.³⁸ The potential effect is most pronounced in the South Platte basin, where as much as 35 percent of the irrigated acres in the basin could be taken out of production.³⁹

In addition to potential decreases in irrigated acres, agricultural producers could be further affected by climate change. Depending on location, higher temperatures in the future could increase water consumption by 2 to 26 percent on the lands still in production (Figure 5.3-1).^{40 41} More frequent or severe droughts could also impact agricultural production and slow economic agricultural activity. During the 2012 drought the state experienced foregone agricultural revenues of \$409 million and an additional loss of \$317 million in secondary spending in local communities.⁴²

Figure 5.3-1: Projected agricultural water demands (acre-feet) with range of climate change increases



As part of the Basin Implementation Plans, the basin roundtables have examined future agricultural water needs. Six basins expect decreases in irrigated acres, while two basins expect increases. All of the basin roundtables aim to reduce expected shortages, and in a few cases meet additional expected agricultural needs. Section 6.5 further explores projects and methods to achieve these goals. Table 5.3-1 provides a brief summary of agricultural needs, as identified in the Basin Implementation Plans.

Table 5.3-1: Summary of agricultural goals indicated in the Basin Implementation Plans

Basin	Identified Agricultural Goals
Arkansas	Increase amount of agricultural augmentation water by 30,000-50,000 acre-feet
Colorado	Reduce agricultural shortages
Gunnison	Reduce agricultural shortages by approximately 17,000 acre-feet
Metro/South Platte	Reduce agricultural shortages
North Platte	Add an additional 28,000 acres of irrigated farmland; continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies
Rio Grande	Manage water use to sustain optimal agricultural economy throughout the Basin's communities
Southwest	Reduce agricultural shortages by implementing at least 10 projects
Yampa/White/Green	Add an additional 14,000 acres of irrigated farmland; reduce agricultural shortages

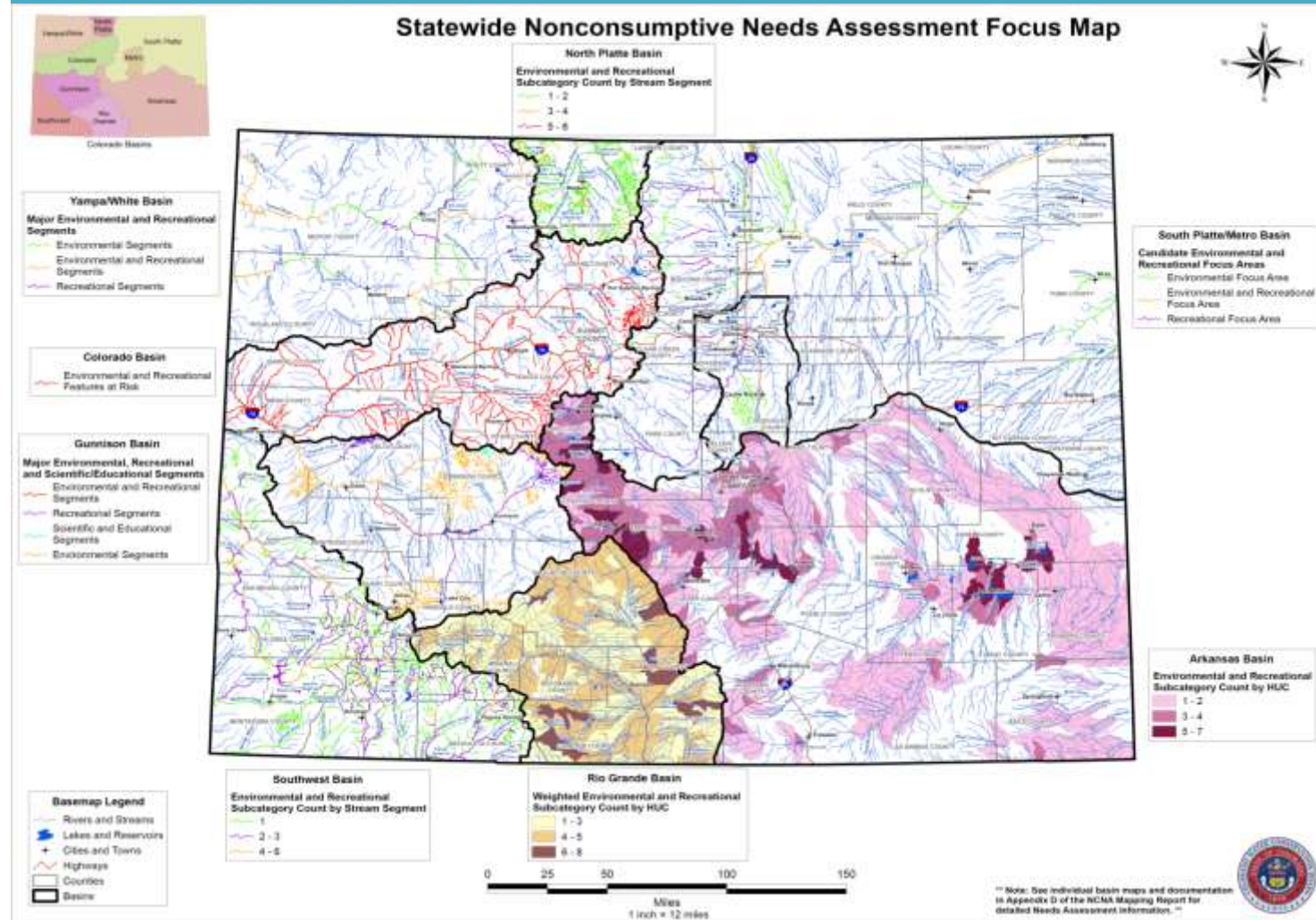
5.4 Overview of Environmental and Recreational Needs

Environmental and recreational attributes are not solely based on the amount of water needed. Water supply, aquatic and riparian habitat, water quality, bank stability, stream access, and habitat connectivity are all critical.

Additionally, many recreational activities are not river-based. Outdoor recreational activities such as golf, hiking, biking, and team sports such as baseball or football require a certain amount of water use to maintain the grassy areas these activities involve. The irrigation of sports fields, golf courses, and grassy open spaces are primarily served by a municipal water provider. Snow skiing and the surrounding tourism industry are major economic drivers in the state, and the water supply for snowmaking is primarily classified as self-supplied industrial, with resort operators owning the associated water rights and infrastructure. Maintaining flows in rivers also can result in economic value through healthier habitats for wildlife and wildlife viewing and real estate.

River-based Therefore, environmental and recreational needs are often represented in number of stream miles or acres of wetland, featuring important attributes which need protection. A collaborative effort between the CWCB and the basin roundtables, as part of SWSI 2010, identified 13,500 perennial stream miles in Colorado that have important attributes and were selected as "focus areas."^{43 44} Figure 5.4-1 shows the important areas identified by the basin roundtables.

Figure 5.4-1: Statewide Environmental and Recreational Needs⁴⁵



The focus area information can be further broken down by attribute. For instance:

- 2,260 perennial stream miles of Colorado River and greenback cutthroat trout habitat were identified in focus areas across the state.
- 3,164 perennial stream miles of warm-water fish habitat were identified in focus areas. These reaches include endangered, threatened, or imperiled fish species.
- 7,642 perennial stream miles of significant riparian areas and wetlands were identified. These include occurrences of exemplary plant communities as well as rare plant communities.

The number of water rights appropriated for in stream flows, natural lake levels, and recreational in-channel diversions demonstrate the existing needs for the environment and recreation:

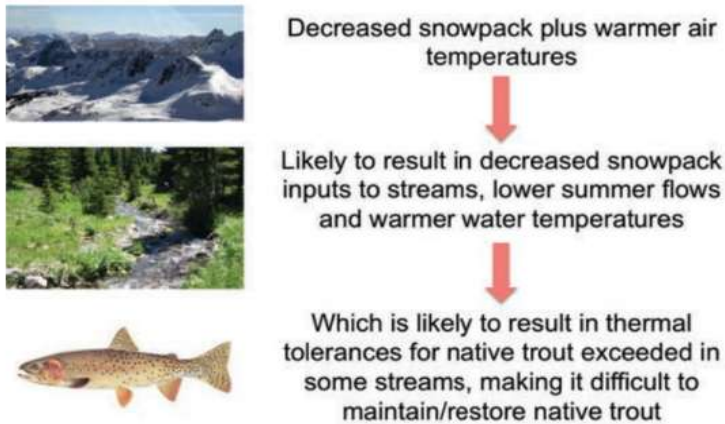
- In stream flow: 9,180 stream miles for 1,595 decreed water rights
- Natural lake levels: 126,000 acre-feet for 476 decreed water rights
- Recreational in-channel diversions: 20 decreed water rights, ranging in size from 5 to 1,800 cubic feet per second

It is critical to note that water is not consumed by environmental or recreational uses, but rather held in streams and designated for those uses. This water is often reused multiple times downstream by agricultural, municipal, or industrial water users.

The ability to decree water using in stream flows and recreational in-channel diversions provides Colorado with important effective tools for meeting environmental and recreational needs and for supporting state and federal values.

Climate change could impact environmental and recreational needs. If temperatures continue to increase, the range of suitable habitat for cold water fish species is expected to diminish (Figure 5.4-2). Rising temperatures could also adversely affect plant communities.⁴⁶ Reduced water supplies, because of increased evapotranspiration, could also be a factor in maintaining the range of cold water species because of the lower capacity of reduced flows to dissipate heat.⁴⁷

Figure 5.4-2: Illustrative climate-informed actions in response to climate change impacts on the availability of suitable habitat for cold water native trout⁴⁸

GOAL: Conservation of cold water native trout populations	
Climate Change Impacts & Vulnerabilities	Example Climate-Informed Actions
 Decreased snowpack plus warmer air temperatures Likely to result in decreased snowpack inputs to streams, lower summer flows and warmer water temperatures Which is likely to result in thermal tolerances for native trout exceeded in some streams, making it difficult to maintain/restore native trout images: B. Inman, B. Shepard, MT-FWP	Fish Management - Identify and restore “warm-adapted” populations of native trout. - Consider <i>not</i> restoring native trout into streams with high probability of warming past thermal limits.
	Habitat Management - Protect and restore currently occupied streams that are expected to stay cold. - Protect and restore streams that are currently too cold.
	Water Management Increase storage of water in upland and wetland areas (e.g., by reintroducing beaver, installing beaver mimic dams, installing upland micro-catchments).

In addition to the previously mentioned state tools, various projects and methods, such as flow maintenance agreements and habitat restoration, help meet environmental and recreational needs. As Figure 5.4-2 indicates, mitigation measures for cold water habitats as well as environmental, agricultural and municipal partnerships will be critical to meet the future needs of cold water fish species. Several examples of multi-purpose projects are listed in Sections 6.6 and 9.2, and a few multi-purpose projects that meet multiple needs are listed below:

- Upper Arkansas Voluntary Flow Management Program
- Alternative Wild and Scenic Processes (e.g., the Upper Colorado, Lower Colorado, and Dolores River)
- Colorado River Cooperative Agreement
- Elkhead Reservoir Enlargement
- Rio Blanco River Restoration

5.5 Actions

The following actions are needed to continue to monitor Colorado's future demands:

- Update the Statewide Water Supply Initiative in 2016, incorporating information from the Basin Implementation Plans.
- Gather information from covered entities and smaller providers, as mandated by the Act "Concerning Additional Information Regarding Covered Entities' Water Efficiency Plans."
- Analyze the potential impacts of climate change to Colorado's water needs.⁴⁹

¹ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010* (Denver, 2011), pg #.

² Ben Harding, *SWSI Climate Impact Support, Development of Projected Gauged Flows Draft Technical Memorandum* (Denver, 2014), pg #.

³ United States Geological Survey, *Estimated Use of Water in the United States in 2005* (Reston, 2005), pg#.

⁴ United States Geological Survey, *Estimated Use of Water in the United States in 2005*, pg#.

⁵ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.

⁶ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.

⁷ Andy Holodny and Elena Kiersz, "Here's how all 50 State Economies are doing, Ranked from Slowest to Fastest," *Business Insider*, August 4, 2014. <http://www.businessinsider.com/state-economic-growth-rankings-2014-8?op=1>.

⁸ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.

⁹ Colorado Department of Local Affairs; State Demographer's Office, *2050 Low, Medium, and High Population Projections* (Denver, 2014), pg#.

¹⁰ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.

¹¹ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.

¹² Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.

¹³ Harding, *SWSI Climate Impact Support, Development of Projected Gauged Flows Draft Technical Memorandum*, pg#.

¹⁴ CWCB, "SWSI 2016 Initial Draft Chapter 7: Scenario Planning & Adaptive Management," CWCB, Denver, 2014

¹⁵ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.

¹⁶ Colorado Water Conservation Board and CDM Smith, *Portfolio and Trade-Off Tool* (Denver, 2011), pg#.

¹⁷ Harding, *SWSI Climate Impact Support, Development of Projected Gauged Flows Draft Technical Memorandum*, pg#.

¹⁸ Harding, *SWSI Climate Impact Support, Development of Projected Gauged Flows Draft Technical Memorandum*, pg#.

¹⁹ Colorado WaterWise and Aquacraft, Inc. *Best Practices Guidebook for Municipal Water Conservation in Colorado* (Denver: Colorado WaterWise, 2010), pg#. <http://coloradowaterwise.org/BestPractices>.

²⁰ Colorado Water Conservation Board, *SWSI Water Conservation Levels Analysis* (2010), pg#. <http://cwcb.state.co.us/public-information/publications/Pages/StudiesReports.aspx>.

²¹ Colorado Water Conservation Board, *AppendixL: SWSI 2010 Municipal and Industrial Water Conservation Strategies* (2011), pg#. http://cwcb.state.co.us/water-management/water-supply-planning/Documents/SWSI2010/AppendixL_SWSI2010MunicipalandIndustrialWaterConservationStrategies.pdf.

²² Interbasin Compact Committee, *Draft No & Low Regrets Action Plan*, pg#.

²³ Interbasin Compact Committee, *Draft No & Low Regrets Action Plan*, pg#.

²⁴ Colorado Water Conservation Board, *SWSI Water Conservation Levels Analysis*, pg#.

²⁵ Colorado Water Conservation Board, *AppendixL: SWSI 2010 Municipal and Industrial Water Conservation Strategies*, pg#.

²⁶ State Demography Office, Department of Local Affairs. *Updated Population Forecasts to 2050 by River Basin*. June 2014.

²⁷ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.

²⁸ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.

- ²⁹ Colorado Water Conservation Board, *SWSI 2010 Consumptive Projects and Methods* (2010), pg#. <http://cwcb.state.co.us/water-management/water-supply-planning/Documents/SWSI2010/SWSI2010Section5.pdf>.
- ³⁰ M. o. R. R. Committee, Interviewee, *Reuse discussion*. [Interview]. April 2014.
- ³¹ Colorado Department of Public Health and Environment Water Quality Control Commission, *Regulation No. 84 Reclaimed Water Control Regulation* (2013), pg#. <https://www.colorado.gov/pacific/sites/default/files/Regulation-84.pdf>.
- ³² C. D. o. W. Resources, "California Water Plan Update," *Integrated Water Management Bulletin* 160-09, 2009.
- ³³ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.
- ³⁴ Colorado Basin roundtable and Yampa/White/Green Basin roundtable, *Energy Development Water Needs Assessment Phase 3 Final Report*, June 30, 2014, pg#.
- ³⁵ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.
- ³⁶ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.
- ³⁷ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.
- ³⁸ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.
- ³⁹ HDR Engineering and West Sage Water Consultants, *Draft South Platte Basin Implementation Plan* (Denver and Longmont, 2014), pg#.
- ⁴⁰ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.
- ⁴¹ Harding, *SWSI Climate Impact Support, Development of Projected Gauged Flows Draft Technical Memorandum*, pg#.
- ⁴² Pritchett, James; Chris Goemans; Ron Nelson, *Estimating the Short and Long-term Economic & Social Impacts of the 2012 Drought in Colorado*, pg 8.
- ⁴³ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.
- ⁴⁴ Colorado Water Conservation Board, CDM Smith, and The Nature Conservancy, *Nonconsumptive Toolbox* (Denver, 2013), pg#.
- ⁴⁵ Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, pg #.
- ⁴⁶ Great Northern Landscape Conservation Cooperative Rocky Mountain Partner Forum Workshop, *Summary Report for the Climate Change and Cold Water Systems Workshop* (Bozeman: GNLCC, 2013), pg#.
- ⁴⁷ Great Northern Landscape Conservation Cooperative Rocky Mountain Partner Forum Workshop, *Summary Report for the Climate Change and Cold Water Systems Workshop*, pg#.
- ⁴⁸ Great Northern Landscape Conservation Cooperative Rocky Mountain Partner Forum Workshop, *Summary Report for the Climate Change and Cold Water Systems Workshop*, pg#.

6. Water Supply Management

Chapter 6 discusses the dynamic strategy needed to meet Colorado's future water needs. This strategy describes the types of projects and methods needed and actions required to implement them. Scenario planning provides the framework for this strategy, indicating what Colorado needs to accomplish in the short-term. Section 6.1 and Section 6.2 provide information needed to assess how close Colorado is to meeting this strategy and discusses the remaining municipal, industrial, agricultural, environmental, and recreational water gaps, and the methods by which basins propose to address them. While Colorado will need a variety of projects and methods to meet its current and future water needs, ranging from storage projects to riparian restoration, two avenues need to be incentivized and deserve special attention. Demand management strategies, such as conservation and reuse, will help address Colorado's growing demands while upholding our Water Values. Section 6.3 looks at various ways to use water efficiently and reduce water demands. Section 6.4 discusses opportunities to share water between agricultural and municipal interests. This is another important option that needs special attention if these alternative methods are going to be effective and help reduce the permanent dry-up of Colorado's irrigated lands. These sections, as well as Sections 6.5 and 6.6, provide a summary of projects, methods, and policies that the Basin Implementation Plans identified as necessary for meeting Colorado's future water needs. Planning for Colorado's water future presents many challenges and opportunities, and this chapter demonstrates the variety of ways that stakeholders at the state and local levels are collaborating to address these important issues.

6.1 Scenario Planning and Developing an Adaptive Water Strategy

Colorado's Water Plan considers a range of possible future conditions and develops a practical, adaptive, and balanced path forward for meeting Colorado's future water needs through stakeholder engagement and sound science.

The purpose of scenario planning is to develop strategies to meet Colorado's future water needs that are based on the best available science and input from stakeholders. Section 6.1 broadly describes what needs to be done to meet our future needs over the next ten to fifteen years and prepare for a broad range of possible futures. Scenario planning also provides the opportunity to consider Colorado's Water Values to build portfolios of solutions. Conservation, reuse, completion of planned projects, and development of alternative agricultural transfers are all needed in the near term. At the same time, Colorado must prepare for the possibility of further agricultural transfers, possibly an additional transmountain diversion, and even higher levels of conservation to meet future municipal and industrial needs while concurrently implementing environmental and recreational projects and continuing to support agriculture.¹

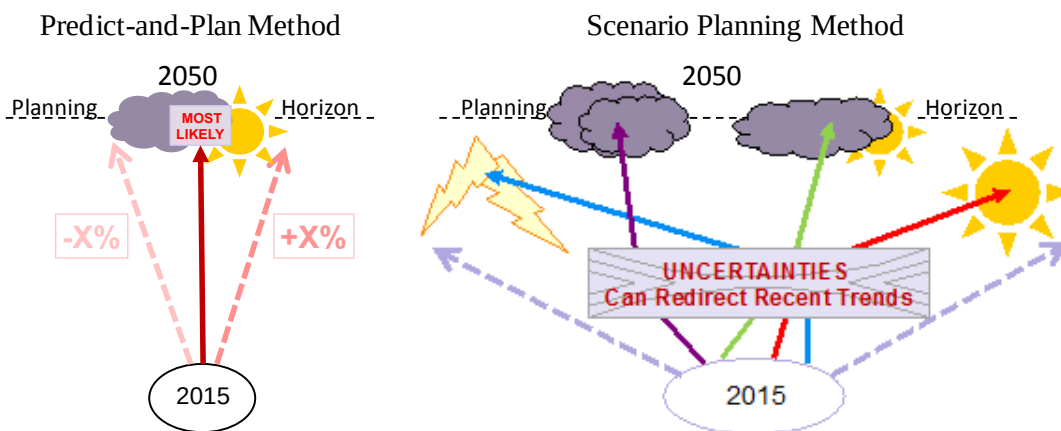
The elements of Colorado's adaptive strategy arose from significant technical work and the early and ongoing engagement of stakeholders. In developing Colorado's Water Plan and

Statewide Water Supply Initiative 2016, the Colorado Water Conservation Board (CWCB), basin roundtables, and the Interbasin Compact Committee (IBCC) adopted the scenario planning process to initiate a conversation among stakeholders about planning for uncertainties and emerging water resource challenges.² These groups worked together to explore how to meet increasing water needs of growing communities while balancing water interests.³ Of particular concern, Colorado must contend with the significant and growing municipal water needs by 2050.⁴ Scenario planning helps answer how much water we may need in the future, how much water may be available to meet our future needs, and what sources of water supply future generations will support. The subsequent sections in Chapter 6, as well as Chapter 8, provide the detail for how we can more specifically respond to an uncertain future by employing the scenario planning approach.

Scenario Planning: *Planning for Multiple Futures*

Given the uncertainties of future water supply and demands, CWCB adopted a planning approach now used by many major water planners across the West: scenario planning.⁵ Our use of scenario planning assumes that the future is unknown and provides flexibility in responding to various future conditions.⁶ Rather than trying to predict the future by looking at the past, scenario planning allows us to identify and account for key uncertainties operating within the planning period (see Figure 6.1-1).

Figure 6.1-1: The traditional “predict-and-plan” approach compared to the scenario planning approach

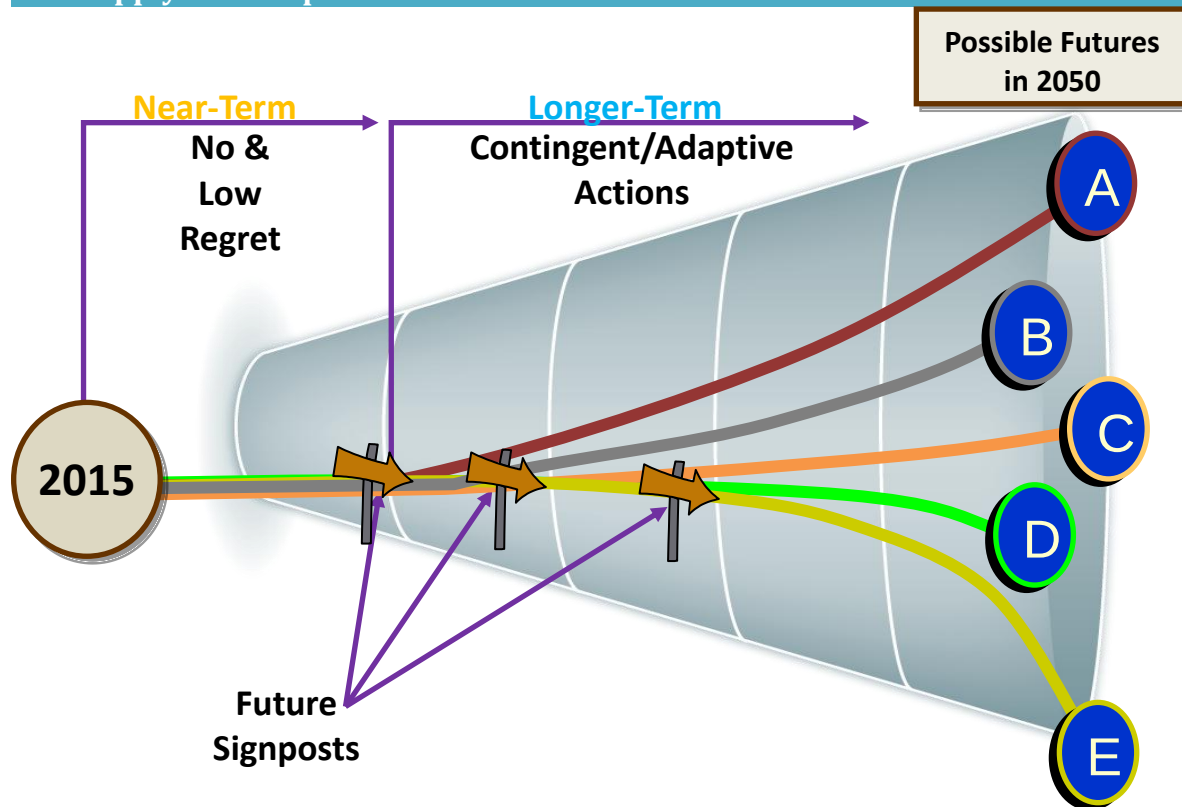


Adapted from Global Business Network, 2012 & Marra, 2013⁷

Scenario planning relies on key driving forces to build multiple plausible futures (i.e. scenarios) rather than the most probable one, as is used to develop the more traditional “predict-and-plan” approach. CWCB explored with stakeholders the implications of multiple plausible futures. Descriptions of several futures were developed and used to identify and evaluate a prospective series of implementable projects and initiatives called portfolios. One goal of this work was to identify projects and policies that occur on multiple pathways. These common actions would therefore apply to multiple futures.

By implementing successive sets of common actions over time, decision makers can have greater confidence that the policies and investments made in the near term will also be viable in the longer term. The near and longer term actions combine with the scenarios to create a forward-looking pathway of actions that both anticipate and prepare for the emerging needs of the future. Figure 6.1-2 conceptualizes how various future conditions can be aligned into near term actions and longer term adaptive strategies.

Figure 6.1-2: Scenario planning identifies successive sets of common actions that apply to multiple futures



Adapted from Marra & Thomure, 2009⁸

In the near term, our way forward is to implement actions common to all or most of the envisioned futures—these are termed the “no and low regret” actions because of their broad applicability. In the mid-to-long term, the direction forward may narrow and favor a smaller set of possible futures. Planned actions and strategies would then be reevaluated and updated based on the status of predetermined “signposts” or decision points that help to reveal whether past uncertainties now have more clarity. For water in Colorado, these uncertainties include water supply, water needs, and Colorado’s social values. Use of scenarios enables planners to respond and adapt to still emerging issues and to explore the opportunities and challenges that each possible future presents without reducing options available going forward.⁹

Developing Alternative Water Supply Portfolios

The Statewide Water Supply Initiative 2010 introduced the “status quo portfolio”—a set of prospective water supply actions that would likely be required if the trajectories of current trends continue. The status quo is counter to Colorado’s Water Values, (presented in Chapter 1), leading to large quantities of water being transferred out of the agricultural sector to satisfy municipal and industrial water supply needs. This transfer would result in a significant loss of agricultural lands and could cause potential harm to the environment and Colorado’s economy. Additional challenges with the status quo portfolio are discussed below. The general statewide consensus is that the status quo portfolio of actions, and the projected future it assumes, is not desirable for Colorado.¹⁰

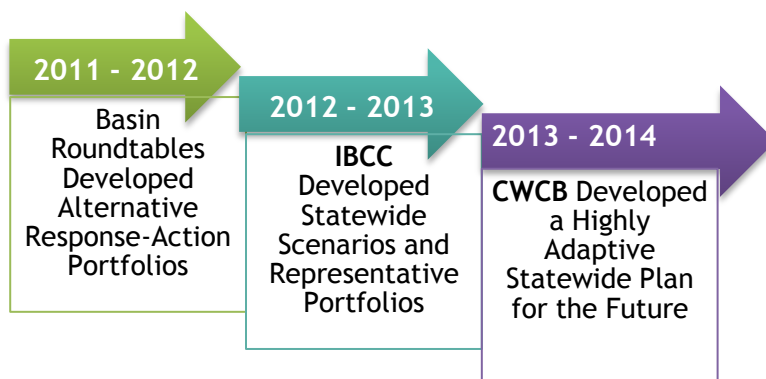
Given these concerns, CWCB initiated a multi-year stakeholder plan development process with the nine basin roundtables and the Interbasin Compact Committee (IBCC). Each basin roundtable represents the water interests of a specific region within Colorado, and the IBCC facilitates conversations among the basin roundtables and addresses broader statewide water issues. The plan development process is summarized in Figure 6.1-3.

Each of the nine basin roundtables developed one or more statewide water-supply portfolios to respond to projected low, medium, or high future water needs for communities¹¹. Each portfolio constitutes a unique combination of possible strategies that could be used to meet a range of projected municipal and industrial water needs. The strategies included conservation,

reuse, agricultural transfers, development of water projects within each basin, and transmountain water diversions. CWCB developed an interactive tool that quantified trade-offs associated with Colorado’s Water Values that would result from each portfolio – impacts to the environment, agriculture, reliability, and cost. This work brought basin roundtables together by showing how one water supply decision has multiple impacts across the state. Most of the 34 portfolios developed by the basin roundtables reduced these tradeoffs, thereby minimizing negative effects statewide and for each basin and developed combinations of solutions that both met a variety of possible future conditions and aligned with Colorado’s Water Values.

The IBCC subsequently synthesized and reduced the 34 basin roundtable-generated portfolios into a smaller set of ten “representative” portfolios which addressed projected low, mid-range, and high municipal and industrial water demands (described in Chapter 5). The basin roundtables determined that the representative portfolios successfully captured the intent and character of the original 34 portfolios.

Figure 6.1-3: Summary of the Stakeholder and Plan Development Process



Formulating Plausible Scenarios

Potential changes in future municipal and industrial water demand and available water supply were among the most important drivers considered by all the basin roundtables when developing their portfolios. Some of the basin roundtables also considered changing societal values and other drivers outside the control of the water community. The IBCC took these perspectives into account when developing the list of nine high-impact drivers to factor into the scenario development process since these will greatly influence the direction of Colorado's water future:

1. Population/Economic Growth
2. Social/Environmental Values
3. Climate Change/Water Supply Availability
4. Urban Land Use/Urban Growth Patterns
5. Energy Economics/Water Demand
6. Level of Regulatory Oversight/Constraint
7. Agricultural Economics/Water Demand
8. Municipal and Industrial Water Demands
9. Availability of Water Efficient Technologies

Using these drivers, the IBCC developed five scenarios that represent plausible futures, noted below, and matched them with five of the ten representative portfolios of solutions which best met the needs described in each scenario and aligned with Colorado's Water Values. The scenarios, summarized below, represent how Colorado's water future might look in 2050 even though the actual future at that time will likely contain a mixture of multiple scenarios. The descriptive names given to the scenarios portray the overall essence embodied in their respective views of the future¹². The IBCC described the scenarios as follows:

A. Business as Usual: Recent trends continue into the future. Few unanticipated events occur. The economy goes through regular economic cycles but grows over time. By 2050 Colorado's population is close to 9 million people. Single-family homes dominate, but there is a slow increase in denser developments in large urban areas. Social values and regulations remain the same, but stream flows and water supplies show increased stress. Regulations are not well coordinated and create increasing uncertainty for local planners and water managers. Willingness to pay for social and environmental mitigation of new water development slowly increases. Municipal water conservation efforts slowly increase. Oil shale development continues to be researched as an option. Large portions of agriculture land around cities are developed by 2050. Transfer of water from agriculture to urban uses continues. Efforts to mitigate the impacts of the transfers slowly increase. Agricultural economics continue to be viable but agricultural water use continues to decline. The climate is similar to the observed conditions of the 20th century.

B. Weak Economy: The world's economy struggles, and the state's economy is slow to improve. Population growth is lower than currently projected, slowing the conversion of agricultural land to housing. Maintaining infrastructure, including water facilities, becomes difficult to fund. Many sectors of the state's economy begin to struggle financially, including most users of water and water-dependent businesses. There is little change in social values,

levels of water conservation, urban land use patterns, and environmental regulations. Regulations are not well coordinated and create increasing uncertainty for local planners and water managers. Willingness to pay for social and environmental mitigation decreases due to economic concerns. Greenhouse gas emissions do not grow as much as currently projected and the climate is similar to the observed conditions of the 20th century.

C. Cooperative Growth: Environmental stewardship becomes the norm. Broad alliances form to provide for more integrated and efficient planning and development. Population growth occurs consistent with current forecasts. Mass transportation planning concentrates more development into urban centers and mountain resort communities, thereby slowing the loss of agricultural land and reducing the strain on natural resources compared to traditional development. Coloradans embrace water and energy conservation. New water-saving technologies emerge. Eco-tourism thrives. Water development controls are more restrictive and require high water-use efficiency along with environmental and recreational benefits. Environmental regulations are more protective and include efforts to re-operate water supply projects to reduce impacts. Demand for more water-efficient foods reduces water use. There is a moderate warming of the climate, which results in increased water use in all sectors, impacting stream flows and supplies. This dynamic reinforces the social value of wide-spread water efficiency and increased environmental protection.

D. Adaptive Innovation: A much warmer climate causes major environmental problems globally and locally. Social attitudes shift to a shared responsibility to address problems. Technological innovation becomes the dominant solution. Strong investments in research lead to breakthrough efficiencies in the use of natural resources including water. Renewable and clean energy become dominant. Colorado is a research hub and has a strong economy. The relatively cooler weather in Colorado (because of its higher elevation) and high tech job market causes population to grow faster than currently projected. The warmer climate increases demand for irrigation water in agriculture and municipal uses, but innovative technology mitigates the increased demand. The warmer climate reduces global food production increasing the market for local agriculture and increasing food imports to the state. More food is bought locally increasing local food prices and reducing the loss of agricultural land to urban development. Higher water efficiency helps maintain stream flows even as water supplies decline. The regulations are well defined and permitting outcomes are predictable and expedited. The environment declines and shifts to warmer weather species. Droughts and floods become more extreme. More compact urban development occurs through innovation in mass transit.

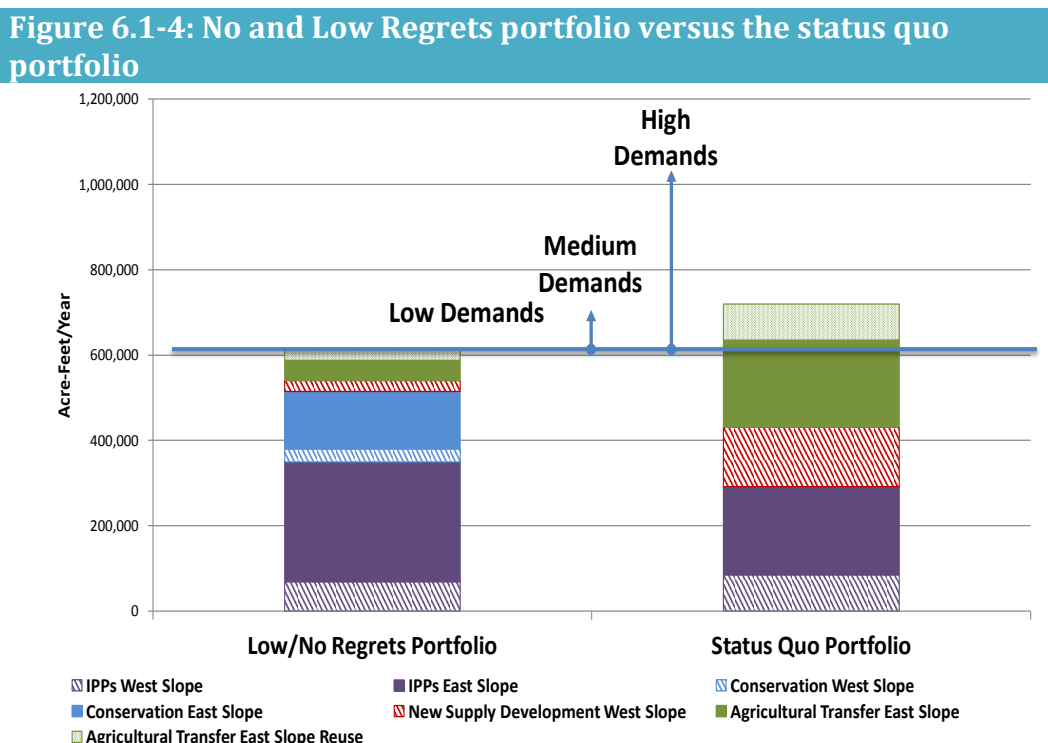
E. Hot Growth: A vibrant economy fuels population growth and development throughout the state. Regulations are relaxed in favor of flexibility to promote and pursue business development. A much warmer global climate brings more people to Colorado with its relatively cooler climate. Families prefer low-density housing and many seek rural properties, ranchettes, and mountain living. Agricultural and other open lands are rapidly developed. A hotter climate decreases global food production. Worldwide demand for agricultural products rises, greatly increasing food prices. Stream flows and water supplies decline. The environment degrades and shifts to warmer weather species. Droughts and floods become more extreme. Communities

struggle unilaterally to provide the services needed for the rapid business and population growth. Fossil fuel is the dominate energy source, and there is large production of shale oil, coal, natural gas, and oil in the state.

The five scenarios collectively capture a broad range of future supply-and-demand possibility and uncertainty. Of the five scenarios, “Business as Usual” is the most conventional while “Adaptive Innovation” and “Hot Growth” are the most difficult to prepare for because of the high water demands combined with the effects of climate change. The challenge is not to pick the most likely or attractive future; rather, it is to develop the capacity to be prepared for all of them.

Developing an Adaptive Water-Management Plan

In analyzing the portfolios, the IBCC identified common near-term strategies and actions that would provide baseline benefits for all five of the envisioned scenarios. Most of these actions are necessary no matter what future Colorado faces and would fully meet low demands, as described in the weak economy scenario. Some strategies prepare Colorado for future projects and methods that may be needed in one or more future. These near-term commonalities are called “no and low regret” strategies and actions since they would most likely be viable no matter how the future might ultimately unfold. Figure 6.1-4 shows how the no and low regret portfolio compares to the status quo.



Comparatively, this portfolio meets future medium or high water demands while maintaining Colorado’s Water Values by reducing environmental and agricultural impacts.

The recommended no and low regret actions are described in more detail below, along with the adaptive strategies needed to prepare Colorado for other potential futures:

- **Minimize statewide agricultural acres transferred and implement agricultural sharing projects:** Limit traditional permanent dry-up of agricultural lands by supporting lower-impact alternatives for more than 300,000 people (50,000 acre-feet) in the near future. At the same time, track the reliability of these alternatives, and plan and preserve the option of additional agricultural transfers should a future scenario necessitate this action. These opportunities are described in Section 6.4.
- **Plan and preserve future options for developing unallocated waters:** Develop additional water supplies from unallocated water on the western slope for local use to serve a minimum of 200,000 people (35,000 acre-feet) and the associated jobs needed to support them in the near future. At the same time, plan for and preserve the option for an additional transmountain diversion, should a future scenario necessitate such a project through the conceptual agreement parameters described in Chapter 8.
- **Establish medium conservation strategies:** Implement strategies to meet medium levels of conservation and apply at least half of these savings to meet future municipal and industrial needs to support approximately 1 million people and the jobs needed to support them in the near future (170,000 acre-feet). At the same time, track the reliability of these conservation savings, and plan for how additional conservation savings could be achieved, should a future scenario necessitate this action. Section 6.3 describes several avenues for accomplishing this.
- **Implement projects and methods that support environmental and recreational uses:** Implement local projects, especially those that support imperiled species and recreational areas that are important to local economies. These projects and methods are described in Section 6.6.
- **Strive for high success rates for projects and methods that are already planned:** Work to support the projects that are already planned, as these already have a project proponent and are often smaller and less controversial than many of the other project options. Statewide, these projects may provide enough water for more than 2 million people and the associated jobs needed to support them in the near future (350,000 acre-feet). Continue to track the success rate of these projects and their ability to meet future community water needs. These projects and methods are further described in Section 6.5.
- **Assess and implement storage projects and other infrastructure:** Implement storage and other infrastructure to maximize flexibility and reliability. Focus on options that support multiple needs, such as for communities, agriculture, and the environment. Storage is further discussed as part of 6.5.
- **Implement water reuse strategies:** Implement strategies that encourage increased use of recycled water, as described in Section 6.3.

The “no and low regrets portfolio” only satisfies the municipal and industrial water supply needs of the “weak economy” scenario and this would only be possible if the portfolio were successfully implemented in the near term. If medium or high water demands had to be met as

envisioned in the other scenarios, additional portfolio actions would be needed in the mid and long term.

Building on the earlier work of the basin roundtables and the IBCC, the CWCB developed a scenario-based adaptive water strategy. While the “no and low regrets portfolio” is necessary no matter what future Colorado may face, the adaptive framework recognizes that the future hinges upon how the primary drivers – *Municipal & Industrial Water Demand*, *Water Supply Availability*, and *Social Values* – change over time. These drivers could tip the still evolving future toward one scenario or another. These tipping points serve as water management decision points or “signposts” that can lead toward the need to implement a certain portfolio of solutions. By developing an adaptive water-management framework, managers and decision makers will be more aware of approaching signposts and can anticipate the need to make timely water management decisions.

The primary drivers can be explained as follows:

- Future changes in *Municipal and Industrial Water Demands* may trend “lower” or “higher” relative to the mid-level water demand forecast used in previous Statewide Water Supply Initiative efforts. Such a change may be anticipated by tracking indicators of economic activity and demographic growth as well as other secondary factors.
- *Water Supply Availability* may similarly trend “lower” or “higher” depending on climate change, watershed hydrology, legal constraints associated with Colorado’s interstate compacts, water law, and environmental regulations. Water Supply Availability will also be assessed as trending lower or higher over time as compared to earlier versions of the Statewide Water Supply Initiative.
- The third primary driver, *Social Values*, is a measure of statewide public sentiment; it may trend toward a more “green” orientation or it may shift toward greater “resource utilization.” “Green” values will likely favor more dense, low-impact urban development, greater reliance on water use and energy efficiency, greater protection of environmental and recreational resources, and preservation of local agriculture and open space. Values associated with more intensive “resource utilization” will gravitate toward full use of existing natural sources as well as the development of new ones to satisfy municipal and industrial water demands.

This scenario-based framework allows for incremental implementation of future portfolio response actions beyond the “no and low regret” actions recommended in the near term. Pre-positioned portfolio actions – such as increased levels of conservation, agricultural transfers, or transmountain diversions – can be implemented at specified key signposts. This will allow decision makers to respond adaptively to changes in critical drivers in real time that cannot be predicted with certainty as the still emerging future continues to unfold. Water demands, water supply, and social values are used as critical drivers.¹³

Table 6.1-1 shows the relationships between the three primary drivers, scenarios, and portfolios of solutions. The five portfolios selected to match the scenarios best meet both the future conditions described in the scenario balanced with Colorado’s Water Values.

Table 6.1-2 Scenarios and their matching portfolios
(see legend for figure 6.1-4)

Water Demand	Water Supply	Social Values	Scenario	Portfolio of Solutions
Higher	Lower	"Resource Utilization"	Hot Growth	 High Demand Mixed Portfolio
Higher	Lower	"Green"	Adaptive Innovation	 High Demand Conservation Portfolio
Higher	Higher	"Resource Utilization"	Business as Usual	 Mid demand Mixed Portfolio
Lower	Lower	"Green"	Cooperative Growth	 Mid demand Conservation Portfolio
Lower	Higher	No change	Weak Economy	 Low Demand Conservation Portfolio / Low and No Regrets Portfolio

The no and low regret actions will not be easy to accomplish. However, if these are not implemented in the next fifteen years, then the impacts will be severe. The water supply gap will be greater than any basin roundtable envisioned, and the solutions will dry up more agriculture and cause further harm to the environment. If Colorado faces high demands, and the no and low regret actions are not fully implemented, projects and methods beyond anything the basin roundtables have envisioned would need to be implemented. This could be an even larger transmountain diversion, draconian conservation measures, or even greater amounts of agricultural dry up. These approaches would not be consistent with Colorado's Water Values; therefore, it is imperative that the no and low regret actions are implemented.

Section 6.2 assesses whether or not the Basin Implementation Plans would meet at least the no and low regrets actions. Sections 6.3 through 6.6 and Chapter 8 explore in detail how, at minimum, the no and low regrets actions can be implemented through the BIPs and other stakeholder projects and methods for obtaining financial support, education efforts, partnerships, and legislative solutions.

If successfully implemented, this adaptive water strategy provides a roadmap to a still evolving future. Given the many vagaries inherent in predicting future conditions, the plan must be a living document. As new critical drivers arise or as decision points change over time,

the scenarios and associated response-action portfolios will need to be reassessed and revised in subsequent updates to the Statewide Water Supply Initiative.

Actions

The following actions are needed to continue to support developing scenario planning and Colorado's adaptive strategies:

1. CWCB, in partnership with other state agencies, will commit state financial, technical, and regulatory resources to the near-term implementation of the no and low regrets.
2. CWCB will continue to monitor the critical drivers through future Statewide Water Supply Initiative updates and gather information from water providers, as mandated by the Act *"Concerning Additional Information Regarding Covered Entities' Water Efficiency Plans."*
3. In partnership with the basin roundtables, CWCB will evaluate progress toward achieving the no and low regrets.
4. CWCB will encourage the basin roundtables to utilize a scenario planning framework at the basin level as part of their Basin Implementation Plans.
5. In partnership with the basin roundtables and IBCC, CWCB will update the scenarios and adaptive strategies as scientific information improves and changes.
6. CWCB will encourage and facilitate the adoption of adaptive strategies for municipal, industrial, agricultural, environmental, and recreational needs as Colorado moves into the future in partnership with project proponents.
7. In partnership with the Climate Change Technical Advisory Group, the CWCB will monitor the potential impacts of climate change to Colorado's water needs¹⁴
8. CWCB and the Division of Water Resources will continue to develop and support the Colorado Decision Support System.

6.2 Meeting Colorado's Water Gaps

Colorado's Water Plan uses a grassroots approach to formulate projects and methods to close water gaps with more agile, informed, and responsible water management. By doing so, Colorado will achieve its long-term objective to meet the needs of municipalities, industry, agriculture, the environment, and recreation in a balanced manner.

6.2.1 Overview

This section describes how the basin roundtables' draft Basin Implementation Plans (BIPs) meet Colorado's growing municipal, industrial, agricultural, environmental, and recreational water needs. This section describes the BIP goals and measurable outcomes and identifies the remaining needs that must be met to accomplish those objectives by basin. These remaining needs are referred to as "gaps." The section relies on previous technical work conducted in the Statewide Water Supply Initiative (SWSI) 2010, the Basin Needs Assessments, and the no and low regrets work described in Section 6.1. Finally, this section ends with a list of actions to support closing Colorado's water gaps. In comparison, sections 6.3 through 6.6 indicate the types of projects and methods the BIPs consider and the actions needed to support them.

Colorado's Water Plan does not endorse specific projects. However, implementing a combination of projects and methods, as outlined in the BIPs, will be necessary to meet Colorado's current and future municipal, industrial, agricultural, environmental, and recreational water needs. Failing to implement the projects and methods outlined in the BIPs will result in an even greater water gap in Colorado's future. The BIPs are still in draft form, and this chapter will be updated as they are completed in 2015.

In compiling its BIP, each basin roundtable developed goals and measurable outcomes which add up to a vision for how each basin plans to support each major sector. While a water supply gap for municipal and industrial (M&I) needs is relatively easy to quantify, the future needs of agriculture, the environment, recreation, and other uses identified in the BIPs, are based on the vision of each basin roundtable.

6.2.2 Goals and Measurable Outcomes by Basin

The degree to which the BIP goals and measurable outcomes demonstrate concurrence across Colorado is remarkable. CWCB developed several long-term themes to meet the objectives outlined in the Governor's Executive Order.¹⁵ These include:

1. Meet municipal water needs throughout Colorado
2. Meet Colorado's agricultural water needs
3. Meet Colorado's environmental and recreational water needs

In addition, Colorado has a long-term goal related to water quality, which is discussed in Section 7.3:

4. Meet Colorado's water quality management needs

Each of these major themes is reflected in the BIP goals and measurable outcomes. Additionally, the Basin Roundtables identified several additional major themes that reached across all BIPs. These include:

- Protect and restore watershed health
- Multi-purpose storage/balance all needs and reduce conflict
- Comply with and manage the risk associated with interstate compacts and agreements
- Continue participation, education, outreach, and communication

Table 6.2-1 demonstrates the common themes found across the eight BIPs, and outlines the steps by which the BIPs propose to specifically address these themes.

Below is a brief summary of how the BIPs addressed these themes.

Meet Colorado's Municipal Water Needs through Conservation and Identified Projects and Methods: Every BIP discusses the importance of conservation. This is especially a focus for the Arkansas, Colorado, South Platte, and Southwest Basin roundtables. The Southwest and South Platte BIPs focus on implementing already identified projects and processes (IPPs) from SWSI 2010. The Southwest and the Colorado BIPs also identify additional projects and methods. BIP Reuse is also featured in the Colorado, South Platte, and Arkansas BIPs.

Meet Colorado's Agricultural Needs: In general, the Arkansas, Colorado, Rio Grande, and Southwest Basin roundtables are approaching agricultural needs from an economic and productivity standpoint. The North Platte and Yampa/White Basin Roundtables seek to increase their irrigated acres, while several basins, such as the Gunnison and Colorado, seek to reduce agricultural shortages. Nearly every basin is also focused on improving agricultural efficiencies and modernizing water infrastructure. The South Platte and Metro Basin roundtables are concerned about maintaining the viability of agriculture in the South Platte against the pressure of agricultural transfers and urbanization, and are therefore exploring alternative options including the successful implementation of conservation, reuse, IPPs, alternative agricultural transfers, and the development of new supplies from the Colorado River system. Some western slope BIPs, such as the Southwest BIP, indicate that agriculture across the state is important and have expressed support for strategies such as high conservation to minimize the potential impact. The South Platte BIP indicates that all of these will be needed to reduce the pressure on agricultural transfers. The Rio Grande BIP expresses concern about maintaining the viability of agriculture in the face of current unsustainable levels groundwater.

Meet Colorado's Environmental and Recreational Needs: Environmental, water quality and quantity needs and objectives are critical for each of our basins. Every BIP discusses the need to recover imperiled and/or threatened and endangered species and protect recreational facilities, wetlands, and riparian areas. In addition, several BIPs state the need to further quantify environmental and recreational needs and the Gunnison, South Platte, and Yampa/White/Green BIPs discuss the need to better determine how agriculture supports environmental and recreational values.

Table 6.2-1: Common these across BIPs

✓ = BIP goal or measurable outcome; ✓ = BIP activity

	Ark	Co	Gu	NP	RG	SP/Mt	SW	Y/W/G
A. Meet Municipal Water Needs throughout Colorado								
• Focus on M&I Gaps	✓	✓	✓	✓	✓	✓	✓	✓
• Focus on Conservation / Demand Management	✓	✓	✓	✓	✓	✓	✓	✓
B. Meet Colorado's Agriculture Needs								
• Focus on agricultural economy	✓	✓			✓			
• Focus on reducing shortages		✓	✓			✓	✓	✓
• Improve agricultural efficiencies	✓	✓	✓		✓		✓	
• Increase irrigated acres				✓				✓
• Conduct the goals while protecting private property rights	✓	✓	✓	✓	✓	✓	✓	✓
C. Meet Colorado's Environmental and Recreational Water Needs								
• Focus on recovering imperiled and/or endangered species	✓	✓	✓	✓	✓	✓	✓	✓
• Protect wetlands and riparian areas	✓	✓	✓	✓	✓	✓	✓	✓
• Protect recreation	✓	✓	✓	✓	✓	✓	✓	✓
• Quantify nonconsumptive needs	✓	✓	✓				✓	✓
H. Meet Colorado's Water Quality Management Needs								
• Includes one or more goals / activities on water quality	✓	✓	✓	✓	✓	✓	✓	✓
D. Protect and Restore Watershed Health								
• Includes one or more goals / activities associated with watershed health	✓	✓	✓	✓	✓	✓	✓	✓
E. Balance All Needs and Reduce Conflict / Multi Purpose Storage								
• Protect Private Property Rights / Water Rights	✓	✓	✓	✓	✓	✓	✓	✓
• Multi-purpose Focus	✓	✓	✓	✓	✓	✓	✓	✓
• Modernize water infrastructure	✓		✓	✓	✓			✓
• Determine how agriculture supports nonconsumptive needs	✓	✓	✓	✓	✓	✓		✓
• Increase storage	✓	✓	✓	✓	✓	✓	✓	✓
F. Comply with Interstate Compacts, agreements, and manage the risk associated with these								
• Includes one or more goals / activities associated with this	✓	✓	✓	✓	✓	✓	✓	✓
G. Continue Participation, Education, Outreach, and Communications								
• Includes one or more goals / activities associated with this	✓	✓	✓	✓	✓	✓	✓	✓

Meet Colorado's Water Quality Management Needs: Although water quality is not an issue traditionally studied by the basin roundtables, every BIP addresses water quality. Section 7.3 summarizes the BIP water quality efforts.

Protect and Restore Watershed Health: While the Arkansas, North Platte, Rio Grande, and Southwest Basin roundtables are the most focused on watershed health, every BIP recognizes the importance of watershed health. Many BIPs link watershed health to environmental needs or

protecting important infrastructure for municipal and agricultural needs. Section 7.1 summarizes the BIP watershed health efforts.

Continue Participation, Education, Outreach, and Communications: Every basin roundtable has active education and outreach activities, as described in Section 9.5.

While each of the above topics demonstrate a gap associated with the goals and measurable outcomes, there are also several other important themes demonstrated throughout the BIPs that do not involve gaps. Some of these include:

- **Protect Private Property and Water Rights:** Every BIP makes it clear that solutions to protect agriculture and the environment need to be done in the context of protecting private property and water rights. This general theme is consistent with Colorado's Water Plan.
- **Comply with and Manage the Risk Associated with Interstate Compacts and Agreements:** Every basin in Colorado must grapple with interstate compacts or agreements and each basin has addressed this topic explicitly in its BIP. Chapter 8 discusses how the BIPs address the issue of transmountain diversions.
- **Multi Purpose Storage and Projects / Balance All Needs and Reduce Conflict:** Every BIP stressed interest in multi-purpose projects and approaches. Some, like the Arkansas, Colorado, North Platte, Rio Grande, and South Platte/Metro Basin roundtables, are interested in how agriculture supports nonconsumptive needs. The Arkansas, South Platte, Rio Grande, and Southwest BIP goals also explicitly discuss the need for multi-purpose projects.

6.2.3 Meet Municipal and Industrial Water Needs throughout Colorado

CWCB identified three statewide long-term goals to meet community water needs throughout Colorado¹⁶:

- Use water efficiently to reduce overall future water needs
- Identify additional projects and processes to meet the water supply gap for municipalities while balancing the needs of agriculture, the environment, and recreation across the state
- Meet community water needs during periods of drought

The Statewide Water Supply Initiative in 2010 indicated that under current conditions the municipal and industrial gap could be between 190,000 and 630,000 acre-feet, depending on how many planned projects are implemented and the rate of population growth in Colorado.

In order to address at least the minimum water gap, the basin roundtables and the Interbasin Compact Committee (IBCC), developed several no and low regrets goals and measurable outcomes, as described in Section 6.1. For M&I uses, example measurable outcomes that would meet these no and low regrets were described for developing IPPs, reuse, conservation, agricultural transfers, and Colorado River supplies, and in many cases were broken out by basin¹⁷:

- *Establish Low/Medium Conservation Strategies*

- Implement strategies at the basin level to meet medium levels of conservation, and apply half of that to meet the M&I Gap, equivalent statewide to 67,000 acre-feet per year by 2030 and 167,000 acre-feet by 2050.
- 2050 Conservation Savings by Basin:

▪ Arkansas: 36,000 AF	▪ South Platte(including Metro Area): 97,000 AF
▪ Colorado: 15,000 AF	
▪ Gunnison: 4300 AF	▪ Southwest: 7500 AF
▪ North Platte: 85 AF	▪ Yampa/White/Green: 3700 AF
▪ Rio Grande: 3200 AF	
- *Have a High Success Rate for IPPs*
 - Implement IPPs to yield 80 percent statewide, equivalent to 70,000 acre-feet per year for the western slope and 280,000 acre-feet per year for the eastern slope
 - 2050 No/Low Regret IPP success by Basin:

▪ Arkansas: 76,000 AF	▪ South Platte(including Metro Area): 200,000 AF
▪ Colorado: 45,000 AF	
▪ Gunnison: 12,000 AF	▪ Southwest: 13,000 AF
▪ North Platte: 100 AF	▪ Yampa/White/Green: 7000 AF
▪ Rio Grande: 6000 AF	
- *Implement Reuse Strategies*
 - 25,000 acre-feet per year of yield resulting from new agricultural transfer and transmountain diversion projects above and beyond the IPPs in the South Platte and Arkansas Basins.
- *Plan and Preserve Options for Existing and New Supply*
 - Develop 35,000 acre-feet per year of new supplies in the Colorado River system for the western slope.
 - A conceptual agreement is developed between basin roundtables regarding how to preserve/not preclude a potential future transbasin diversion from the western slope to the eastern slope. (The Draft Conceptual Agreement developed by the IBCC is discussed in Chapter 6.)

Many of the BIPs seek to accomplish these short and long-term goals, and this subsection reviews information by basin. Table 6.2-2 summarizes the success of each basin in meeting the overall water supply gap for municipalities and industry.

Table 6.2-2: Summary of BIPs addressing the Municipal and Industrial No and Low Regrets and Gaps

Basin	2050 New Needs (AF) ¹⁸	2050 Gap (AF) ¹⁹	BIP ID'd Potential New P&M AF	# of New Projects w/ AF Info	Are No/Low Regrets Likely Met?	Notes
Arkansas	110,000 - 170,000	45,000 - 94,000	In Process	0	Uncertain: still in process w/ conservation strategy and determining new projects and methods; express need to implement IPPs; will do reuse w/ new development; expresses similar concepts to and discusses conceptual agreement	The Draft BIP will develop additional detail by April 2015 ²⁰
Colorado	65,000 - 110,000	26,000 - 48,000	534,000 – 564,000	52	Yes: high conservation; some IPP success; identify additional Colorado River Basin supply projects; plans to discuss conceptual agreement	The Draft BIP identified projects by region, and each region sufficiently meets their M&I gap ²¹
Gunnison	16,000 - 23,000	3,700 - 6,100	300	2	Partially: accept conservation standards; some success of IPPs; identify limited amount of additional Colorado River Basin supply projects; expresses similar concepts to conceptual agreement and agree to further engage in future	Draft BIP indicates M&I needs “are generally expected to be managed with sufficient existing supplies and/or through planned projects” ²²
North Platte	100-300	10 - 30	N/A	Completed Project	Yes: accept conservation standards; IPP success; does not discuss conceptual agreement	The North Platte has met its municipal gap ²³

Basin	2050 New Needs (AF) ¹⁸	2050 Gap (AF) ¹⁹	BIP ID'd Potential New P&M AF	# of New Projects w/ AF Info	Are No/Low Regrets Likely Met?	Notes
Rio Grande	7,700 - 13,000	2,300 - 5,100	None Identified	0	Partially: little conservation discussion; some IPP success; support conceptual agreement in concept	The Draft BIP did not identify additional acre-feet for municipal projects, but described several potentials ²⁴
South Platte	340,000 - 505,000	203,000 - 312,000	In Process	6 projects + Portfolios	Partially: largely conceptual, some conservation, some IPP success, additional reuse IPPs, support conceptual agreement in concept	The Draft BIP will develop additional detail by April 2015 ²⁵
Southwest	20,000 - 31,000	8,800 - 16,000	32,000	7	Yes: conservation policies; high IPP success; develop additional Colorado River Basin supplies; support many aspects of conceptual agreement and indicate conceptual agreement is "in progress"	Additional yield info is needed to fully describe how the Draft BIP identified projects provide water where it is needed most within the SW sub-basins ²⁶
Yampa / White / Green	34,000 - 95,000	24,000 - 83,000	211,000	6	Mostly: some conservation; high IPP success; develop additional Colorado River Basin supplies; discusses some similar concepts to conceptual agreement and will continue to engage	Conducted a thorough M&I shortage analysis, which shows there are still some M&I shortages of up to 10% with climate change. ²⁷

This column represents the total number of acre-feet gathered from the projects and methods (P&M) identified in the BIPs, which could serve municipal or industrial uses. Conservation is included as a method. The values do not consider hydrological limitations. Some BIPs are still "in process" in developing acre feet associated with newly identified projects and methods.

The current no and low regrets and SWSI 2010 gap calculations do not take into account the potential effects of climate change. As discussed throughout this plan warming temperatures can affect water supply, water availability, and demands. Should average annual temperature continue to increase at projected levels (2.5-5° F) by mid-century it is reasonable to expect that the existing gap would increase.



Arkansas

The Arkansas Basin faces an immediate municipal gap in some areas, especially if the need to replace nontributary groundwater in El Paso and Elbert counties is taken into account.²⁸ Future needs in the Arkansas Basin are likely to increase by 110,000 to 170,000 acre-feet and currently planned projects leave a municipal water supply gap within the basin of between 45,000 to 94,000 acre-feet. This assumes that identified projects and processes are implemented at a relatively high success rate.²⁹

Arkansas Goals and Measurable Outcomes:

To address this municipal gap, the Arkansas BIP identifies four goals related to meeting M&I needs.³⁰ These goals and the associated measurable outcomes are below:

- Meet the municipal supply gap in each county within the basin.
 - Generate a study by December, 2015, determining surpluses and deficits within subregions/counties.
 - Funds provided in support of collaborative efforts reported annually.
- Support regional infrastructure development for cost-effective solutions to local water supply gaps.
 - Agreements to regional use of identified IPPs such as Southern Delivery System.
 - New WSRA grant request for regional infrastructure studies.
 - Agreements for off-take of conduit water; funding of conduit processes and construction.
- Reduce or eliminate Denver Basin groundwater dependence for municipal users.
 - Presentations by groundwater dependent entities on solutions that have been implemented.
 - Presentations on interim solutions and funding requests to support those solutions.
 - Funds provided in support of collaborative efforts reported annually.
- Develop collaborative solutions between municipal and agricultural water users, particularly in drought conditions.
 - Pilot project implemented as reported annually.
 - Engineering template implemented by the Division of Water Resources to expedite temporary transfers at reduced cost.

Meeting the Arkansas' Municipal and Industrial Gaps

The Arkansas Basin is still in the process of exploring additional projects and methods to meet its future municipal needs beyond the identified projects and processes in SWSI 2010.³¹ However, the Arkansas Basin supports development of the four strategies identified during SWSI 2010³²:

1. Active and passive conservation;
2. Implementation of all identified projects and processes;
3. Alternatives to agricultural transfers; and
4. Development of Colorado River supplies;

As the BIP indicates, "Regional solutions are emerging. A collaborative initiative began in 2009 to define the elements of agriculture following rotations. The roundtable moved forward on three

tracks simultaneously: technical studies, public policy investigations and pilot projects to test these strategies. Although this was noble effort, the efficacy of the outcome remains uncertain. In the meantime, regional solutions in the upper basin are emerging, the lower basin is gaining greater understanding of its challenges, and the Pikes Peak region is investigating cooperative infrastructure configurations.”³³



Colorado

The Colorado Basin faces a gap that could begin as early as 2030 in Mesa County.³⁴ Future needs in the basin are likely to increase from between 65,000 to 110,000 acre-feet, and currently planned projects leave a municipal water supply gap within the Colorado Basin of 26,000 to 48,000 acre-feet. This assumes that identified projects and processes are implemented at a relatively high success rate.³⁵

Colorado Goals and Measurable Outcomes:

To address this municipal gap, the Colorado BIP identifies seven goals related to meeting M&I needs.³⁶ These goals and the associated measurable outcomes are below:

- Develop land use policies requiring and promoting conservation
 - Develop recommendations for city, county, and state governing bodies promoting water awareness and efficiency in land use policy
 - Develop educational materials or opportunities for municipal and county elected officials and planning officials on water supply issues and conservation options
 - Preserve agriculture and reduce the transfer of agriculture water to municipal use
- Raise awareness of current obstacles and efforts facing water providers
 - Publish summary of state and basin water providers' true cost of water by analyzing operation and maintenance costs including sustainable infrastructure replacement programs
 - Development of national, state or local funding assistance programs to replace aging infrastructure
 - All basin water providers have sustainable infrastructure replacement funding programs
- Protect drinking water supplies from natural impacts such as extended droughts, forest fires, climate change, among others
 - Every basin water provider has a reliable redundant water supply to meet 2050 demands
 - Colorado Basin Roundtable or CWCB to establish a biannual basin conference on natural disaster planning for water providers and government officials
- Develop water court process recommendations to encourage efficiency, conservation, and reuse
 - Recommendations to improve the objector process
 - Recommendations to limit vulnerability of water rights when changing existing water rights in water court

- Improvements to Colorado water law to encourage agricultural water efficiency practices without harming water right value
- Secure growing water demand by developing in-basin supplies and expanding raw water storage supply
 - All basin water providers to meet current supply needs with redundancy, develop drought plans, and viable project options to meet future water needs
 - Reduce average permitting time for reservoir project to under 10 years
 - Establish regional water provider and ditch company cooperatives focused on improving regional relationships, water supply redundancy and flexibility, water quality, coordinated efforts for multi-beneficial projects, and addressing environmental and recreational needs
 - Reduce demands by establishing water conservation goals and strategies
- Improve Colorado Water Law to encourage efficiency, conservation, and reuse
 - Revise Colorado Water Law through legislation to allow more flexibility among water providers and the agricultural community to promote stream health through conservation, bypass flows, and flexibility in diversion location
 - Reduce time of average Division 5 water court process by adding staff including judges, referees, and supporting staff
- Pursue continued municipal and industrial conservation
 - Achieve and sustain a high level of conservation by all basin water providers and industrial users

Meeting the Colorado's M&I Gaps

The Colorado BIP developed an extensive list of potential M&I projects by interviewing more than 60 water providers throughout the basin.³⁷ If all of the projects and methods identified were implemented, as a whole the Colorado Basin's M&I gap would be more than met. The BIP identified 54 potential M&I projects that quantified the acre-feet. These added up to nearly 510,000 to 540,000 acre-feet, which far exceeds the amount needed under no and low regrets and also the high potential M&I gap of 48,000 acre-feet identified in SWSI 2010.³⁸ In addition, each geographic region identified in the BIP could meet its future needs if the listed projects were implemented.³⁹ However, uncertainty exists whether each municipality would be able to access these water supplies and the projects' viability given that many have not identified a project proponent.

In addition to these projects, the Colorado BIP also advocates for high conservation standards, as identified in SWSI 2010. This would likely result in another 24,000 acre-feet of saved water from active conservation that could be applied to meet future demands. The BIP supports the implementation of conservation best practices and education about land use decisions to support accomplishing high conservation.

In conclusion, if the Colorado River basin were able to implement high conservation and a tenth of the yield identified in the new projects identified, then the M&I gap should be fully met. However, there is uncertainty regarding the ability of many of the projects to be implemented and specific commitments from water providers to rely on these projects or commit to high conservation levels.



Gunnison

The Gunnison Basin faces a gap that could begin as early as 2035 in Delta County⁴⁰. Future needs in the basin are likely to increase by 16,000 to 23,000 acre-feet and currently planned projects leave a municipal water supply gap within the Gunnison Basin of 3,700 to 6,100 acre-feet. This assumes that identified projects and processes are implemented at a relatively high success rate.⁴¹ In addition, the Gunnison BIP

states that demands in Ouray County may be higher than indicated in SWSI 2010.⁴²

Gunnison Goals and Measurable Outcomes:

To address this municipal gap, the Gunnison BIP identifies one goal related to meeting M&I needs.⁴³ That goal and the associated measurable outcomes are below:

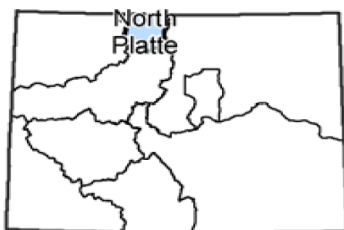
- Identify and address M&I water shortages
 - Reliably meet 100 percent of essential municipal water provider system demands in the basin through the year 2050 and beyond
 - Continue the current baseline of effective water conservation programs by covered entities in the basin, producing at least medium levels of conservation savings as defined in SWSI 2010 and employing relevant conservation strategies listed for both the low and medium levels of SWSI 2010

In addition, the Gunnison BIP outlines the following statewide principles related to municipal conservation, including implementation steps⁴⁴:

- Water conservation, demand management, and land use planning that incorporates water supply factors should be equitably employed statewide.
 - Work with other basin roundtables to support conservation, demand management, and the incorporation of water supply factors into land use planning and development.
 - Promote programs that encourage drought tolerant vegetation and discourage lawn irrigation.

Meeting the Gunnison's M&I Gaps

The Gunnison Basin roundtable identified two water conservation activities and two projects that were not identified in SWSI 2010 that would help meet future M&I needs. The two projects would provide approximately 300 acre-feet.⁴⁵ While this volume does not fully meet the gap identified in SWSI 2010, the Gunnison BIP states that "Municipal and Industrial needs ... are generally expected to be managed with sufficient existing supplies and/or through planned projects."⁴⁶ Given this analysis, the Gunnison Basin's M&I gap is considered partially met.



North Platte

The North Platte Basin no longer has an M&I supply gap. As stated in the North Platte BIP, "The North Platte Basin has only one municipal water provider, the Town of Walden, serving a population of about

600. Limitations to the town's water supply were identified in the original SWSI report, and subsequently addressed through a CWCB-funded study and multi-alternative project, eliminating the only municipal water supply gap in the basin."⁴⁷

North Platte Goals and Measurable Outcomes:

Nonetheless, the BIP indicated support for municipal conservation, which could help meet any additional needs. This goal and associated measurable outcome are below:

- Support the equitable statewide application of municipal water conservation.
 - Comply with future statewide municipal conservation strategies and any related legislation by 2020 or as appropriate.

Meeting the North Platte's M&I Gaps:

In summary, the North Platte's future M&I needs are met by 2050.



Rio Grande

The Rio Grande Basin has a relatively small, though important municipal and industrial gap. According to CWCB analyses, this gap could begin as early as 2025 in Costilla County.⁴⁸ These studies indicate that future needs in the Rio Grande are likely to increase by 7,700 to 13,000 acre-feet and currently planned projects leave a municipal water supply gap within the Rio Grande Basin of between 2,300 to 5,100 acre-feet. This assumes that identified projects and processes are implemented at a relatively high success rate.⁴⁹ The Rio Grande Basin would like to better determine the amount, timing, and location of the gap once the Rio Grande Decision Support System groundwater model is ready. It is anticipated that most water providers will have a gap and will need to join a groundwater management subdistrict or develop an independent augmentation plan.

Rio Grande Goals and Measurable Outcomes:

To address this municipal gap, the Rio Grande BIP identifies three primary goals related to meeting M&I needs. These goals and the associated measurable outcomes are below⁵⁰:

- Operate, maintain, rehabilitate, and create necessary infrastructure to meet the basin's long-term water needs, including storage.
 - A database of existing water infrastructure including documentation of infrastructure condition and mapping of all storage reservoirs and major ditch diversions is created.
 - Reservoirs operate at full design capacity without restrictions.
 - Diversion structures and conveyance systems function optimally.
 - Municipal potable water supplies are adequate to meet needs.
 - Water supplies and wastewater treatment systems are fully functional and meet all necessary standards.
- Support the development of projects and methods that have multiple benefits for agricultural, municipal and industrial, and environmental and recreational water needs.

- Opportunities for multiple use benefits have been explored and implemented where possible.
 - Multiple-purpose projects will have preference in the funding process.
- Meet new demands for water, to the extent practicable, without impacting existing water rights and compact obligations.
 - Minimize per capita per day water use to a reasonable level.
 - Inventory existing and expected future M&I and environmental and recreational water needs.
 - Add hydropower electrical generating capacity where possible.
 - Develop an M&I plan that addresses water needs, availability, and a strategy for meeting the needs for M&I while sustaining agricultural water use and minimizing impacts to other uses.

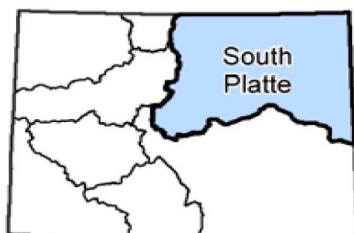
Meeting the Rio Grande's M&I Gaps:

The Rio Grande BIP identified very few municipal projects beyond the identified projects and processes in SWSI 2010, and none of these provide additional acre-feet to meet these growing municipal needs. The BIP acknowledges this by stating:

While M&I and self supplied industrial (SSI) water use will remain a small percentage of overall basin water use, it is important to provide additional resources to M&I water providers to assist them in meeting future needs by identifying and assisting in the development of:

- Measures to manage water demands and return flows and develop methods to receive augmentation credits for wastewater discharges and lawn irrigation return flows.
- Water rights, storage and augmentation supplies, either directly or through the groundwater management subdistricts.
- Finalization of the Rio Grande Decision Support System groundwater model so that municipal and industrial pumping depletions can be determined in amount, timing, and location⁵¹

Because of this, the Rio Grande has not yet quantified its future M&I gap. Once well pumping depletions have been determined in amount, timing, and location, the municipal and industrial providers will either join a subdistrict or develop an independent augmentation plan.



South Platte (including the Metro Area and Republican Basin)

The Metro, South Platte, and Republican Basins face a municipal gap that could begin as early as 2020 in the Lower South Platte, as is immediate in the South Metro area when taking into account the need to replace nontributary groundwater.⁵² The potential gap in the Lower South Platte is relatively small compared to the urbanized Front Range, which holds the largest gap in Colorado. Future needs in the basin as a whole are likely to increase by 340,000 to 505,000 acre-feet. However, the additional water needs from hydrologic fracturing must be added to the water supply gap. With existing data, currently planned projects leave a municipal water supply gap within Colorado's northeast region of 203,000

to 312,000 acre-feet. This assumes that identified projects and processes are implemented at a relatively high success rate.⁵³

South Platte Goals and Measurable Outcomes:

To address this M&I gap, the South Platte BIP developed a long-term goal to meet M&I needs⁵⁴:

Meet Community Water Needs throughout Colorado by: 1) Using water efficiently with high levels of participation in conservation programs; 2) Developing additional water throughout the state through balanced, multi-purpose projects and methods; and 3) Assuring strong drought protection programs through broad development of protection plans and dedicated reserves potentially including storage, interruptible service agreements (ISAs), water banks, water use restrictions and non-tributary groundwater, among others.

In the short-term, the South Platte developed four goals and associated measurable outcomes to meet the large M&I water supply gap in the South Platte Basin⁵⁵:

- Continue the South Platte River Basin's leadership in wise water use.
 - Further quantify the successes of programs implemented in the past several years throughout the South Platte River Basin and establish a general baseline against which the success of future programs will be assessed.
 - Distribute and encourage adoption of "best management practices" as "guidelines" (not standards) for M&I water suppliers to consider in their "provider-controlled" programs recognizing the significant differences in climates, cultures, and economic conditions throughout the South Platte River Basin.
 - Maintain and enhance current levels of municipal water reuse and consider studies to quantify the effects of: 1) additional municipal water conservation on water available for reuse; 2) additional municipal water reuse in relation to water available for exchanges; 3) reuse and successive uses of water downstream including effects on agricultural water shortages.
 - Ensure conservation, reuse, and drought management plans take into consideration environmental and recreational focus areas and attributes.
- Bring a high percentage of entries in the updated IPP list online as a key strategy consistent with the "no/low regrets" scenario planning approach.
 - Maximize implementation of the updated IPP list.
 - Encourage projects that also provide environmental and recreational considerations.
 - Foster opportunities to improve environment and recreation conditions of affected watersheds in association with IPPs.
- To the extent possible, develop multi-purpose storage, conveyance, system interconnections, and other infrastructure projects to take advantage of limited remaining South Platte supplies and enhance water use efficiencies and supply reliability.
 - Explore opportunities to maximize yield from additional South Platte Basin strategic and multi-purpose storage and other infrastructure including collaborative inter-

- connections between water supply systems and above ground and groundwater (e.g. ASR) storage.
- Encourage multi-purpose projects that provide environmental and recreational considerations.
- Take into consideration environmental and recreational attributes when considering Storage and Other Infrastructure projects and methods.
- Develop agreements governing additional transbasin water imports that: 1) are in accordance with the South Platte Basin's overarching theme that economic, environmental, and recreational benefits should equitably accrue to both the western slope and the eastern slope; 2) include project(s) or project elements that provide multiple types of uses; 3) supported with State investment; and 4) provide enough certainty in conditions to significantly lessen current trends of traditional buy-and-dry transfers from agricultural uses to M&I uses.
 - Negotiate a conceptual agreement with the western slope basin roundtables on investigating, preserving, and developing potential options so that future multi-purpose projects benefiting both slopes can be addressed on a timely basis.
 - Encourage multi-purpose projects that provide environmental and recreational considerations.

Meeting the South Platte's M&I Gaps:

The Draft South Platte BIP developed a list of potential M&I projects, a conservation strategy, and some initial portfolio development to accomplish these goals and meet the identified M&I gaps.⁵⁶ The South Platte BIP used similar categories to the no and low regrets work described in Section 6.1 and a comparison is provided below:

- The BIP partially meets the no and low regrets goals associated with conservation. South Platte BIP applies 36 percent of Metro and 10 percent of South Platte active conservation savings plus all of passive savings to meet future needs in their portfolio work. Out of a total of 210,000 acre-feet of quantified potential savings, 110,000 acre-feet is passive, and another 50,000 acre-feet of active conservation savings is applied to future needs. A significantly higher percentage of active conservation would need to be applied to fully meet the no and low regrets goal of applying 197,000 acre-feet to meet new demands.
- The BIP partially meets the no and low regrets goals associated with having a high success rate for the IPPs, indicating a yield of 179,000 acre-feet compared to 199,000 acre-feet identified in the no and low regrets. The no and low regrets action assumed a higher success rate to the IPPs of about 70 percent, which includes planned reuse, agricultural transfers, in-basin projects, and planned cooperative transmountain diversions (see below). The South Platte BIP assumes a 60 percent success rate. In addition the BIP identified a total of six new projects (three for reuse, one agricultural transfer, and two in basin projects) that were not previously in SWSI 2010. However, the total amount of IPPs is nearly the same, because of decreases in the yields of other IPPs.
- The no and low regrets indicated that 22,000 acre-feet of reuse water would need to be generated from new agricultural diversions and any new transmountain diversion projects.

Although discussed in the South Platte BIP, no reuse from these new projects was calculated in the BIP's portfolio work.

- The no and low regrets action plan identified the need for 44,000 acre-feet of additional agricultural transfers was needed at a minimum, and states that these transfers should ideally be alternative agricultural transfers. The BIP identified 30,000 acre-feet of alternative agricultural transfer methods (ATMs). It also identified that with conservation applied to meet new demands, between 13,000 and 170,000 acre-feet of additional agricultural dry-up would be needed for portfolios B and C. Therefore, the BIP likely meets this no and low regrets goal.

Additional communication will be needed as the South Platte BIP is finalized to reconcile the broader level work that went into the no and low regrets work and the South Platte BIP work.



Southwest

The Southwest Basin faces a gap that could begin as early as 2015 in Montrose County.⁵⁷ Future needs in the Southwest Region are likely to increase by 20,000 to 31,000 acre-feet, and currently planned projects leave a municipal water supply gap within the Southwest region of 8800 to 16,000 acre-feet. This assumes that identified projects and processes are implemented at a relatively high success rate.⁵⁸

Southwest Goals and Measurable Outcomes:

To address this municipal gap, the Southwest BIP identified four goals related to meeting M&I needs. These goals and the associated measurable outcomes are below⁵⁹:

- Pursue a high success rate for identified specific and unique projects and processes to meet the municipal gap and to address all water needs and values.
 - Complete 41 IPPs aimed at meeting municipal water needs.
- Provide safe drinking water to Colorado's citizens and visitors.
 - Consistently meet 100 percent of residential, commercial, and industrial water system demands identified in SWSI 2010 in each sub-basin, while also encouraging education and conservation to reduce demand.
 - Implement at least 1 IPP that protects or enhances the ability of public water supply systems to access and deliver safe drinking water that meets all health-based standards.
- Promote wise and efficient water use through implementation of municipal conservation strategies to reduce overall future water needs.
 - Change the ratio of in-house to outside treated water use for municipal and domestic water systems (referred to as water providers herein) from the current ratio of 50 percent in-house use and 50 percent outside use, to 60 percent in-house use and 40 percent outside use (60/40 ratio) for Southwest Colorado and the entire state by 2030.
 - The water providers in the state that are using dry up of agricultural land (defined as requiring a water court change case) and/or pursuing a new transmountain

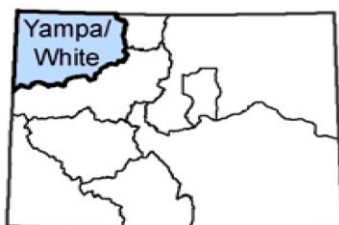
diversion (TMD) (as defined by IBCC to be a new western slope to eastern slope diversion project) shall have a higher standard of conservation. The goal for these water providers is a 70/30 ratio by 2030. This is a prerequisite for the roundtable to consider support of a new TMD.

- Support and implement water reuse strategies.
 - Implement three informational events about water reuse efforts, tools, and strategies.

Meeting the Southwest's M&I Gaps:

The Southwest BIP developed a list of potential municipal and industrial projects by interviewing providers in each sub-basin.⁶⁰ The Southwest BIP identified 37 new projects that would meet future municipal supply needs, and several others that would address other infrastructure needs within the basin. Of these projects, seven quantified acre-feet, totaling nearly 32,000 acre-feet. However, from the information provided it is not clear if each geographic region identified in the BIP will be able to meet its future needs if the listed projects are implemented.⁶¹

The Southwest Basin roundtable acknowledged that while not every identified project was quantified in the BIP, the projects and methods identified would fully meet their municipal and industrial water supply gap as well as the infrastructure needs of the basin.



Yampa/White/Green

The Yampa/White/Green Basin faces a gap that could begin as early as 2015 in Rio Blanco and Moffat Counties.⁶² Future needs in this northwest Colorado region are likely to increase by 34,000 to 95,000 acre-feet according to SWSI 2010. However, these needs must likely be revised downward since all indications are that oil shale will not become commercially viable by 2050.⁶³ Energy development from hydrologic fracturing is a new need that also should be taken into account when calculating the M&I water supply gap. With existing data, currently planned projects leave a municipal water supply gap within Colorado's northwest region of 24,000 to 83,000 acre-feet. This assumes that identified projects and processes are implemented at a relatively high success rate.⁶⁴

Yampa/White/Green Goals and Measurable Outcomes:

To address this M&I gap, the Yampa/White/Green BIP identified four goals related to meeting M&I needs. These goals and relevant measurable outcomes and processes are below⁶⁵:

- Protect and encourage agricultural uses of water in the Yampa-White-Green Basin within the context of private property rights.
 - Encourage and support M&I projects that have components that preserve agricultural water uses (process).
- Identify and address M&I water shortages.
 - Reliably meet 100 percent of M&I demands in the basin through the year 2050 and beyond through the following processes:

- Identify specific locations in the basin where M&I shortages may exist in drought scenarios, quantify the shortages in time, frequency, and duration.
- Identify impacts throughout the basin in the context of water shortages (drought and climate change), wildfire, and compact shortage on M&I demands.
- Identify projects and processes that can be used to meet M&I needs.
- Encourage collaborative multi-use storage projects.
- Support efforts of water providers to secure redundant supplies in the face of potential watershed impacts from wildfire.
- Encourage municipal entities to meet some future municipal water needs through water conservation and efficiency.

Meeting the Yampa/White/Green's M&I Gaps:

The Yampa/White/Green BIP conducted the most thorough analysis of how well implementation of future projects and methods would meet M&I needs. In addition, the BIP assessed these needs under a hot and dry future. Below is an excerpt from the BIP describing future shortage potentials:

Municipal Shortages:

M&I demands are small compared to agricultural demands in the YWB Basin. Under Baseline Conditions, no shortages exist to M&I demand nodes due to generally adequate water supply and augmentation from reservoirs.

While M&I shortages exist under the high demand, low water supply scenarios of the Dry Future IPP Scenario and the Dry Future Scenario, the shortages remain below 10%. Under both scenarios, District 43 Existing M&I in Rio Blanco County (Rangeley Water, Meeker Demand) and District 58 Existing M&I in Routt County (the City of Steamboat Springs) begin to exhibit shortages, whereas Moffat County municipal nodes do not show M&I shortages under either scenario. If IPPs are developed that include M&I use, shortages would likely decrease in locations with supply augmentation.

Industrial Shortages

Under Baseline Conditions, no shortages exist for Self-Supplied Industrial (SSI), which consist of thermoelectric power generation needs. Slight shortages exist for the Hayden Station and units 1 and 2 of Craig Station under the Dry Future IPP Scenario and the Dry Future Scenario. These scenarios meet thermoelectric demands with redundant water supplies from Steamboat Lake for Hayden Station and Elkhead and Stagecoach Reservoirs for Craig Station. The shortages occurred for both locations in a dry month in March 1961 but become nearly negligible (0.14% for Hayden Station and 0.12% for units 1 and 2 at Craig Station for both scenarios) when averaged over the 56-year period of record used in the P&M Study.

However, SSI water users consider their water supply short when they must rely upon redundant water supplies. For example, the years 2002, 2003, 2012, and 2013 were considered water supply short or borderline short by some SSI water users due to reliance on redundant supplies. Further discussions will take place on the most appropriate Baseline Conditions and the assessment of shortages in light of drought, climate change, and evolving power generation technologies.⁶⁶

Figure 6.2-1 Municipal, industrial, and agricultural shortages in a dry future with identified projects and processes implemented

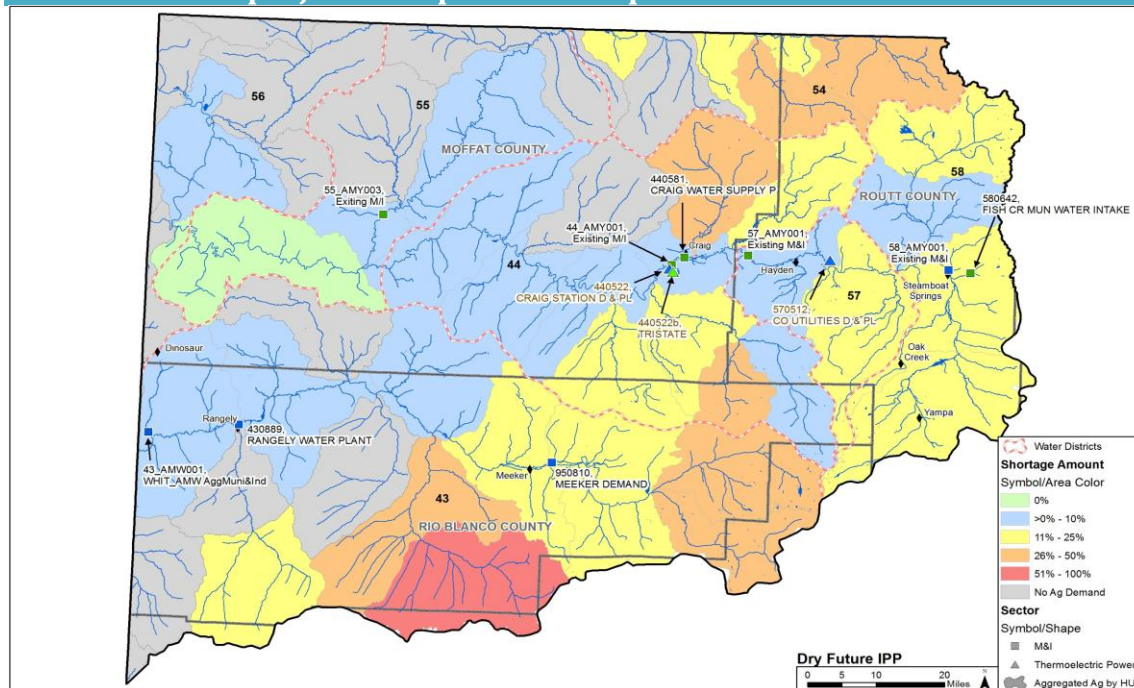


Figure 6.2-1 from the BIP demonstrates these shortages for all sectors in a dry future with projects and methods implemented.

Overall, the BIP modeled six projects and methods, including conservation in Steamboat Springs, which were not previously identified in SWSI 2010. Only projects that identified a project proponent, a location, physical characteristics, and operations were modeled. Most of the acre-feet quantified are associated with meeting the potential needs of the energy industry. The total newly quantified acre-feet adds up to 211,000 acre-feet to meet M&I needs.⁶⁷ Although the total acre-feet identified exceeds the M&I gap, when modeled, some shortages of up to 10 percent exist for several communities and a few power plants. The basin roundtable plans to complete the BIP by identifying “opportunities for additional multiuse projects,” adding them to the model, and then reassessing the results.⁶⁸ In conclusion, the BIP identified projects that mostly meet future M&I demands in Rangeley, Meeker, and Steamboat Springs, and fully meet future demands in Craig.

6.2.4 Meet Colorado’s Agricultural Needs

The agricultural gap is defined as the difference between what a basin indicates it wants to achieve with regard to agriculture, as defined in its goals and measurable outcomes, and what projects and methods it has determined could be implemented to meet those needs.⁶⁹ While every basin indicated that maintaining viable agriculture is one of the most important aspects of its BIP, this definition allows for considerable variability between basins, which face different issues related to agriculture.

Colorado's irrigated acres are expected to decline in almost every basin by 2050 (Figure 6.2-2), but these projected declines have differing causes. Similarly, every basin has agricultural shortages. The BIPs work to address these challenges by identifying projects that could reduce shortages, maintain the agricultural economy, and in some cases increase irrigated acres.

To address the challenges of shortages and declining irrigated acres, CWCB identified three statewide long-term goals⁷⁰:

- Ensure agriculture remains a viable economic driver in Colorado, supporting food security, jobs, and rural communities while maintaining and protecting private property rights.
- Meet Colorado's agricultural demands.
- Implement efficiency and conservation measures to maximize beneficial use and production.

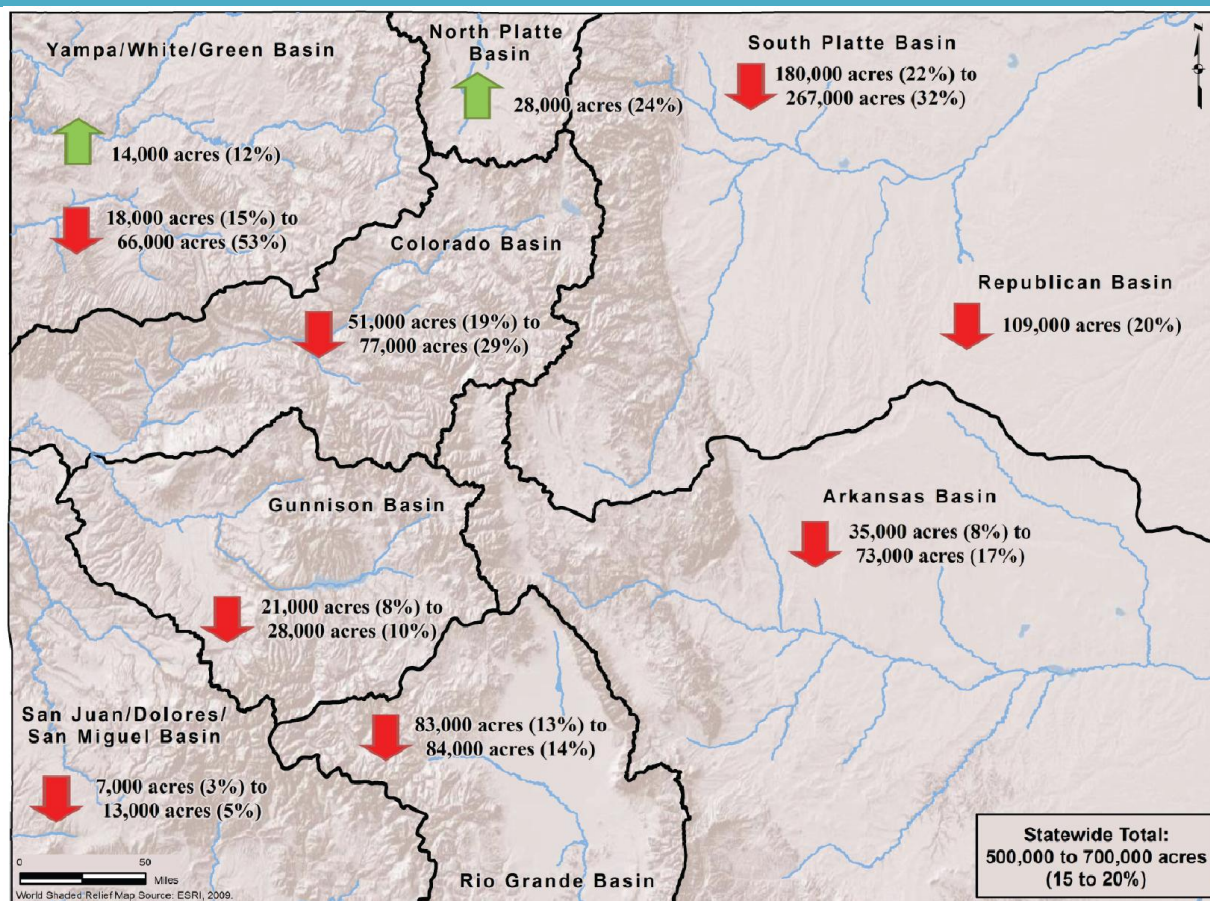
Prior to exploring how the BIPs developed solutions to meet these and other local goals, it is important to understand some of the statewide issues related to shortages and a decline in irrigated acres. Irrigated acres are expected to decline for three primary reasons⁷¹:

1. Urbanization of agricultural lands, which is primarily an issue in the South Platte and Colorado Basins;
2. Conversion of agricultural water rights to municipal rights to meet future municipal needs, which is mostly occurring in the South Platte, Colorado, and Arkansas Basins; and
3. Voluntary reductions in water use associated with sustainable groundwater supplies and meeting compact obligations, which is ongoing in the Rio Grande and Republican Basins.

Underlying many of the reasons for agricultural decline are temporary and downward state, national, and international agricultural economic trends. However, by 2050 the agricultural economy is expected to be increasingly viable because of a global increase in the number of people who need food, and also those who can afford high quality and high-protein agricultural products.⁷² The importance of Colorado's agricultural production is also vital locally. As described in Chapter 5, in some counties 50 percent of jobs are related to agriculture.

Figure 6.2-2 Potential changes in irrigated acres by 2050⁷³

(▲ = increase in irrigated acres; ▼ = decrease in irrigated acres)



From a statewide perspective, it is important to provide options and incentives that help maintain or even increase Colorado's agricultural economy and productivity in the face of losing irrigated acres. The difference between the status quo, which shows a reduction in irrigated acres in almost every basin (see figure 6.2-2), and the strategic position Colorado and the basins would like to be in from an agricultural perspective in 2050 is the "agricultural gap." Nevertheless, quantifying this prospective agricultural gap is difficult, resulting in many basins choosing to reduce agricultural shortages or find alternative sources of water so that the transfer of agricultural water is not the default solution to meet Colorado's growing needs.

Several basins discuss reducing shortages, and it is therefore important to understand how an agricultural shortage is defined. As described in the Gunnison BIP, agricultural shortages can be caused by three primary factors⁷⁴:

Physical shortages are due to lack of physical supply. Such shortages are often seen later in the irrigation season principally by irrigators on smaller tributaries. Though irrigation water rights may be in priority, there is not enough supply. Although these shortages are

exacerbated in dry years, on many of the tributaries physical flow is not sufficient to meet the CIR [crop irrigation requirement] for the entire growing season even in wet years.

Legal shortages are those due to lack of legal supply; there may be physical supply at a headgate, but it must be bypassed to meet downstream senior water rights. This type of shortage is often seen later in the season by irrigators with junior water rights in average and wet years, and may be the situation for junior irrigators the entire growing season in dry years.

Irrigation Practice “shortages” result from specific irrigation practices; the irrigator may have physically and legally available supply but chooses not to irrigate. For example, some irrigators may need to reduce or cease irrigation to allow the land time to dry prior to haying or grazing. In addition, an irrigator may cease diverting because there is not enough time left in the growing season for an additional cutting. Note, though this [is] a very different type of shortage, it is equally important to document. Identification of shortages related to irrigation practices helps to quantify the difference between CIR and actual consumptive use in SWSI and other statewide planning efforts. In addition, since irrigation practice shortages cannot be addressed by increased water supply, their identification helps to focus on the implementation of projects that meet physical and legal shortages.

Due to economic viability, irrigation practice “shortages,” and other factors, an agricultural shortage is not necessarily an agricultural gap. Colorado continues to have a healthy agricultural economy, despite shortages between 17 and 45 percent statewide.

This subsection reviews information by basin, and table 6.2-3 summarizes the success of each basin in meeting the agricultural gaps they defined through their goals.

Table 6.2-3: Summary of How Each Basin Met Its Agricultural Gaps

Basin	Irrigated Acres ⁷⁵	Shortage (AFY) ⁷⁶	Potential New AF	# of New Projects w/ AF Info	Summary of How BIPs Met Their Ag Goals / Gap
Arkansas	428,000	30,000 – 50,000 (augmentation gap) ^a	In process	0	Not sustain ag \$1.5B economy w/ actions, but establish tracking; not develop specific augmentation water projects; policies and projects support rotational fallowing, policies to support ag related rec and env. w/ cons easements
Colorado	268,000	100,000	453,000 – 483,000	41	Yes ↓ shortages; no specific efforts to develop incentives or ↓ urbanization and ag to urban transfers
Gunnison	272,000	111,000 ⁷⁷	123,000	16	Yes ↓ shortages, partially discourage

^a The Arkansas Basin roundtable aspires to maintain the agricultural economy in the basin, and does not identify the agricultural gap in terms of irrigated acreage. Under the Arkansas River Compact, consumptive use is limited, so the roundtable believes that a gap expressed in terms of an “augmentation gap” is a more appropriate evaluation of needs.

					transfer out of ag w/ policies
North Platte	117,000	89,000	12,000	12	↑ irrigated acreage to partially meet 17,000 acre goal; ↑ storage to partially meet 37,000 AF goal
Rio Grande	622,000	428,000	N/A	N/A	Yes, improve infrastructure; partially improve ag economy
South Platte	1,381,000 (831,000 SP, 550,000 Republican)	579,000 (379,000 SP, 200,000 Republican)	In process	0	Partially ↓ permanent dry up w/ conceptual ATMs & alternative sources, not ↓ urbanization or shortages
Southwest	259,000	198,000	7600	4	Partially ↓ shortages; Yes, ↑ efficiency w/ 10 IPPs; policy to minimize acres transferred, no ag sharing IPPs
Yampa / White / Green	119,000	54,000	54,000	5	↑ # of irrigated acres to partially meet 15,000 acre goal; partially ↓ shortages by 10%
TOTAL	3,466,000	1,589,000 – 1,609,000	537,000	61	



Arkansas

The Arkansas Basin has the third highest acreage of irrigated land in Colorado and the highest percentage of shortages as a basin (45 percent).⁷⁸ In addition, irrigated acres are likely to decline by eight to seventeen percent.⁷⁹ These declines are primarily because of agricultural transfers from both within the basin and from municipal interests in the South Platte Basin. However, as many as 3000 (1 percent) irrigated acres could be urbanized as well.

Arkansas Goals and Measurable Outcomes:

To address these pressures, the Arkansas BIP identified four goals related to sustaining agriculture.⁸⁰ These goals and the associated measurable outcomes are below:

- Sustain an annual \$1.5 billion agricultural economy in the basin
 - Increase in measured economic productivity by update of Colorado State University (CSU) Study in 2020.
- Provide increasing quantities of augmentation water for increased farm efficiencies
 - Document the baseline of current augmentation water available.
 - Track available storage facilities for augmentation sources.
- Develop a viable rotating fallow and/or leasing program between agriculture and municipal interests to address drought and provide agricultural risk management.
 - Report on pilot projects underway as of December 2015.
 - Complete and present report by December 2015.
 - Survey of permanently retired acreage as of Year 2020.
- Sustain recreational and environmental activities that depend on habitat and open space associated with farm and ranch land.

- Measure the economic contribution of tourism to the basin economy within the CSU 2020 update.
- Change of status for “protected” attributes as measured by nonconsumptive projects and methods in SWSI 2016 report.

Meeting the Arkansas' Agricultural Gap:

The primary goal is to support the \$1.5 billion agricultural economy in the face of agricultural loss.⁸¹ As the BIP indicates, a multi-pronged strategy is necessary:

“To maintain that level of economic productivity, projects and methods described in [the BIP] focus on development of rotating fallowing, conservation easements, and increased storage capacity to allow agricultural water to sustain agricultural productivity. In particular, a three-pronged approach to understanding rotational fallowing within the Prior Appropriation Doctrine is underway – an administrative and accounting tool, pilot projects and public policy dialogue – and will continue.”⁸²

However, the Arkansas Basin is still in the process of developing specific projects and methods that would address these goals; therefore, this basin does not yet meet its defined agricultural gap.



Colorado

The Colorado Basin has the fifth highest acreage of irrigated land in Colorado and the lowest percentage of shortages as a basin (17 percent).⁸³ In addition, irrigated acres are likely to decline by nineteen to twenty-nine percent.⁸⁴ These declines are primarily because of urbanization, which account for 65-80 percent of the loss, or 40,000 to 50,000 acres. The remaining agricultural loss is

due to agricultural to municipal transfers.⁸⁵

Colorado Goals and Measurable Outcomes:

To address these pressures, the Colorado BIP identified four goals related to sustaining agriculture.⁸⁶ These goals and the associated measurable outcomes are below:

- Reduce agricultural water shortages
 - Identify multi-purpose storage projects and methods that address the annual 100,000 acre-feet agricultural shortage
 - Maintain existing irrigated agricultural acreage
 - Research local agricultural shortage values in the Colorado River Basin
 - Improve Colorado water law to encourage agricultural water efficiency practices without harming water right value
 - Establish lease programs for excess water from existing supply projects in the M&I sector or multi-use projects
- Minimize potential for transfer of agricultural water rights to municipal uses
 - Identify farm improvements to develop strong sustainable farm economics

- Develop a set of quantifiable factors of agriculture pressures that can be measured and evaluated in the future to incentivize production and reduce trends towards transfers
 - Adopt local land use codes to conserve water and reduce pressures for agricultural water transfers
 - Promote conservation easements with the expected result that they will be more widely considered by the agricultural community
- Develop incentives to support agricultural production
 - Reimburse agriculture for value added to the environment including, water quality, wildlife, and views capes
 - Track effectiveness of agricultural incentives in maintaining irrigated acres
 - Minimize regulatory disincentives such as overly stringent requirements for reservoir construction
 - Reduce taxes for true self-sustaining agriculture
 - Develop incentives that encourage continued agricultural production
- Promote agricultural conservation that maintains agricultural production and viability
 - Revised Colorado Water Law to allow agricultural conservation and improved efficiency measures without impacting water right value or risk of abandonment
 - Strive towards a high level of conservation and efficiency within the agricultural industry

Meeting the Colorado's Agricultural Gaps:

The Colorado BIP identified 41 projects with quantifications of acre-feet that could reduce agricultural shortages in the basin by a total of 453,000 to 483,000 acre-feet. These projects could also meet M&I demands and, if implemented, could eliminate the 100,000 acre-feet of shortages in the basin. However, neither a spatial nor hydrological analysis has been done to confirm this. Furthermore, it is unclear how many of these projects are likely to be implemented as several do not have active project proponents. With regard to addressing agricultural losses due to urbanization, the BIP has several suggestions concerning land use. These could have an effect on reducing urbanization, but that effect has not been quantified in the BIP. In addition, the BIP states a need to promote other activities to minimize agricultural loss from water rights transfers, improve agricultural efficiency, and support agricultural production. More detail is needed to make these policies implementable.

In summary, the BIP most likely fully addresses the basin's agricultural shortages and partially addresses the other listed goals.



Gunnison

The Gunnison Basin has the fourth highest acreage of irrigated land in Colorado and the second lowest percentage of shortages as a basin (20 percent).⁸⁷ In addition, irrigated acres are likely to decline by eight to ten percent.⁸⁸ These declines are primarily because of urbanization, which could take 20,000 to 26,000

acres out of the production.⁸⁹

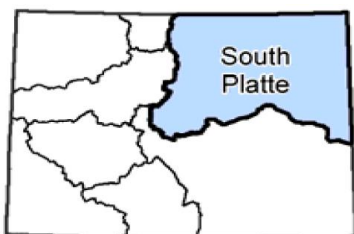
Gunnison Goals and Measurable Outcomes:

To address these issues, the Gunnison BIP identified two goals related to sustaining agriculture.⁹⁰ These goals and the associated measurable outcomes are below:

- Improve agricultural water supplies to reduce shortages
 - Reduce basin-wide agricultural shortages by developing 10 projects from the list of recommended solutions in the GBIP by the year 2030
 - Implement the Inventory of Irrigation Infrastructure Improvement Needs projects from the list of recommended solutions in the GBIP by 2020
- Discourage the conversion of productive agricultural land to all other uses within the context of private property rights.
 - Preserve the current baseline of 50,000 protected acres and expand by five percent by 2030

Meeting the Gunnison's Agricultural Gaps:

The Gunnison Basin roundtable identified 16 projects that it expects to be implemented in the near-term which, if implemented, would reduce shortages in the basin. In addition, there are infrastructure improvement projects which may not yield acre-feet, but will improve agricultural efficiencies. The Gunnison BIP also states a goal of protecting more irrigated acres. Currently, out of the 272,000 irrigated acres in the basin, 50,000 are protected through conservation easements and other heritage protection efforts. The Gunnison Basin roundtable would like to see another 2500 acres protected by 2030, and it is not clear if policies within the BIP will enable this to happen. Therefore, the BIP is considered to partially meet the second goal.



Metro/South Platte/Republican

The South Platte and Republican River Basins have the highest acreage of irrigated land in Colorado and the percentage of shortages in the region as a whole is 25 percent.⁹¹ In addition, irrigated land is likely to decline by 22 to 32 percent in the South Platte Basin and by 20 percent in the Republican Basin according to SWSI 2010.⁹² The South Platte BIP reexamined potential loss of irrigated lands in the South Platte Basin based on past trends, and indicated a range of 17 to 21 percent for the South Platte Basin.⁹³ These declines are primarily due to agricultural to municipal transfers, but urbanization is expected to account for six to seven percent of the loss, equivalent to 47,000 to 61,000 acres.⁹⁴ In the Republican Basin, the loss of over 100,000 irrigated acres is related to factors associated with sustainable groundwater and compact related issues.

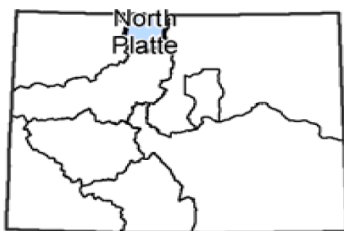
South Platte Goals and Measurable Outcomes:

To address these issues, the South Platte BIP identified one goal related to sustaining agriculture.⁹⁵ This goal and the associated measurable outcomes are below:

- Fully recognize the importance of agriculture to Colorado's future well-being, and support continued success and develop new voluntary measures to sustain irrigated agriculture.
 - Support strategies that reduce traditional permanent dry-up of irrigated land through implementation of other solutions including conservation, reuse, successful implementation of local IPPs, successful implementation of alternate transfer methods, and development of new Colorado River supplies.
 - Support strategies by municipalities and other local and state land use authorities that reduce loss of irrigated land from urbanization.
 - Support strategies to address agricultural water shortages through IPPs, new multi-purpose projects, and innovative measures to maximize use of available water supplies.
 - Develop local tools and political/community support for tools to sustain irrigated farmland.
 - Encourage maintenance of existing wetlands in focus areas associated with agricultural lands.
 - Ensure agricultural dry-up and alternatives take into consideration environmental and recreational focus areas and attributes.

Meeting the South Platte's Agricultural Gaps:

The BIP discusses several strategies to reduce agricultural shortages and minimize permanent agricultural losses. Conceptually, the BIP indicates that 30,000 acre-feet of future municipal demands could be met through alternative transfer methods (ATM). However, the BIP also lists several barriers to ATMs, which need to be overcome. In addition, the BIP discusses the need to preserve the option for developing additional transmountain diversion water, which would lessen the need for significantly more agricultural transfers to occur. There are no IPPs identified that explicitly address agricultural shortages. The BIP indicates the Basin roundtable would like to further investigate options surrounding land use, which could increase urban densities, and therefore reduce the number of agricultural acres that are urbanized. The BIP does not go into depth with regard to developing local political tools or ensuring that environmental and recreational values associated with agriculture are taken into account. Therefore, the BIP is considered to partially meet its goals and measurable outcomes.



North Platte

The amount of irrigated land in the North Platte Basin has declined since the Supreme Court's Equitable Apportionment Decree, which states that the North Platte in Colorado can continue to irrigate at those historical levels. The North Platte BIP has indicated an interest in irrigating more lands.⁹⁶

North Platte Goals and Measurable Outcomes:

To address this issue, the North Platte BIP has two goals related to sustaining agriculture.⁹⁷ These, along with the associated measurable outcomes are below:

- Maintain and maximize the consumptive use of water permitted in the Equitable Apportionment Decree and the baseline depletion allowance of the Three State Agreement.
 - Develop three projects from the list of recommended solutions by 2020.
 - Incrementally bring up to 17,000 additional acres under irrigation by 2050.
 - Develop 37,000 acre-feet of additional storage (doubling of current storage) by 2050.
- Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies.
 - Develop three projects from the list of recommended solutions by 2020.

Meeting the North Platte's Agricultural Gaps:

The North Platte identified 12 projects with estimates of acre-feet, acreage, or cubic feet per second. Six of the projects have water volume information, and half of these do not identify the associated increase in acreage that they would provide. It is estimated that approximately 12,000 acre-feet could be generated from these projects. Similarly, nine potential projects include information on the acreage that could be served, but six descriptions do not include how many acre-feet are associated with the projects. In sum, over 12,000 acres were identified in the BIP. It is assumed that the three projects without associated acreage would add to this number, but given the available data, approximately seventy percent of the North Platte BIPs goal to increase acreage is met. Additionally, there are several listed projects that work to restore, maintain, and modernize water infrastructure in the basin. However, the goal to increase storage by 37,000 acre-feet is only partially met by the BIP.



Rio Grande

The Rio Grande Basin has the second highest acreage of irrigated land in Colorado and the basin as a whole uses 67 percent of its crop irrigation water requirement.⁹⁸ Agriculture is the primary water use and is the base of the economy. At the same time, the water balance must be corrected to achieve sustainability between senior surface water rights and the more junior groundwater rights. In order to achieve sustainability and protect senior water rights, it is estimated that approximately 15 percent or 80,000 currently irrigated acres may be dried up. These issues are being addressed either by the new rules and regulations being developed by the State Engineer or the formation of groundwater management subdistricts.⁹⁹¹⁰⁰ The purpose of the rules and regulations is as follows:

The overall objective of this Subdistrict Plan is to provide a water management alternative to state-imposed regulations that limits the use of irrigation wells within the Subdistrict, that is, a system of self-regulation using economic-based incentives that promote responsible irrigation water use and management and insure the protection of senior surface water rights.¹⁰¹

Rio Grande Goals and Measurable Outcomes:

To address these issues, the Rio Grande BIP identified two goals related to sustaining agriculture.¹⁰² These goals and the relevant measurable outcomes are below:

- Operate, maintain, rehabilitate, and create necessary infrastructure to meet the basin's long-term water needs, including storage.
 - A database of existing water infrastructure including documentation of infrastructure condition including municipal and industrial facilities, storage reservoirs and major ditch diversions is created.
 - Reservoirs operate at full design capacity without restrictions.
 - Diversion structures and conveyance systems function optimally.
- Manage water use to sustain an optimal agricultural economy throughout the basin's communities.
 - The cultural heritage of agricultural water use in the San Luis Valley is recognized.
 - Agriculturally supported jobs are sustained.
 - Rangeland is maintained and improved.
 - Soil health is enhanced and soil loss is minimized on both farmland and rangeland.
 - Alternative agriculture practices that improve soil health and/or reduce consumptive use without impacting crop yields are supported and implemented to the extent practicable.

Meeting the Rio Grande's Agricultural Gaps:

As a result of Rio Grande Compact delivery requirements to downstream states and current unsustainable groundwater pumping, the Rio Grande seeks to better manage its agricultural water resources and economy with the formation of groundwater subdistricts that reduce pumping and sustain aquifer levels. Consequently, most of the 15 agricultural related projects analyzed in the Draft Rio Grande BIP do not have new acre-feet associated with them. Six of the projects identified in the BIP focus on monitoring, assessment, and planning. The storage improvement and expansion projects are largely focused on improved augmentation and administration opportunities that would help meet irrigation as well as environmental and recreational water needs. The Rio Grande Basin roundtable plans to continue to develop details for additional projects and methods for its final BIP. In summary, the Rio Grande's Draft BIP partially meets its defined agricultural gap, and this will be reassessed once additional projects and methods are analyzed.



Southwest

The basins in the Southwest have the sixth highest acreage of irrigated land in Colorado and the third highest percentage of shortages as a basin (34 percent).¹⁰³ In addition, irrigated acres are likely to decline by three to five percent.¹⁰⁴ These declines are primarily because of urbanization, although if Colorado River supplies are not available, some agricultural to urban transfers may be necessary.¹⁰⁵

Southwest Goals and Measurable Outcomes:

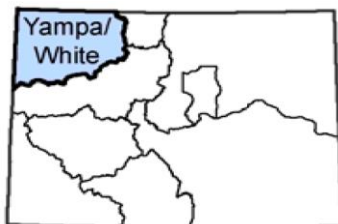
To address these issues, the Southwest BIP identified three goals related to sustaining agriculture.¹⁰⁶ These goals and the associated measurable outcomes are below:

- Minimize statewide and basin-wide acres transferred.

- Implement projects (e.g. ATMs, efficiency, among others) to help preserve agriculture and open space values, and to help address municipal, environmental, recreational, and industrial needs; while respecting private property rights.
- Implement strategies that encourage continued agricultural use and discourage permanent dry-up of agricultural lands.
- The water providers in the state that are using dry-up of agricultural land (defined as requiring a water court change case) and/or pursuing a new TMD (as defined by IBCC to be a new western slope to eastern slope diversion project) shall have a higher standard of conservation. The goal for these water providers is a ratio of 70 percent use occurs in-house while 30 percent use occurs outside (70/30 ratio).
- Implement efficiency measures to maximize beneficial use and production.
 - Implement at least 10* agricultural water efficiency projects identified as IPPs (by sub-basin).
- Implement IPPs that work towards meeting agricultural water supply shortages.

Meeting the Southwest's Agricultural Gaps:

The Southwest BIP contains an extensive IPP list that includes 10 agricultural water efficiency projects. In addition, it identifies four projects that have new acre-feet associated with them. These identified projects work toward reducing agricultural water supply shortages. As stated in the BIP, there are no identified projects that support agricultural sharing or implement strategies that discourage permanent dry-up of agricultural lands. This is because no agricultural transfers to meet future municipal needs are expected beyond urbanization of agricultural lands. Therefore, the BIP meets its defined agricultural gaps.



Yampa/White/Green

The Yampa, White, and Green River basins have the second lowest acreage of irrigated land in Colorado and the third lowest percentage of shortages as a basin (23 percent).¹⁰⁷ In addition, irrigated acres could either increase by twelve percent with adequate investment or decrease by 15 to 53 percent.¹⁰⁸ The potential loss of irrigated acres will be determined by whether oil shale or other energy interests grow into a large commercial industry and need to rely on agricultural transfers to meet their needs. Very few additional declines in irrigated acres are related to urbanization of agricultural lands.¹⁰⁹

Yampa/White/Green Goals and Measurable Outcomes:

To address these issues, the Draft Yampa, White, and Green BIP identified two goals related to sustaining agriculture.¹¹⁰ These goals and the associated measurable outcomes are below:

- Improve agricultural water supplies to increase irrigated land and reduce shortages.
 - Reduce agricultural shortages basin-wide by 10 percent by the year 2030.
 - Preserve the current baseline of 119,000 irrigated acres and expand by at least 14,805 acres.

- Protect and encourage agricultural uses of water in the Yampa-White-Green Basin within the context of private property rights.
 - Preserve the current baseline of approximately 119,000 protected acres and expand by 12.4 percent by 2030.
 - Encourage land use policies and community goals that enhance agriculture and agricultural water rights

Meeting the Yampa/White/Green's Agricultural Gaps:

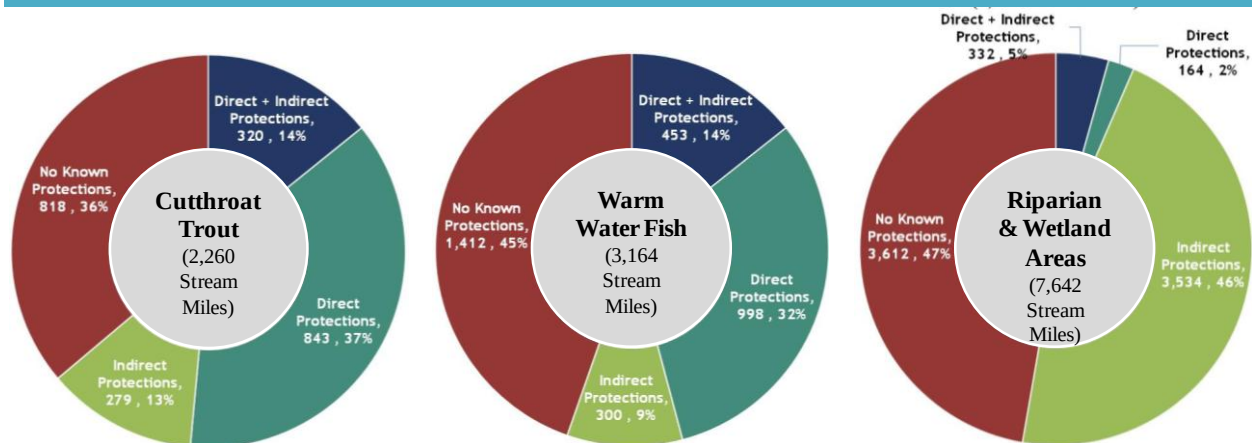
Figure 6.2-1 indicates the modeled level of shortages that still exist within the basin after the BIP's planned projects are implemented in a dry future. These projects not only include the agricultural projects, but also potential energy projects and some municipal projects. The planned energy project would meet much of the needs of a full-scale oil shale industry, and would therefore decrease the potential number of irrigated acres that would need to be transferred for industrial purposes. However, some of these projects could cause additional shortages in the basin, although shortages are significantly reduced in the Yampa River between Craig and Maybell. This area has some of the most significant agricultural land in the basin. In addition, the identified projects would help develop some of the additional acreage planned for in the BIP. While the document stresses the need for land use policies that support agriculture, no specific policies are identified. All in all, the BIP mostly meets its defined agricultural gaps, and the Basin roundtable plans to continue to refine this work for the final version.

6.2.5 Meet Colorado's Environmental and Recreational Needs

The water gap needed for environmental and recreational use is defined as the difference between what a basin indicates it wants to achieve with regard to meeting its environmental and recreational needs, as defined in its goals and measurable outcomes, and what projects and methods it has determined could be implemented to meet those needs.¹¹¹ While every basin indicated that meeting its environmental and recreational needs is an important aspect of its BIP, this definition allows for considerable variability between basins, which face different issues related to the environment and recreation.

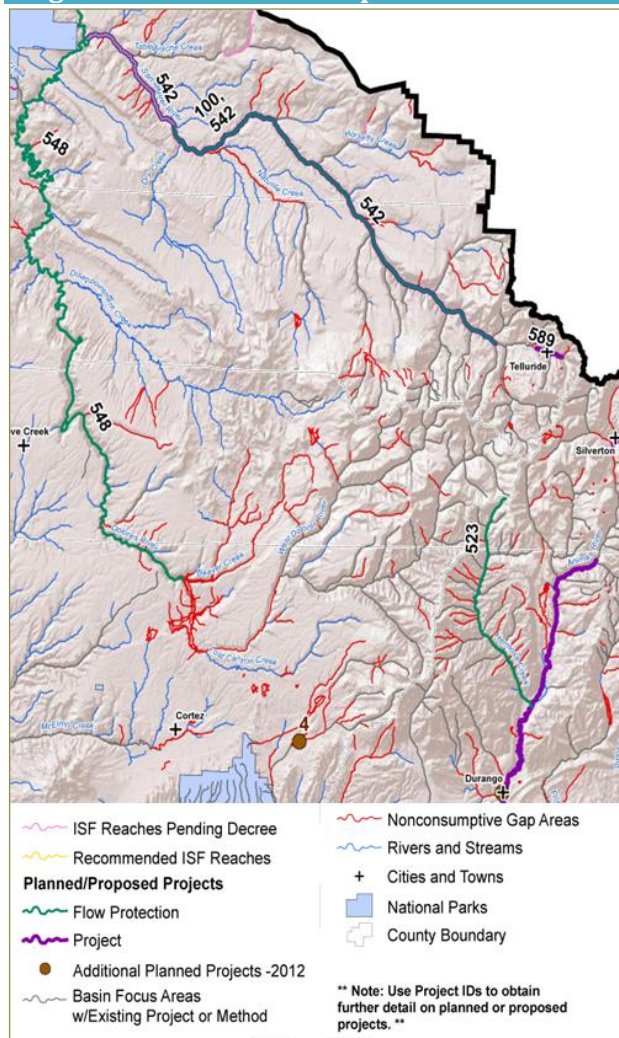
Colorado's environmental and recreational needs can be met through protection or restoration projects and methods. These projects and methods could have flow, habitat, water quality, species connectivity, or non-native species management components. In some cases, senior water rights holders help meet environmental and recreational needs upstream. Because of the diversity of projects and methods that can help the environment and recreation, the water gap is often measured in stream miles. With support from the CWCB, each basin roundtable developed focus area maps as part of their 2011 needs assessments. These indicate where significant species, recreational areas, and other environmental attributes are located. The CWCB then conducted a study to identify and determine the locations of existing and planned projects that meet the needs of some of the environmental and recreational focus areas identified by each basin roundtable. From this data, areas with no known protections can be identified, versus areas with some type of protection (see Figure 6.2-3). This information was mapped and included in the Nonconsumptive Toolbox and an example in the Southwest is shown on Figure 6.2-4.¹¹²

Figure 6.2-3: Percent of perennial stream miles statewide with protection for cutthroat trout species, warm water fish, and important riparian and wetland focus areas.



While not every area that has a project or method may be sufficiently protected, and not every stream reach within the focus areas needs protection, these maps provide a good starting point for

Figure 6.2-4: Nonconsumptive Toolbox



assessing the locations of potential environmental and recreational gap areas. CWCB is currently working to further refine this methodology and include the additional projects and methods identified in the BIPs.

To address the challenges in meeting the needs of the environment and recreation, the CWCB identified five statewide long-term goals to accomplish this work¹¹³:

- Promote Restoration, Recovery, and Sustainability of Endangered, Threatened, and Imperiled Aquatic and Riparian Dependent Species and Plant Communities
- Protect and Enhance Economic Values to Local and Statewide Economies Derived from Environmental and Recreational Water Uses, Such as Fishing, Boating, Waterfowl Hunting, Wildlife Watching, Camping, and Hiking
- Support the Development of Multi-Purpose Projects and Methods that Benefit Environmental and Recreational Water Needs as well as Water Needs for Communities or Agriculture
- Protect, Maintain, and Improve Conditions of Streams, Lakes, Wetlands, and

Riparian Areas to Promote Self- Sustaining Fisheries and Functional Riparian and Wetland Habitat to Promote Long-Term Sustainability

- Maintain Watershed Health – Protect or Restore Watershed that Could Affect Critical Infrastructure and/or Environmental and Recreational Areas

Each BIP addressed at least four out of five of these long-term goals. However, future work is needed to better determine how many stream miles the new projects and methods cover and how to strategically address these long-term goals. In addition, several of the BIPs indicate that there is still a significant information gap in relation to understanding environmental and recreational needs and gaps as well as what projects could address these gaps.

Table 6.2-4 summarizes the BIP work associated with meeting each basin roundtable's environmental and recreational needs, along with perennial stream miles of the environmental and recreational focus areas. These were derived from the USGS national hydrologic database.

Table 6.2-4: Summary of f How Each Basin Meets Its Environmental and Recreational Gaps

NOTE: The % of streams with no known protections do not represents gaps for specific species or plant communities, which may be larger.

Basin	Focus Area Perennial Stream Miles	No. of Perennial Stream Miles w/ No Known Protections	Number of New Projects w/ Stream mile Info	Quantified Stream Miles w/ New Projects or Methods	Summary of How BIPs Met Their Environmental and Recreational Goals / Gap
Arkansas	3,124	1,372 (44%)	1	3	The Arkansas is still in progress
Colorado	1,762	844 (48%)	3	32	Partially through support of projects and methods; not identify new funding source or how establish regional cooperatives
Gunnison	1,106	270 (24%)	0	None identified	Yes, identified: 10 projects to be implemented, 5 multi-purpose projects, support cutthroat trout conservation strategy; explored some alternative funding sources
Metro/South Platte	959	325 (34%)	2	2.5	The Metro/South Platte Basin roundtables are still in progress
North Platte	954	231 (24%)	0	None identified	Mostly, identified more than 3 environmental and 2 multi-purpose projects to be implemented; likely increases fishing, waterfowl hunting & viewing by 5% if implemented
Rio Grande	2,735	397 (15%)	1	5	Partially through project implementation, but quantification of how meet goals and measurable outcomes not performed until final
Southwest	2,433	1,009 (41%)	6	183	Partially through project implementation, and further

					quantification of how meet goals and measurable outcomes will be provided
Yampa / White / Green	485	155 (32%)	0	None identified	Mostly, quantifies and determines many projects that would support the current PBO on the Yampa, new PBO on the White, warm water fish, riparian areas, and recreational boating; integrates consumptive and env. and rec. interests
TOTAL	13,557	4,602 (34%)	13	225.5	



Arkansas

In the 2011 Needs Assessment, the Arkansas Basin roundtable identified 342 perennial stream miles with Arkansas darter, 371 with greenback cutthroat trout, and 1811 of important riparian and wetland areas. Very few of the perennial stream miles with Arkansas darter are protected. However, two-thirds of greenback cutthroat trout stream miles have some level of protection, whether direct or indirect. Approximately one-third of riparian and wetland areas identified by the basin roundtable have some level of protection, and most of those are indirect protections. In addition, 57 percent of the identified fishing areas and 22 percent of the identified waterfowl hunting and view areas have some level of protection.

Arkansas' Environmental and Recreational Goals:

To address their environmental and recreational needs, the Arkansas BIP established seven goals¹¹⁴:

- Preclude federal endangered listing of native fish
- Restore state imperiled fish species populations
- Maintain, improve and increase recreational fishing opportunities
- Maintain and restore riparian habitats
- Maintain important avian areas associated with water
- Maintain and restore wetlands
- Maintain, improve, and increase flat water recreation

Meeting the Arkansas' Environmental and Recreational Gaps:

The Arkansas BIP indicates that the environmental and recreational components of the plan are incomplete. This work will be completed by finalization of the BIPs, and whether the BIP meets their environmental and recreational gaps will be assessed at that point in time.



Colorado

In the 2011 Needs Assessment, the Colorado Basin roundtable identified 676 perennial stream miles with Colorado River

cutthroat trout, and 435 with imperiled warm water fish, including the endangered fish species. An additional 1098 perennial stream miles of important riparian and wetland areas were also identified. A full two-thirds of the warm water fish species stream miles have some level of protection, with much of it direct protection. Three-quarters of Colorado River cutthroat trout stream miles also have some level of protection. Similarly, approximately three-quarters of riparian and wetland areas identified by the basin roundtable have some level of protection; however, most of these protections are indirect. In addition, over 90 percent of the identified fishing areas have direct protection.

Colorado's Environmental and Recreational Goals:

To address their environmental and recreational needs, the Colorado BIP developed the theme to *protect and restore healthy streams, rivers, lakes and riparian areas* and identified five goals. These goals and the associated measurable outcomes are listed below¹¹⁵:

- Protect and rehabilitate healthy rivers, streams, lakes, and riparian areas
 - A map depicting high priority reaches that have insufficient or poorly timed flows (e.g., 15-Mile Reach, 303(d) impaired streams, instream flows, monitoring and evaluation reaches, ecological impacted, recreational significant, reaches with existing dams
 - Map or list of reaches where habitat has deteriorated as a result of non-flow related changes and could be restored
 - Improve habitat conditions in all identified prioritized reaches in exchange for harm caused by existing or additional water development
 - Reduce the number of river miles where non-native invasive fish and invasive riparian species have degraded aquatic and riparian communities
 - Identify reaches where additional flows can restore degraded rivers
- Define water quality needs and at-risk water bodies (further described in Section 7.3)
- Preserve high quality recreational river and stream reaches with appropriate flows
 - Maintain number of boater days on 28 reaches identified as recreation priorities by American Whitewater in cooperation with the WFET work
 - Protect access and flow levels to 28 popular recreational reaches
 - Develop more Recreational in-Channel Diversions (RICDs) structures and water rights on community and basin supported reaches to protect recreational flows
- Develop a basin-wide funding system to meet basin environmental and recreational needs
 - Establish a new funding agency or identify existing agency for the basin or in every county in the basin to fund environmental and recreational management
 - Leverage existing financial resources to further protect or restore all streams, rivers, and lakes that host prioritized recreational or natural attributes (determine source and scope of funding)
 - Fund the acquisition of conservation easements that retain agricultural purposes and current uses of water
- Expand regional cooperation efforts to improve efficiency, provide water supply flexibility, and enhance environmental and recreational amenities

- Establish regional water provider, ditch company and environmental and recreational advocate cooperatives focused on improving regional relationships, water supply redundancy and flexibility, water quality, coordinated efforts for multi-beneficial projects and addressing environmental and recreational needs
- Increase permanent interconnects between water providers where feasible

Meeting the Colorado Basin's Environmental and Recreational Gaps:

The BIP identified 59 projects that are explicitly environmental and recreational projects. In addition another 13 address recreational needs and an additional 13 that address water quality. Many of these are associated with the Colorado River Cooperative Agreement and the Windy Gap Firming Intergovernmental Agreement. Of these approximately two thirds are new projects and methods.

The BIP recognizes that a basin-wide stream management plan is a top priority needed to better determine how to advance projects necessary to strategically meet the identified needs. The BIP states, "From this effort projects could be identified, funded and completed across the Basin, between watersheds and across county lines to make lasting impacts to our streams, riparian areas and overall ecosystem. A project champion needs to be determined as well as funding sources and identified metrics."¹¹⁶

The BIP further contends that that "all basins statewide must have a number one priority of protecting and improving the health of our rivers and streams."¹¹⁷

At this point in time, it is not clear if the dozens of projects identified would adequately address the environmental and recreational goals and measurable objectives identified, but these projects would at least partially meet the BIPs objectives and a streamflow management plan, if implemented, would likely meet all of the objectives. One of the outstanding issues identified by the BIP is the development of a new funding source within the basin.

Gunnison

In the 2011 Needs Assessment, the Gunnison Basin roundtable identified 142 perennial stream miles with warm water fish species, including federally-listed species. Of these, more than 80 percent have some level of protection, and most of these stream miles have one or more forms of direct protection. All of the identified 173 perennial stream miles with Colorado River cutthroat trout have some level of protection, with approximately two-thirds of these miles including direct protection. Nearly 90 percent of the 800 miles of identified perennial stream miles with important riparian and wetland areas have some level of protection as well. However, nearly all of these methods of protection are indirect.



Gunnison Basin's Environmental and Recreational Goals:

To address its environmental and recreational needs, the Gunnison BIP identified two goals, which are listed below, along with the associated measurable outcomes¹¹⁸: In the 2011 Needs Assessment, the Gunnison Basin roundtable identified 142 perennial stream miles with warm water fish species, including

federally-listed species. Of these, more than 80 percent have some level of protection, and most of these stream miles have one or more forms of direct protection. All of the identified 173 perennial stream miles with Colorado River cutthroat trout have some level of protection, with approximately two-thirds of these miles including direct protection. Nearly 90 percent of the 800 miles of identified perennial stream miles with important riparian and wetland areas have some level of protection as well. However, nearly all of these methods of protection are indirect.

- Quantify and protect nonconsumptive water uses.
 - Meet identified environmental and recreational needs basin-wide by developing 10 projects from the list of recommended solutions in the Gunnison BIP by the year 2030
 - Implement the Environmental and Recreational Project Identification and Inventory projects from the list of recommended solutions in the Gunnison BIP by 2020
 - Improve the current baseline of native trout and endangered fish populations in the Gunnison Basin through the year 2050
- Describe and encourage the beneficial relationship between agricultural, environmental, and recreational water uses
 - Complete at least five new multi-purpose water projects, including two storage projects, in the Gunnison Basin by 2025 that meet multiple needs as identified in this report and other studies
 - Explore and develop recommendations on alternative sources of funding from recreational users within the basin to support development of those multi-purpose water projects

Meeting the Gunnison Basin's Environmental and Recreational Gaps:

The BIP reexamined their environmental and recreational needs, and added eight focus segments. Within those segments, the BIP explored how well existing programs support the Colorado River Recovery Program for endangered fish species, cutthroat trout and the three imperiled warm water fish species: bluehead sucker, flannelmouth sucker, and roundtail chub.

The BIP indicated that it supports the ongoing recovery program and the reoperation of the Aspinall Unit to meet environmental flow requirements to support these species. This reoperation was first tried in 2014, and will continue to be monitored and adapt to the needs of the endangered fish species. The BIP highlights that non-native fish species are the most significant cause for concern in the Gunnison Basin and recommends “that Colorado explore a must-kill policy for nonnative fish control.”

The BIP indicated that the ongoing work associated with the Colorado River Cutthroat Trout Conservation Strategy adopted by Colorado, Utah, and Wyoming, was likely sufficient to meet cutthroat trout habitat needs.

There is an interstate Three Species Agreement in place to protect the three warm water fish species, and Colorado Parks and Wildlife is in the process of developing a State Strategy. As part of this work, “it is imperative that fishery managers work with water managers to continue to implement the actions articulated in the Three Species Agreement. In the Gunnison, flow protection

provided by downstream senior water rights (e.g., the Redlands Water and Power Company water rights) become an important means of maintaining the native fishery.”¹¹⁹

In addition to these ongoing efforts, the BIP identified several additional efforts. Out of the 38 projects and methods assigned to tier 1, which are planned to be completed by 2020, 14 have nonconsumptive components that meet one or more of the BIPs identified environmental and recreational goals. The BIP also identified 17 important ongoing environmental and recreational protection and monitoring projects that meet one or more of the goals. Included in the tier 1 projects are many studies that would further develop additional nonconsumptive projects to meet each regions need. The BIP identified several types of projects that could be implemented while preserving existing agricultural uses. These include¹²⁰:

- Diversion infrastructure improvements that increase accuracy and reduce maintenance costs while preserving stream connectivity
- Temporary and voluntary instream flow leasing arrangements that sustain flows during critical drought periods
- Voluntary partial instream flow donations that maintain historical irrigation practices on a more limited basis
- Multi-purpose storage projects that include operational flow agreements and/or dedicated environmental and recreational flow components

In summary, if the BIP is fully implemented, the goals and measurable outcomes would be fully satisfied, and the Gunnison Basin would meet its environmental and recreational gaps.



North Platte

In the 2011 Needs Assessment, the North Platte Basin roundtable identified 222 perennial stream miles with important fishing areas as the roundtable’s top priority. Approximately one-third of these miles have some direct protection, and the remaining stream miles have no known protections. There are 93 miles of perennial streams with waterfowl hunting and viewing, 45 percent of which have some form of direct protection. Over a quarter of the 220 miles of identified perennial stream miles with important riparian and wetland areas have some level of protection as well.

North Platte Basin’s Environmental and Recreational Goals:

To address its environmental and recreational needs, the North Platte BIP identified two goals. These goals and the associated measurable outcomes are below¹²¹:

- Maintain healthy rivers and wetlands through the strategic implementation of projects that meet prioritized nonconsumptive needs.
 - Increase fishing user days by five percent by 2020.
 - Increase waterfowl hunting and viewing days by five percent by 2020.
 - Develop three projects from the list of recommended solutions by 2020.
- Describe and quantify the nonconsumptive benefits of agricultural use.

- Complete at least two new multi-purpose water projects in the North Platte Basin by 2025 that meet multiple needs as identified in this report and other studies.

Meeting the North Platte Basin's Environmental and Recreational Gaps:

To better determine where the Basin roundtable should focus its efforts, the BIP developed a weighted attribute map. The map takes into account both the number of attributes and the priority rank given by the Basin roundtable during the needs assessment process. The BIP states "This map will be used to help target projects to address identified environmental and recreational attributes in the basin, including both multi-purpose projects and specific environmental and recreational projects."¹²²

The BIP identified 49 planned environmental and recreational projects, three of which are multi-purpose. Out of the list of potential projects, the BIP developed project summaries and methods for 14 projects. Of these, five help maintain healthy rivers and wetlands, and four of these projects also demonstrate the connection between agricultural, environmental, and recreational values. The BIP describes these projects as follows:

The projects include reservoir improvements to preserve a major water supply for the maintenance of habitat at the Arapahoe National Wildlife Refuge, the improvement of a major diversion structure to address fish connectivity while addressing other water user needs, improvement of fisheries habitat at State Wildlife Areas (public access fishing), and two inventory projects that could help identify other multi-purpose project opportunities.¹²³

All in all, if implemented, the BIP would address the measurable outcomes that together call for five projects that meet nonconsumptive needs. It is not clear if these projects will reach the fishing and waterfowl hunting targets identified by the BIP. However, the BIP mostly meets its identified environmental and recreational gaps.



Rio Grande

In the 2011 Needs Assessment, the Rio Grande Basin roundtable identified 564 perennial stream miles with Rio Grande chub, an imperiled fish species. Fifty four percent of the stream miles have some level of protection, most of which is direct. Another warm water imperiled fish species is the Rio Grande sucker, which is listed as state endangered. Over 60 percent of the 346 perennial stream miles that support this species have some level of protection, though more than half of it is indirect. Nearly 40 percent of the identified 748 perennial stream miles with Rio Grande cutthroat trout have some level of protection, although most of this protection is indirect. As of October 2014, the U.S. Fish and Wildlife Service determined that the Rio Grande cutthroat trout is not warranted for listing as "endangered," and ongoing, extensive recovery efforts will continue for this species. Similarly, just over 40 percent of the 2138 miles of identified perennial stream miles with important riparian and wetland areas have some level of protection, with most of it direct.

However, in the course of the BIP planning process, the Rio Grande's Environmental and Recreational Subcommittee chose to expand beyond the attributes previously identified in 2011

and undertake a more comprehensive approach that utilizes updated geographic information system (GIS) layers to determine where key environmental and recreation components exist, to better determine their extent and conditions, to identify where measures are in place to protect or restore those components, and identify where action needs to be taken. Using these methods, the subcommittee has worked to identify the priority environmental and recreational attributes that are in need of additional protection, restoration, or management.

For longer-term projects and methods, the Environmental and Recreational Subcommittee will continue to inventory, update, and quantify environmental attributes in relation to water needs. Through this process, the group will define and update maps of environmental and recreational focus areas in the Rio Grande Basin and develop strategies to address needs and sustain their attributes.

The BIP also indicates that the San Luis Valley has approximately 200,000 acres of internationally important wetlands that provide critical habitat for endangered bird species as well as large numbers of migrating birds and water fowl.

Rio Grande Basin's Environmental and Recreational Goals:

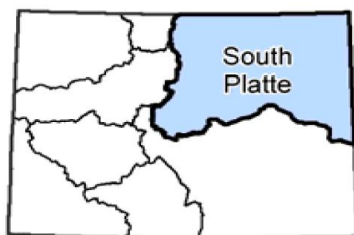
To address its environmental and recreational needs, the Rio Grande BIP identified four goals. These goals and the associated measurable outcomes are below¹²⁴:

- Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the basin.
 - Species that are listed by either the federal or state government as threatened, endangered, or candidate species are recovered or de-listed.
 - Additional species are prevented from being listed by the federal or state government.
 - Economic impact studies for environmental and recreational benefits are considered in the decision-making process for new water supply projects.
 - Wildlife habitat needs are considered in the decision-making process.
 - Natural resource agencies in the San Luis Valley (Rio Grande) coordinate and cooperate with each other to comply with the groundwater rules and regulations and augmentation plans to benefit wildlife and recreation to the largest extent possible.
 - Water needs for wildlife habitat are addressed in plans, databases and San Luis Valley-wide surveys of appropriate wildlife populations.
- Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.
 - Identify the needs for properly functioning wetlands and riparian areas.
 - Restore the ecological function of wetlands and riparian areas.
 - Develop and implement projects to restore, conserve, and sustain functioning wetlands, riparian areas, and associated habitats with a focus on incorporating species connectivity.

- Work to establish active river flows throughout the year in cooperation with water users and administrators to restore and sustain ecological function of the rivers and floodplain habitats within the context of existing water rights and compact obligations.
 - Negotiate active plans and cooperative agreements that enhance streamflows through re-operations while ensuring full compliance with Colorado water law.
- Maintain and enhance water dependent recreational activities.
 - Floatable flow levels are identified by reach.
 - Cooperative water management provides flows to extend recreational opportunities.
 - Recreational facilities are improved and/or enhanced.
 - Quality and quantity of fishing opportunities are improved. Fish and boat passages are installed where appropriate.
 - Conservation pools are rehabilitated, secured and/or conserved as possible.
 - Quality and quantity of hunting (e.g., waterfowl, small game, and big game) opportunities are improved.
 - Fish hatcheries have sustainable, secure, and adequate physical and legal water supplies.
 - Recognize economic benefits of recreation in decision-making processes.

Meeting the Rio Grande Basin's Environmental and Recreational Gaps:

Out of the 18 projects analyzed in the Rio Grande BIP, 12 projects help meet the goals identified above. In addition, the BIP will analyze an additional eight projects that address environmental and recreational information gaps, which will further clarify the environmental and recreational gaps. At this point in time, the BIP partially meets its environmental and recreational water gaps.



South Platte (including Metro and Republican)

In the 2011 Needs Assessment, the South Platte and Metro Basin roundtables identified 628 perennial stream miles with warm imperiled plains fish species; approximately two-thirds of which have some level of protection. 90 percent of the 79 perennial stream miles identified with greenback cutthroat trout have some level of protection, although more than half of this protection is indirect. Approximately half of the 628 miles of identified perennial stream miles with important riparian and wetland areas have some level of protection, most of it direct. In addition, approximately half of the important fishing areas identified and one-third of the waterfowl hunting and viewing stream miles have some level of protection.

South Platte Basin's Environmental and Recreational Goals:

To address its environmental and recreational needs, the South Platte BIP developed a goal, which along with the associated measurable outcomes is listed below¹²⁵:

- Fully recognize the importance of, and support the development of, environmental and recreational projects and multi-purpose projects that support water availability for ecologically and economically important habitats and focus areas.
 - Promote Restoration, Recovery, and Sustainability of Endangered, Threatened, and Imperiled Aquatic, Riparian and Wetland Dependent Species and Plant Communities:
 - i. Maintain or increase the habitat for federally- and state-listed threatened and endangered species or plant communities.
 - ii. Maintain or increase habitats in the nonconsumptive focus areas with imperiled species or plant communities and secure the species in these reaches to the extent possible within the existing legal and water management context.
 - iii. Maintain or increase the wetland, lake, or stream habitat used by migratory and breeding birds.
 - Protect and Enhance Economic Values to Local and Statewide Economies Derived from Environmental and Recreational Water Uses, Such as Fishing, Boating, Waterfowl Hunting, Wildlife Watching, Camping, and Hiking
 - i. Maintain or increase the surface area, stream miles, or public access for recreational opportunities of high economic value.
 - ii. Maintain or increase the miles and general appearance of trails and greenways to promote aesthetic values and enhance quality of life.
 - iii. Maintain or increase public access to fishing opportunities in lakes and streams.
 - iv. Maintain or increase the total area for birding, waterfowl hunting, and wildlife viewing.
 - v. Maintain or improve the amount of river miles or flatwater surface acres available to river and flatwater boaters.
 - Protect, Maintain, and Improve Conditions of Streams, Lakes, Wetlands, and Riparian Areas to Promote Self-Sustaining Fisheries and Functional Riparian and Wetland Habitat to Promote Long-Term Sustainability
 - i. Maintain or increase the number of stream miles or surface area of streams, lakes, wetlands, and riparian areas for self-sustaining aquatic species populations, and wetland/riparian habitat.
 - ii. Maintain or improve fish habitat by providing habitat enhancements, eliminating dry up points, and promoting connectivity.
 - iii. Maintain or improve watershed health through source water protection, wildfire mitigation, sedimentation control, and erosion control.
 - iv. Encourage existing and develop new innovative tools to protect instream flows where appropriate.

Meeting the South Platte Basin's Environmental and Recreational Gaps:

Through the basin roundtable process, the BIP identified seven additional focus area reaches that were added to the basin needs assessment maps. This work expands the number of areas where a focus on addressing environmental and recreational needs is important. The BIP also assessed

dry-up points within the South Platte Basin, identifying 15 areas that experience no flows during some years at some points in time. These dry up points affect species connectivity and habitat.

To determine the types of projects needed to address these environmental and recreational concerns, the BIP assessed the types of projects needed in the following regions:

1. Headwater areas (Upper Mountain area)
2. Metro Corridor
3. Boulder/Fort Collins (Northern Area)
4. Plains (Lower South Platte)

For each of these regions a suite of project types (e.g., instream flows, stewardship projects, species reintroduction, fish passages, modification or improvements to dry-up points or diversion structures that inhibit fish passage, stewardship programs, and instream flow programs with water rights components which dedicate historic consumptive use to a downstream user while improving streamflows within a reach of concern) were developed and the number of miles with existing or planned protections was assessed.

To move forward with addressing the South Platte Basin's environmental and recreational needs, several recommendations are provided throughout the BIP. Some of these include [4]:

- Proactively pursue projects to maintain and enhance the recreational and environmental attributes in the South Platte Basin.
- Ensure that environmental and recreational attributes are protected or potentially enhanced by multi-purpose and collaborative projects through cooperation with M&I and agricultural users.
- Work to meet the M&I gap, while minimizing the impacts to agricultural uses, while also providing protections and enhancements to environmental and recreational attributes in candidate focus areas.
- Provide reliable funding sources to assist with environmental and recreational projects, which is essential for projects to move forward. Some of these funding sources include assisting with a portion of the funding needed for multi-purpose projects so that environmental and recreational stakeholders can be a partner on such projects.
- Further develop, investigate, and document projects and methods and the presence and sufficiency of those projects and methods to enhance and protect environmental and recreational attributes.

The South Platte and Metro Basin roundtables have a grant to continue further developing the environmental and recreational components of their BIP. They plan to address several data gaps and further explore projects that could meet the needs of the basin. The current draft partially meets the environmental and recreational gaps identified through the goals and measurable outcomes process.



Southwest

In the 2011 Needs Assessment, the Southwest Basin roundtable identified 834 perennial stream miles with imperiled warm water fish species, including the flannelmouth sucker, bluehead sucker, and roundtail chub. CWCB's work in 2011 indicates that nearly two-thirds of these stream miles have or plan to have some level of protection, although most of these are indirect. Approximately 70 percent of the identified 178 perennial stream miles with Colorado River cutthroat trout have some level of protection, and most of this protection is also indirect. Just fewer than 60 percent of the 762 miles of identified perennial stream miles with important riparian and wetland areas have some level of protection, all of which is direct. The Needs Assessment report also identified various forms of recreation, such as fishing, waterfowl hunting, and viewing. Very few stream miles have identified protections for these values.

Southwest Basin's Environmental and Recreational Goals:

To address its environmental and recreational needs, the Southwest BIP identified three goals. These goals and the associated measurable outcomes are below¹²⁶:

- Maintain, protect, and enhance recreational values and the value to local and statewide economies derived from recreational water uses such as fishing, boating, hunting, wildlife watching, camping, and hiking.
 - Implement 10 IPPs to benefit recreational values and the economic value they provide.
 - At least 80 percent of the areas with recreational opportunities have existing or planned IPPs that secure these opportunities and supporting flows/lake levels within the contemporary legal and water management context. Based on the map of recreational attributes generated for SWSI 2010, 80 percent of each specific value equates to approximately 428 miles of whitewater boating, 185 miles of flat- water boating, 4 miles of Gold medal Trout Streams, 545 miles of other fishing streams and lakes, 3 miles of Audubon Important Bird Area, 143 miles of waterfowl hunting/viewing parcels, and 6 miles of Ducks Unlimited projects.
 - Address recreational data needs.
- Encourage and support restoration, recovery, and sustainability of endangered, threatened, and imperiled aquatic and riparian-dependent species and plant communities.
 - Implement 15 IPPs to directly restore, recover, or sustain endangered, threatened, and sensitive aquatic and riparian-dependent species and plant communities.
 - At least 95 percent of the areas with federally-listed water dependent species have existing or planned IPPs that secure the species in these reaches to the extent possible within the existing legal and water management context.
 - At least 90 percent of areas with identified sensitive species (other than Endangered Species Act species) have existing or planned IPPs that provide direct protection to these values. Based on the map of environmental attributes generated for SWSI 2010, this 90 percent of areas with identified sensitive species equates to individual species as approximately 169 miles for Colorado River cutthroat trout, 483 miles for

roundtail chub, 794 miles for bluehead sucker, 700 miles for flannelmouth sucker, 724 miles for river otter, 122 miles for northern leopard frog, 921 miles for active bald eagle nesting areas, and 229 miles for rare plants.

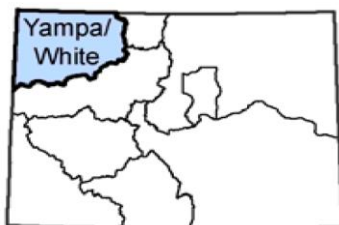
- Protect, maintain, monitor, and improve the condition and natural function of streams, lakes, wetlands, and riparian areas to promote self-sustaining fisheries, and to support native species and functional habitat in the long-term, and adapt to changing conditions.
 - Implement 26 IPPs to benefit the condition of fisheries and riparian/wetland habitat.
 - At least 80 percent of areas with environmental values have existing or planned IPPs that provide direct protection to these values.

Meeting the Southwest Basin's Environmental and Recreational Gaps:

The Southwest BIP identified six environmental and recreational projects and methods that included stream mile information, which cover over 180 miles of stream. This is a subset of the 71 projects identified; however the Southwest Basin indicates that they can provide additional stream mile information. If implemented, these projects are sufficient to meet the number of IPPs the BIP has identified in the above categories. However, an analysis of the extent to which these projects meet the stream mile goals has not yet been conducted.¹²⁷ In addition, the BIP identified two efforts that would extend across the sub-basin to better identify environmental and recreational needs:

1. Evaluation of environmental and/or recreational gaps is planned to be conducted for improvement of non-consumptive resources and/or in collaborative with development of consumptive IPPs. The evaluations may be conducted by a subgroup of the roundtable or by individuals, groups, or organizations with input from the roundtable. The evaluation may use methodologies such as the Southwest attributes map, Flow Evaluation Tool, R2Cross, and any other tools that may be available.
2. Where environmental and/or recreational gaps are identified, a collaborative effort will be initiated to develop innovative tools to protect water identified as necessary to address these gaps.

Until additional stream mile information associated with the identified projects and methods is provided, it is unclear how well the BIP meets its measurable outcomes.



Yampa/White/Green

In the 2011 Needs Assessment, the Yampa, White, and Green Basin roundtable identified 218 perennial stream miles with state imperiled warm water fish species, and 142 miles with federally-listed warm water fish species. Approximately 55 percent of these stream miles have some level of protection, with most of it direct. Nearly two-thirds of the identified 35 perennial stream miles with Colorado River cutthroat trout have some level of protection, although most of this protection is indirect. Over three-quarters of the 275 miles of identified perennial stream miles with important riparian and wetland areas have some level of protection as well, with nearly all of it direct. The Needs Assessment report also

identified various forms of recreation. Very few stream miles have identified protections for these values.

Yampa/White/Green Basin's Environmental and Recreational Goals:

To address its environmental and recreational needs, the Yampa/White/Green BIP identified two goals. These goals and the relevant measurable outcomes and processes are below¹²⁸:

- Quantify and protect non-consumptive water uses.
 - To the extent that non-consumptive needs can be specified and projects can be analyzed, there will be projects for non-consumptive attributes within the existing legal and water management context.
 - Multi-purpose projects and methods will be researched and designed to meet the other goals enumerated here.
 - The Programmatic Biological Opinion (PBO) and its depletion coverage for the Yampa River Basin for existing and future expected and unexpected depletions will meet base flow targets in critical habitat areas and assist with endangered fish recovery.
 - A new PBO is agreed upon for the White River Basin that provides certainty for existing and future anticipated and unanticipated depletions and that assists with endangered fish recovery.
 - The flow protection and any water leasing or re-operation of projects needed for native warm water fish, for cottonwoods, and for recreational boating on reaches with greater and overlapping flow alteration risks are integrated with the flow protection for endangered fish recovery and with projects to meet in-basin, consumptive needs. The flow needs of these non-consumptive attributes are otherwise met, including the avoidance of or offsetting the loss of minimum or optimal boating days that are related to multi-purpose projects and unrelated to drier or wetter hydrology.
 - The flow needs for all other non-consumptive attributes are quantified, integrated with projects to meet in-basin consumptive needs, and otherwise met through non-consumptive IPPs. Multi-purpose projects will be researched and designed to improve riparian or aquatic ecology and bank stability without changing the existing flow regime while voluntarily modernizing irrigation diversion systems and reducing bedload. Similar projects will be researched and designed to improve recreational boating for existing flows while voluntarily modernizing irrigation systems.
 - The economic values of the relatively natural flow regimes of the Yampa and White River systems are recognized and protected, along with the economic values of consumptive water use.
 - Acres of restored riparian areas, degraded streams, and wetlands to restore natural water storage capacity, and improve water quantity and quality for non-consumptive needs.
 - Assess and quantify impact of IPP's on peak flows and ascertain whether further non-consumptive IPP's need to be identified.

- Develop an integrated system of water use, storage, administration, and delivery to reduce water shortages and meet environmental and recreational water needs.
 - Success in permitting and constructing in-basin storage projects.
 - Reduction in consumptive shortages in drought scenarios.
 - Reduction in identified non-consumptive shortages in drought scenarios.
 - Administration and infrastructure improvements making decreed amounts of water available to diversion structures with reduced need for seasonal gravel dams in the river.
 - Reduce the potential incidence of severe low flows in order for water users to exercise their water rights.

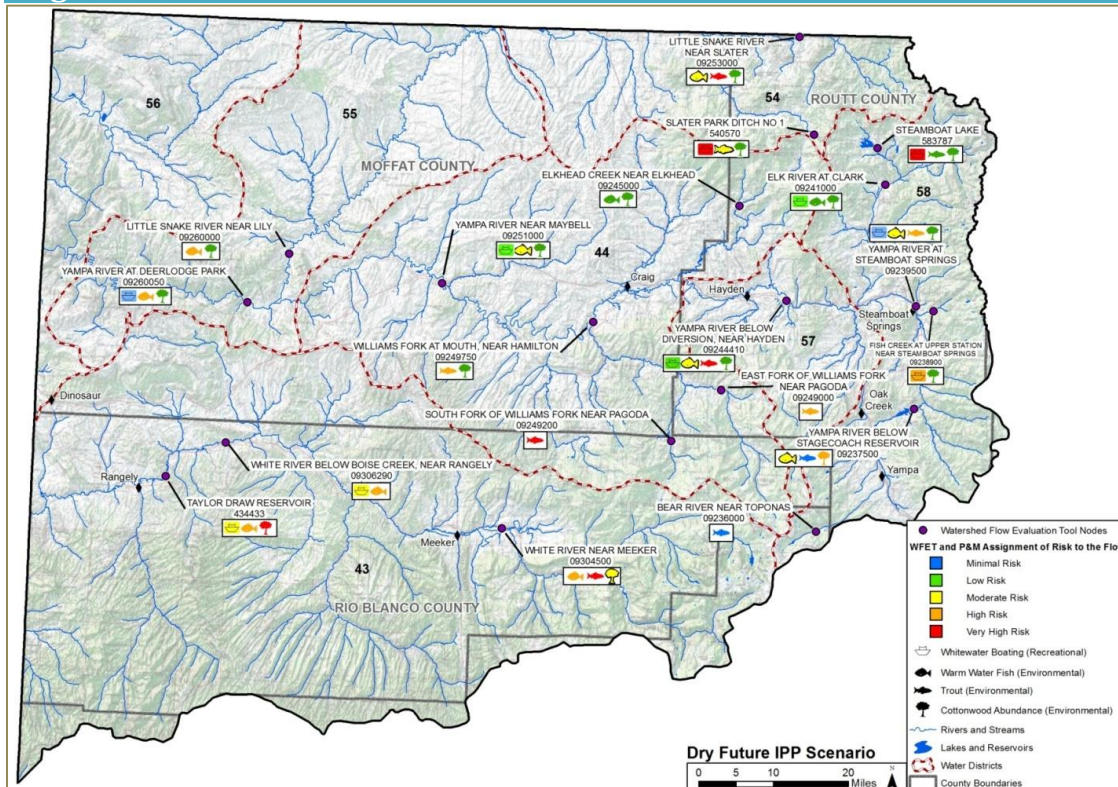
Meeting the Yampa/White/Green Basin's Environmental and Recreational Gaps:

The previous Watershed Flow Evaluation Tool work examined whether cottonwood, warm water fish, or cold water fish were vulnerable due to flow conditions within the basin roundtable's environmental and recreational focus areas. Additional analysis within the BIP assessed how often instream flows and recreational in-channel diversions were being met throughout the basin. These three efforts provide significant insight into how well environmental and recreational needs are currently being addressed in the basin. Furthermore, the BIP overlaid potential future conditions within the basin to determine how future climate change and developing identified projects and processes would affect:

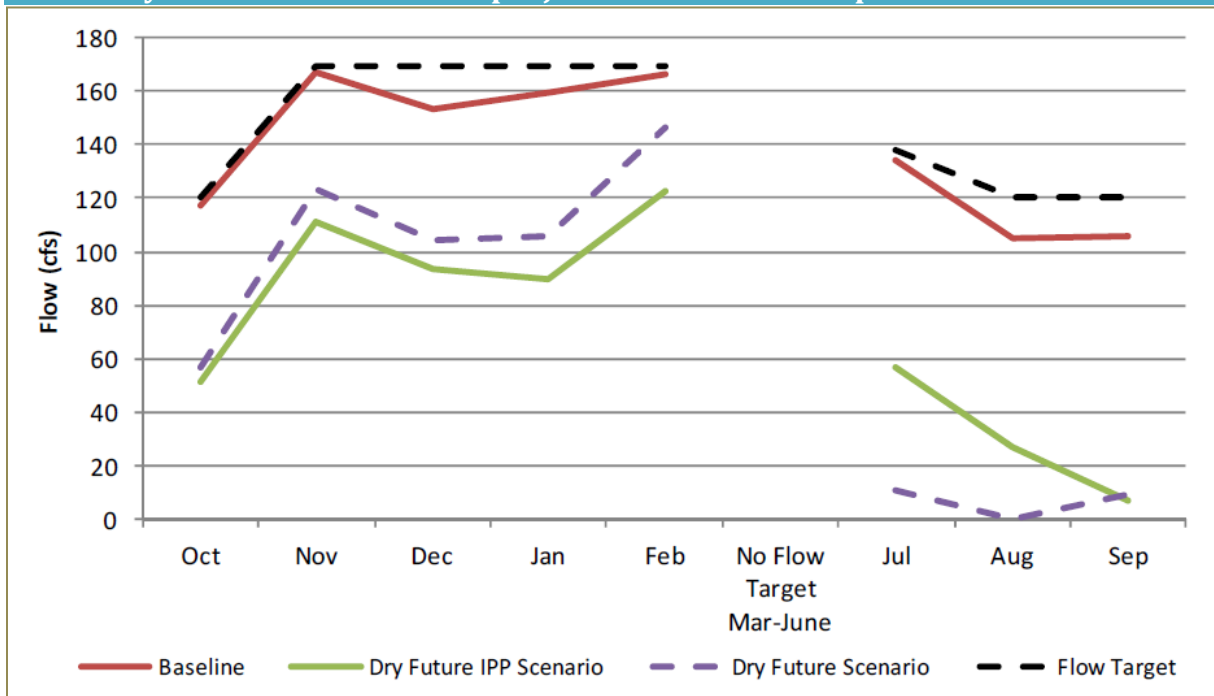
1. The vulnerability of the species within the environmental and recreational focus areas,
2. The instream flow shortages, and
3. The recreational in channel diversion shortages

For example, the BIP states that “the modeling indicates that the implementation of the IPPs [in a dry future] would increase instream flow shortages by 27 percent on Trout Creek. The development of IPPs could reduce instream flow shortages on the following reaches: Oak Creek (by 1.4 percent, node 582290), Slater Creek (by 3.5 percent, node 542076), and Willow Spring and Pond (by 1.8 percent, node 582162).”¹²⁹ IPPs appear to have little affect for most locations due to vulnerability (Figure 6.2-5), but could modestly impact endangered fish recovery flows in the Yampa River during the fall and winter (Figure 6.2-6).

Figure 6.2-5



6.2-6 Demonstration of how the Yampa PBO could be impacted by a dry future and a dry future with identified projects and methods implemented



The purpose of this analysis is to provide a course examination of potential environmental and recreational “shortages.” This is the most thorough technical analysis provided in any of the BIPs. In addition the BIP identifies 17 environmental and recreational IPPs. These IPPs are further supported by five multi-purpose projects and seven consumptive projects that could provide secondary benefits to environmental and recreational values. As stated in the BIP, “the Basin Roundtable will continue to explore additional multi-purpose opportunities where they may exist through future planning efforts.”¹³⁰

In summary, the BIP demonstrates progress towards meeting its future environmental and recreational needs and, if implemented, mostly meets the measurable outcomes listed above.

6.2.6 Other BIP identified gaps

Other needs identified by the BIPs include those associated with education, watershed health, and water quality. These needs are further explored in Section 9.4, 7.1, and 7.3, respectively.

6.2.7 How other states have worked to meet their gaps

The challenge of meeting future water supply needs is not unique to Colorado’s boundaries. Other states across the west are facing the challenge of increased population and potentially limited water supplies. Other neighboring states have also undertaken water planning efforts, for better certainty at the intra- and inter- state level.

State and federal water projects account for a substantial portion of the ongoing efforts around the west: for example, California’s State Water Project, the Central Arizona Project, and the Lake Powell Pipeline all represent massive financial and political undertakings, with the goal of meeting future water supply needs. Other efforts include water banking, with efforts underway in California. A key issue in the west is also the settlement of water rights issues with tribes located throughout several states. Existing settlements in New Mexico and Arizona have provided a greater certainty to tribes and to water management agencies within the state. The State of Texas has invested large sums of capital into project implementation, Kansas has invested in Corps sponsored projects for storage, and the State of Utah has collaborated with the federal government on the Central Utah Project.

For more information on neighboring states’ efforts to close water supply gaps, refer to the Appendix 6.2-A.

6.2.8 Actions

The projects and methods in the BIPs met many of the identified gaps; however, gaps remain even with the significant efforts identified. To help the BIPs meet their needs, several next steps are needed. The Gunnison BIP summarized many of these next steps and potential actions, and this work has been updated in Table 6.2-5.

Table 6.2-5: Strategies for implementation of the BIPs

Category	Constraint	Next Steps and Potential Actions
Project Evaluation	Conflict	• Partnerships • Cooperative Strategies
	Perception	• Public Education and Outreach • Incentive-Based Programs
	Regulations	• Cooperative Strategies • Effective and Efficient Permitting
Project Feasibility	Cost	• Creative Funding Mechanisms • Partnerships and Cooperative Strategies
	Water Availability	• Water Availability Analyses • Water Administrative Strategies
	Constructability	• Feasibility Analyses • Engineering Design

One of the primary purposes of Colorado's Water Plan is to address the gap. To accomplish this, several of the next steps and potential actions identified in Table 6.2-5 are discussed throughout the plan:

- Partnerships and cooperative strategies are vital to overcoming conflict and building local consensus so that a project or method can move forward. This approach is further discussed in Section 9.4 on more effective and efficient permitting.
- Public education and outreach can also help inform people of Colorado's water needs and solutions. Section 9.5 explores avenues to better support this type of water education throughout Colorado.
- Incentive-based programs are mentioned throughout many sections of Colorado's Water Plan. For instance, Section 6.3 explores opportunities to encourage conservation, reuse, and water-wise land use practices. Section 6.4 explores opportunities to encourage alternative agricultural transfer methods.
- Funding is also a common theme throughout many of the BIPs. Funding options are further explored in Section 9.2.
- Permitting and other regulatory concerns are also expressed in many of the BIPs, and Section 9.4 explores how to make these processes more effective and efficient.

Colorado's water gaps must be identified and addressed. The following recommendations would help accomplish this:

- CWCB will support the evaluation, feasibility, and completion of the BIPs through WSRA grants.
- CWCB will support increased consistency and technical support in the BIPs in the following ways:

- Provide technical support for several of the BIPs through continued decision support development and maintenance to explore municipal, agricultural, industrial, and environmental shortage analyses similar to those found in the Yampa/White/Green BIP.
- Provide technical support for several of the BIPs to explore the use of project sheets and project tiering, similar to the Rio Grande, North Platte, and Gunnison BIPs.
- Support the further quantification of project and methods costs, new acre-feet developed, new irrigated acres developed, and new stream miles protected.
- CWCB will incorporate the BIP information into SWSI 2016 and will reassess the municipal, industrial, environmental, recreational, and agricultural gaps at that time.

6.3 Water conservation and reuse

Colorado's Water Plan promotes technical and financial assistance throughout Colorado to plan and implement long-term water efficiency strategies to meet local and statewide water needs, and achieve the following statewide long-term goals:

- Reduce overall future water needs through cost-effective water efficiency measures
- Integrate water efficiency planning and projects into overall water resource management
- Instill a water efficiency ethic throughout Colorado

Introduction

Water conservation activities and water reuse will play an important role in balancing the need for additional water supply with strategies to lessen that need. By implementing a comprehensive statewide approach for water conservation and water reuse activities, we encourage programmatic consistency from the local level up to the state level. While conservation and reuse are not “silver-bullets,” we can achieve benefits by creating scalable technical resources, bolstering local initiatives through financial incentives, and sharing best-practices.

This section examines water conservation, reuse, land use, agricultural water conservation, self-supplied industrial conservation, and state agency conservation. These various water management strategies will define the road that Colorado will take to close the supply gap, maintain a healthy environment, promote livable and sustainable cities, and preserve agricultural production into the future.

6.3.1 Municipal water conservation

Governor John Hickenlooper stated that “Every conversation about water should start with conservation.”¹³¹ Water providers and municipalities have progressed in water conservation over the last decade, as was seen in Chapter 5. Building on those efforts, future actions will define which direction Colorado takes to close the supply and demand gap.

Benefits of water conservation

Water savings achieved through water efficiency activities can reduce water demands, assisting providers in avoiding, downsizing, or postponing the construction and operation of water supply

facilities and wastewater facilities, as well as eliminating, reducing, or postponing water purchases. In addition to these water supply benefits, other societal, political, and environmental benefits can be achieved including:¹³²

- Reducing wastewater discharges through indoor water savings, which can improve water quality and aquatic habitat.
- Reducing outdoor irrigation runoff, which can improve water quality.
- Demonstrating our commitment to sustainability.
- Meeting political and regulatory requirements necessary to obtain permitting for local and regional water supply projects.
- Delaying capital costs for new projects.

Water conservation in Colorado

Municipalities have done a remarkable job in the past decade reducing per capita water needs. Statewide, this amounts to just under twenty percent, but some municipalities have reduced their per capita water use by as much as thirty percent.¹³³ Most of the largest water providers in Colorado have CWCB approved water conservation plans and the majority of the municipal and industrial (M&I) statewide demand is accounted for in these approved plans. According to C.R.S. 37-60-126, covered entities, defined as those entities that deliver more than 2000 acre feet of water annually, are required to have a CWCB approved water conservation plan.

Many water providers have adopted best practices, including landscape efficiencies, water loss management, and inclining block rate structures. For example, of the CWCB approved water conservation plans on file, approximately 85 percent of water providers along the front range and eastern slope and 77 percent of western slope water providers have inclining block rate structures.¹³⁴ There are many great examples of water conservation across the state; here are a few examples that highlight some of the best efforts to date:

Aurora Water

Aurora Water has implemented landscape and irrigation standards along with tiered rate structures. Additionally, Aurora Water created a customer information system using GIS, an Excel based water use calculator and state-of-the-art communication tools to efficiently focus incentives to specific customers and to collaborate with their customers more closely.

Douglas County

All covered entities in Douglas County have CWCB approved water conservation plans and the majority of the smaller providers manage water conservation activities under a regional water conservation plan. Of the covered entities, all are implementing water conservation best practices such as landscape/irrigation ordinances, landscaper certification requirements, a variety of incentives, tiered rate structures (including water budgets), smart metering with a customer feedback loop, new construction requirements in relation to water conservation, and customer education.

Denver Water

Denver Water has made significant progress through its “Use Only What You Need” campaign over the last 8 years. Now Denver Water is customizing water budgets based on irrigated area for their largest commercial customers. Water budgets allow both Denver Water and the customers to know exactly “what they need.” As a result of this new program, schools, park

districts and multifamily community associations have already found significant leaks and irrigation clock malfunctions and have identified large areas for future conversion to landscaping other than turf.

Greeley, Boulder, Highlands Ranch and Castle Rock

All of these municipalities have adopted water budget rate structures tied to actual water use on a site. Using winter quarter average as a proxy for indoor use and GIS imagery to define water use outside, these communities have used this tool to manage their summer peak demands through technology, education, and appropriate pricing.

Ute Water/Grand Junction/Clifton

Starting in 2002, the Grand Valley Water Providers came together to create a drought response plan called Drought Response Information Project or DRIP. The plan was a success and is still active. Modeling this effort, the providers came together again to create a regional water conservation plan. This effort was practical because their systems are interconnected and generally reside in the same media shed.

More Regional Plans

Many communities and water providers are not required by statute to have a CWCB approved conservation plan because of their small size. These small water providers can, however, come together and to create savings that equate to more than the sum of their parts.

- In the lower Arkansas Valley, 38 small water providers came together to create a regional water conservation plan, under guidance from Southeastern Colorado Water Conservancy District, as a roadmap for conservation planning and implementation over the next 50 years. The main impetus behind the plan is to ensure all the water systems are more efficient before connecting to the Arkansas Valley Conduit thus stretching the new supply further.
- Steamboat Springs completed a community conservation plan that brought together three water providers under a single community plan in 2010.
- Presently, five communities in the Roaring Fork Watershed (Aspen, Snowmass Village, Basalt, Carbondale, and Glenwood Springs) are creating a regional conservation plan that ties directly into their Roaring Fork Watershed Plan.

Other Projects-Sterling Ranch Rainwater Harvesting Pilot project

The Sterling Ranch Precipitation Harvesting Pilot Study was approved in July 2010 and is currently in its fifth year and is the only pilot project in Colorado. HB 09-1129 allowed for up to three pilot projects in each river basin across the state. Sterling Ranch is located in Douglas County within the South Platte Basin. The 3400 acre planned development received final approval from Douglas County on July 10, 2013. Precipitation harvesting systems are being incorporated into the first phase of development and are planned to occur within the next few years. The Sterling Ranch Water Conservation Plan is key to meeting the site's water conservation goals with a substantial planned reduction in water demands. Preliminary estimates indicate that precipitation harvesting on average can supply as much as one third of the irrigation demand for a typical Sterling Ranch water wise home, further reducing Sterling Ranch's reliance on non-renewable water supplies.¹³⁵

Water conservation practices across the United States

Texas

In 2013 Texas voters approved Proposition 6 which amended the state's constitution to create funds for cost effective water projects.¹³⁶ The legislature set aside \$2 billion for projects in the Texas' water plan of which no less than 20 percent would be used for water conservation and reuse projects under House Bill 4.¹³⁷ This equates to about \$400 million which on a per capita basis would equate to approximately \$75 million for Colorado focused on water conservation and reuse projects.

Tennessee

A foundational area that is gaining more attention across the United States is the requirement for submitting regular water loss audits using the AWWA M36 Water Loss Audit methodology. In recent years, Texas, Georgia, California, and Tennessee have all required water providers to implement and report water loss audits to state agencies.¹³⁸ For example, Tennessee began by requiring water loss audits in 2007 and in 2013 they improved the requirement by having all providers use the M36 Water Loss Audit methodology with benchmarks associated with the reporting. All providers must attain a data validity score of at least 65 with non-revenue water as a percent by cost of operation that is 30 percent or less in the first year. Subsequent years must show continued improvement. These two parameters guarantee that the water provider has confidence in the data and the non-revenue number gets at the economic level of acceptable loss. These parameters are much more sophisticated than a simple percentage of water loss per total treated volume. If these benchmarks are not met, water providers will be referred to the Tennessee Water and Wastewater Financing Board where the Board can ensure compliance through the courts. In Tennessee's case the enforcement is by a financial regulator which frames this as a water system financial best practice.^{139,140}

Turf Replacement

Since 1999, Southern Nevada Water Authority (SNWA) has been rebating for turf removal on residential and commercial properties. SNWA offers \$1.50 per square foot of grass removed up to 5000 square feet and \$1.00 per square over 5,000 square feet. As of 2011, the program converted over 150 million square feet and from 2000 to 2010 it reduced demand by more than 127,000 acre feet.¹⁴¹ SNWA also worked with local municipalities, who receive SNWA water service, to enact landscape ordinances for new construction that prohibit new grass in residential front yards and sets limits on total amount of turf allowed per lot.

As of November 2014, the Los Angeles Department of Water and Power (LADWP) increased their rebate for turf removal to \$3.75 per square foot up to 1500 square feet with \$2 per square foot for 1500 square feet and greater. This is an increase up from \$3 per square foot and promotes "California Friendly" landscaping versus lawns. According to LADWP, since 2009 they have replaced 7.4 million square feet of turf with California Friendly landscaping for a savings of 220 million gallons per year.¹⁴²

Social Norming/Behavioral Water Efficiency

At the local water provider level, computer and smart metering technology have improved greatly in recent years allowing for a direct link between provider and customer. Through this direct link a water provider can communicate educational messaging such as water consumption targets, water restrictions, and leak detection. The field of social norming or behavioral water efficiency is becoming standard operating procedure for a number of water providers in Colorado. Fort Collins, Denver Water, Greeley Water, and City of Brighton are all using technology to provide water consumption goals, current usage statistics and comparisons between neighbors to elicit more water efficient behavior change. WaterSmart Software is a leading company in this field of behavioral water efficiency and is working with a number of Colorado water providers. By sending a personalized *Home Water Report* to a water customer, showing their consumption, how it compares to their neighbors and with customized actions to reduce water use, residential customers can save 5 percent on their water consumption.¹⁴³ With Advanced Metering Infrastructure (AMI), this feedback can be delivered daily and even hourly if needed. This communication link does not need to be limited to water efficiency messaging and illustrates the changing relationship between water provider and water customer. Continued financial support and research of the technology and educational programming needed for these types customer relation/education tools will be an important path toward more efficient water usage and a more water literate water customer base in the future. Conservation and other demand management practices are further explored in sections 6.1 and 6.5.

Recent Legislation

Partly in response to the work of the basin roundtables and the IBCC, there have been some recent legislative developments in water conservation. The legislative process can be contentious and does not always reflect the collaborative nature found at the basin roundtables and IBCC. Many of the basin roundtables have expressed an interest in working more closely with their legislative representatives to increase the level of understanding for both bodies. The legislature has passed bills that will direct the course of statewide water conservation implementation for the foreseeable future.

In 2014, the governor signed legislation seeking to identify and quantify the types of best practices that could be used to limit municipal outdoor water conservation and to determine if proposed legislation is needed to facilitate the implementation of those practices. The bill directly refers to the work of the basin roundtables and the IBCC, stating, "As part of the Colorado Water Conservation Board's statewide water supply initiative and the interbasin compact committee and basin roundtable process, a "No/Low Regrets Action Plan" has been developed, an important element of which is to establish and implement conservation strategies to extend the ability of existing water supplies to meet increasing needs and thereby minimize agricultural dry-up."¹⁴⁴

The fixtures bill was signed into law by the governor in 2014.¹⁴⁵ The law phases out less efficient water using fixtures and requires that only WaterSense specified fixtures can be sold in Colorado. These fixtures carry the Environmental Protection Agency (EPA) WaterSense label, are third party certified, and presently are 20 percent more efficient than existing fixtures. In addition, these

fixtures do not cost more than their less-efficient counterparts. The bill's proponents estimate that it will garner approximately 40,000 acre-feet of savings annually by 2050 and would increase the replacement rate of existing fixtures.¹⁴⁶ The bill is consistent with the IBCC's suggestion to explore legislative options to help increase indoor water efficiencies.

Past Legislation

In 2010, the governor signed legislation that requires most water providers to submit water use and conservation data to the CWCB.¹⁴⁷ This allows quantifying and tracking water conservation activities and water demand. Implementation of this bill began in 2014 and will provide valuable data to the water plan.

In 2010, the governor signed legislation that requires the builder of a new single-family detached residence, for which a buyer is under contract, to offer the buyer a selection of water-saving options, including:

Water-efficient toilets, lavatory faucets, and showerheads;

Dishwashers and clothes washers that meet federal EPA energy star program standards if they are to be financed, installed, or sold as upgrades through the home builder;

If the landscaping is financed, installed, or sold as upgrades through the home builder and maintained by the homeowner, landscape design that follows the Green Industry's best management practices; and

Installation of a pressure-reducing valve that limits water pressure in the residence to 60 pounds per square inch.¹⁴⁸

In 2009, the governor authorized a pilot program for the collection of precipitation from rooftops for nonpotable uses. The program can include up to 10 new residential or mixed-use developments. At present, the Sterling Ranch development in Douglas County is the first and only pilot to begin and is at the beginning of their first construction phase.¹⁴⁹

In 2005, the governor signed legislation that protected water right owners against abandonment of their water right if certain conditions were met. Two conditions refer to "a water conservation program approved by a state agency and a water banking program as provided by law." While these conditions do not allow for water sharing, the bill does protect a water right holder from losing their right if non-use results from water conservation activities.¹⁵⁰

In 2005, the governor signed legislation that protected homeowners' property rights in regard to installation of xeriscape landscaping. This legislation amended the law regulating HOAs, including a provision that invalidates any new or existing covenant or condition that prohibits or discourages a unit owner from employing xeriscape or that requires landscaping to consist exclusively or primarily of turf grass.¹⁵¹

Interbasin Compact Committee (IBCC) No and Low Regrets Actions

In 2010, the IBCC Water Conservation Subcommittee developed a list of water conservation strategies that were included in the IBCC letter to the governors.¹⁵² Among the recommendations were many short-term and longer-term conservation actions that ranged from statewide education campaigns to legislation addressing indoor and outdoor water use.

In 2013, the IBCC developed the “No and Low Regrets Action Plan” for water conservation.¹⁵³ This strategy outlines what minimum level of water conservation should be carried out statewide. The IBCC reached consensus on the need to reach low to medium levels of water conservation regardless of the future scenario, and the near term potential future actions needed to achieve this (Table 6.3.1-2).

Potential Water Savings
170,000 acre-feet could serve
1.1 million people statewide

The minimum amount of water saved through water providers’ active conservation efforts is a goal that was identified through three stakeholder processes. The basin roundtables underwent a process to develop portfolios of water solutions to meet future water needs; the Interbasin Compact Committee (IBCC) examined these as part of their no and low regrets action plan and determined that low to medium conservation levels defined in SWSI 2010 were needed; and the scenario planning process determined that all of low, or half of medium conservation SWSI active conservation levels, or nearly 170,000 acre-feet will be needed. This is enough water to meet the needs of about 1.1 million people, or thirty percent of all the new people expected to move to Colorado between now and 2050.¹⁵⁴ Many stakeholder-based efforts such as the 2010 Statewide Conservation “mini-summit,” work of the IBCC Conservation Subcommittee, and work of the Colorado Water Conservation Board’s (CWCB) Water Conservation Technical Advisory Group, have helped to 1) determine the minimum levels of conservation needed and 2) chart potential ways to achieve these levels of active conservation. Conservation also acts as a management tool to buffer against drought by demands through conservation over the long-term and implementing short term conservation strategies when there are shortages. The amount of water realized through long-term water conservation efforts could be stored as a drought reserve to be used during periods of shortages. In these cases, greater storage is required to maintain a drought reserve.¹⁵⁵

1) Improve Tracking and Quantification of Conservation

2) Establish a Statewide Conservation Goal with Intermittent Benchmarks

- a) Develop general political support for a statewide conservation goal
- b) Develop statewide agreement tying conservation to new supply development and agricultural transfers
- c) Support local entities in their efforts to outline and report their own approaches to help achieve the statewide goal.
- d) Explore best approach to implementation of standards to achieve goal
- e) Develop and implement conservation standards

3) Continue to Support Local Implementation of Best Practices

- a) Continue implementation of state conservation programs
- b) Encourage use of levels framework and best practices guidebook

4) Promote Enabling Conditions for Use of Conserved Water

- a) Maintain and develop storage and infrastructure for the use of conserved water
- b) Promote incentives for the use of conserved water
- c) Identify and, where possible, resolve legal and administrative barriers to the use of conserved water
- d) Identify and explore barriers to sharing conserved water

5) Develop New Incentives for Conservation

- a) Explore funding options in support of the Water Efficiency Grant Program
- b) Develop professional education and certification programs
- c) Develop new eligibility requirements for state grants and loans that include certain conservation levels or indications of commitment to conservation
- d) Develop conservation standards for communities planning to use agricultural transfers or new supplies for future water needs
- e) Develop incentives that incorporate the following concepts: encourage a base level of conservation; assess issues, benefits, and drawbacks of the current definition of "covered entities;" conservation water markets; small community support; permitting incentives

6) Explore Legislative Concepts and Develop Support

- a) Explore legislative options and support for indoor plumbing code standards
- b) Explore legislative options and support for outdoor water efficiency standards
- c) Engage in outreach and education efforts to explain the need for legislation; develop political support

7) Implement Education and Outreach Efforts

- a) Track public attitudes through baseline and ongoing surveys
- b) Develop statewide messaging and use focus groups to refine and guide implementation
- c) Develop decision-maker outreach strategies
- d) Pursue a coordinated media campaign

Basin Implementation Plans

For 2014, each basin roundtable formulated their own implementation plan that includes water conservation goals and activities in addition to already planned projects and methods, use of Colorado River water, and alternatives to agricultural water transfers.

Arkansas Basin

The Arkansas Basin addressed conservation by stating, “Stakeholders should take all actions required to maintain current water supplies and prevent future water supply gaps from increasing.” The Arkansas Basin went on to state four goals for meeting municipal water needs:

Meet the municipal supply gap in each county within the basin;

Support regional infrastructure development for cost-effective solutions to local water supply gaps;

Reduce or eliminate Denver Basin groundwater dependence for municipal users; and,

Develop collaborative solutions between municipal and agricultural users of water, particularly in drought conditions.

As a solution for preventing future water supply gaps from increasing and attaining the basin goals, the basin listed several recommendations related to water conservation. The recommendations focus on water rates, landscape water efficiency, and education; specifically the creation of water budgets for every user, efficient irrigation through rotary sprinkler nozzles, landscaper training in design and maintenance of efficient irrigation systems, widespread water education messaging to K-12 schools throughout the basin, and high level regional outreach messages throughout the basin.¹⁵⁶

Colorado Basin

The Colorado Basin stated its desire to “encourage a high level of basinwide conservation” with two goals specifically for municipal and industrial water conservation:

Improve Colorado water law to encourage efficiency, conservation, and reuse; and

Pursue continued municipal and industrial conservation.

These goals are supported by measurable outcomes such as revising Colorado water law to allow more flexibility in promoting stream health through conservation and achieving and sustaining a high level of conservation by all basin water providers. The Colorado Basin identified projects and methods to implement these such as comparing Colorado water law and procedures with other western states to identify alternative practices to facilitate water transfers and various local water conservation efforts happening today and future planned efforts. Additionally, the Colorado Basin created an extensive section with water conservation intertwined with land use policies. This is described in the land use section of this chapter (section 6.3.3).¹⁵⁷

Gunnison Basin

The Gunnison Basin focused on identifying and addressing municipal and industrial shortages. As a way of fulfilling this goal the basin stated that it would, “Promote the development of voluntary regional water conservation plans to help smaller entities (delivering less than an annual 2000

acre-feet) achieve water savings and related reductions in expenses related to treatment, distribution, and infrastructure.”¹⁵⁸

To attain this goal, the plan listed two measurable outcomes for water conservation:

Reliably meet 100 percent of essential municipal water provider system demands in the basin through the year 2050 and beyond.

Continue the current baseline of effective water conservation programs by covered entities in the basin, producing at least medium levels of conservation savings as defined in SWSI 2010 and employing relevant conservation strategies listed for both the low and medium levels of SWSI 2010.

The Gunnison Basin describes their Water Conservation Planning Process for the Upper Gunnison Basin as a means of reaching these measurable outcomes and the goal of addressing municipal and industrial shortages in the future.¹⁵⁹

North Platte Basin

The North Platte Basin focuses mainly on agricultural and environmental water issues as the municipal need is low because of lack of population. The North Platte Basin roundtable (NPBRT) states that it, “supports the extensive water conservation efforts of major Colorado water providers, and encourages further conservation as permitted by technology, economics, and legislation. The NPBRT supports a wide variety of water conservation methods including municipal conservation programs, strategic growth and development, and landscape limitations. The NPBRT believes that the best way to promote statewide water conservation is through incentive-based measures as opposed to regulatory methods.”¹⁶⁰

To maximize water savings and avoid an unnecessary burden on smaller rural water providers, the NPBRT supports focusing conservation efforts on covered entities by:

Supporting the use of state funding to provide incentives for reaching municipal conservation and efficiency standards.

Working with appropriate entities to ensure that statewide conservation strategies and any related legislation allow flexibility to meet the needs of local governments.

A measurable outcome for the NPBRT for this process would be to:

Comply with future statewide municipal conservation strategies and any related legislation by 2020 or as appropriate.

No proposed projects are currently identified to address this goal; however, the NPBRT will remain involved in the ongoing processes of the IBCC and Colorado Water Plan to support the equitable statewide application of municipal water conservation measures.¹⁶¹

Rio Grande Basin

Much like the North Platte Basin, the Rio Grande Basin roundtable (RGBRT) focuses on agricultural water and environmental needs. With that said, the RGBRT does have a goal “to meet new demands

for water, to the extent practicable, without impacting existing water rights and compact obligations.”¹⁶²

For M&I water conservation the RGBRT has several measurable outcomes:

Minimize per capita per day use to a reasonable level.

Inventory existing and expected future M&I and environmental and recreational water needs.

Develop an M&I plan that addresses water needs, availability, and a strategy for meeting the needs for M&I while sustaining agricultural water use and minimizing impacts to other uses.¹⁶³

South Platte/Metro Basin

The South Platte/Metro Basin has an overarching theme of continuing “its leadership role in efficient use and management of water . . . the State’s future, and the future of each of its river basins, depends on efficient, sustainable and collaborative solutions.”¹⁶⁴ They also have the following goals and measurable outcomes:

Goal: Continue the South Platte River Basin’s leadership in wise water use.

MO#1 – Further quantify the successes of programs implemented in the past several years throughout the South Platte River Basin and establish a general baseline against which the success of future programs will be assessed.

MO#2 – Distribute and encourage adoption of “best management practices” as “guidelines” (not standards) for M&I water suppliers to consider in their “provider-controlled” programs recognizing the significant differences in climates, cultures and economic conditions throughout the South Platte River Basin.

NC MO#1 – Ensure conservation, reuse and drought management plans take into consideration environmental and recreational focus areas and attributes.

The Metro and South Platte Basin focused on demand reductions that could be achieved based on current trends in water conservation best practices and barring future regulation and major land use changes. The Metro Basin roundtable recommends that it pursue conservation programs that would reduce per capita water use from a baseline of 155 gallons per capita per day (gpcd) in 2010 to 129 gpcd by 2050. The South Platte Basin roundtable recommends conservation programs that would reduce per capita water use from a baseline of 188 in 2010 to 146 gpcd by 2050 (Table 6.3.1-1). The South Platte Basin roundtable believes these goals are aggressive based on the present day state of conservation best practices and the possible societal changes required to exceed these levels.¹⁶⁵

Measure	Metro			South Platte		
	Baseline 2010	2050	Reduction (%)	Baseline 2010	2050	Reduction (%)
Residential Indoor	43.7	34	22	60.1	40	33
Non- Residential Indoor	37.5	32	15	39.2	33	15
Outdoor	62.8	54	15	73.7	63	15
Water Loss	10.9	9	17	15	10	33
TOTAL	155	129	17%	188	146	22%

The South Platte/Metro Basin shares some examples of future work that will help achieve conservation savings. The South Platte/Metro Basin suggests that “further standardization of the term “per capita water use” and improvement in the understanding of the factors impacting water consumption rates can help the basin and State better understand the ways that conservation programs and reductions in per capita water consumption can help meet supply gaps.”¹⁶⁶

Additionally, the South Platte/Metro Basin states that certain regulatory, rate structure driven, educational, and incentive based approaches will assist in achieving conservation goals. “Providers encourage conservation through water rate designs, education, watering schedules, and rebate programs as well as water waste rules. Finding effective methods to strengthen code requirements and enact stronger land use regulations will be an important factor in building efficiencies through conservation.”¹⁶⁷

Southwest Basin

The Southwest Basin has a “goal of promoting and incentivizing wise and efficient water use through implementation of municipal conservation strategies to reduce overall future water needs.”¹⁶⁸ The Southwest Basin was a major supporter of the original language in SB14-017, which focused on reducing outdoor usage to a 70 percent indoor to 30 percent outdoor ratio for those communities transferring water out of agricultural use and a 60/40 percent split for all other utilities in Colorado. The bill was turned into an investigation by the Interim Water Committee, and it started a serious conversation on what should constitute outdoor water use in residential development.

The Southwest Basin stated the following goals for water conservation in their basin implementation plan:

Consistently meet 100 percent of residential, commercial, and industrial water system demands identified in SWSI 2010 in each sub-basin, while also encouraging education and conservation to reduce demand.

Change the ratio of in-house to outside treated water use for municipal and domestic water systems (referred to as water providers herein) from the current ratio of 50 percent in-house use and 50 percent outside use, to 60 percent in-house use and 40 percent outside use (60/40 ratio) for southwest Colorado and the entire State by 2030.

The water providers in the state that are using dry up of agricultural land (defined as requiring a water court change case) and/or pursuing a new Trans Mountain Diversion (TMD) (as defined by IBCC to be a new western slope to eastern slope diversion project) shall have a higher standard of conservation. The goal for these water providers is a 70/30 ratio by 2030. This is a prerequisite for the roundtable to consider support of a new TMD.

Specific IPPs have not been developed for all possible management and conservation opportunities but overall strategies include:

Continue to reduce the amount of water needed for municipal, domestic, and industrial purposes through conservation efforts to meet the goal and measureable outcome herein.

Two project concepts that were identified during the Southwest Basin process were 1) to work with public water suppliers, including municipalities, to assess their current indoor to outdoor water use ratio and to incentivize attainment of the 60/40 ratio included in the Southwest Basin Measureable Outcome B3 and; 2) the development of irrigation efficiency program. These are ideas for projects or processes in the basin that do not have an entity that is actively pursuing them yet.¹⁶⁹

Yampa/White/Green Basin

The Yampa/White/Green Basin identifies M&I water conservation as one of the ways to help meet future demands in the basin through processes and measurable outcomes such as:

Identifying specific locations in the basin where municipal and industrial shortages may exist in drought scenarios, quantifying the shortages in time, frequency, and duration.

Identifying impacts throughout the basin in the context of water shortages (drought and climate change), wildfire, and compact shortage on municipal and industrial demands.

Encourage municipal entities to meet some future municipal water needs through water conservation and efficiency.¹⁷⁰

Measurable Outcomes:

Reliably meet 100 percent of municipal and industrial demands in the basin through the year 2050 and beyond.

One water conservation project is identified and quantified in the Yampa/White/Green Basin. The project goal is to save 720 acre-feet by 2035 in the Steamboat Springs through passive conservation and active conservation such as leak detection programs, fixture rebate programs, and reducing landscape irrigation needs.¹⁷¹

Actions

The actions described below are based off the IBCCs No and Low Regrets Action Plan, the work of the Water Conservation Technical Advisory Group, the work of the Basin Roundtables, and utility water conservation plans.

Support Foundational Activities for all Water Providers:

The State of Colorado should provide incentives and support local efforts to implement foundational activities such as water budgets, smart metering, comprehensive water loss management programs, and improved data collection on customer water uses.

Better Tracking and Quantification:

The CWCB should provide technical and financial assistance for the creation of savings tracking tools, savings estimating tools and other technical resources for water providers.

WaterSense Specifications for Outdoor Irrigation Technology:

The State of Colorado should consider adoption of WaterSense specifications for outdoor technology at the retail level. These specifications create a minimum standard that can be adapted easily to accommodate higher efficiency technologies as they are created and certified.

Incentives for outdoor water conservation measures:

The CWCB should provide incentives for retrofitting higher water landscape with lower water landscapes, more efficient irrigation systems and selectively siting higher water use landscapes to create more appropriate use areas would help garner higher levels of water savings.

Statewide No/Low Regrets Target + Stretch Target Discussion:

In addition to the 170,000 acre-foot goal of active conservation that needs to be achieved regardless of which future scenario Colorado may face, a stretch goal should be considered. At the request of the IBCC Water Conservation Subcommittee, CWCB will support a stakeholder process that examines various options, including options for local providers to establish targets consistent with the goal.

Water Conservation Education and Outreach:

The State of Colorado should implement far reaching education and outreach measures that include water conservation topics. More detail regarding specific education and outreach recommendations are detailed in Section 9.5. Education and outreach that include water conservation topics will help to create water stewards across different segments of the population from children to adults to elected officials to citizens. The education and outreach recommendations outlined in Section 9.5 will tie together the other actions illustrated within this section and provide the “why” for carrying out these actions. For example, actions could include education for land use planning professionals. Additionally, these efforts could be rooted in each BIP and carried out to address specific issues that occur in each basin. As part of this work, surveys of public attitudes will need to be carried out and partnerships with water providers and other water educators will also be critical in accomplishing these tasks.

Support Local Water Smart Ordinances:

The State of Colorado should support local regulatory efforts that shape how new construction interacts with water use to accomplish local water conservation goals. For example, local jurisdictions could craft landscape and irrigation ordinances, tap fees that reflect actual water uses and more stringent green construction codes that include higher efficiency fixtures and appliances and more waterwise landscapes.

Encourage education of landscape professionals:

The State of Colorado should encourage robust professional education and certification programs for the landscape industry. Industry best practices could be tied to local ordinances making a consistent approach for the landscape industry to be more successful and be more water efficient. Green Industries of Colorado (GreenCO) have shown support for this type of regulation in the past as a way to level the playing field and encourage the highest level of professionalism.

Strengthen Partnerships:

The CWCB should create or renew partnerships between the CWCB and the following groups to reach our water conservation goals:

- a. Local Water Providers- Probably our most important partners in that they carry out water conservation programs to benefit their water system.
- b. Intra-state government (Department of Local Affairs, Division of Water Resources, Department of Regulatory Agencies and State Facilities).
- c. Green Industry (GreenCO, Irrigation Association, Associated Landscape Contractors of Colorado).
- d. Home Building/Construction (Home Builders Association, LEED, U.S. Green Building Council).
- e. Non-Governmental (Colorado WaterWise, Alliance for Water Efficiency, Western Resources Advocates, American Water Works Association, Water Research Foundation).
- f. Academia (Colorado State University, CU-Boulder, CU-Denver, One World One Water Center-Metropolitan State).

Funding:

The CWCB should maintain current funding through the Water Efficiency Grant fund, the Water Supply Reserve Account and add creative funding sources such as expanding the CWCB's loaning ability to encompass conservation actions. As Colorado water providers implement more sophisticated and integrated water conservation programs, annual funding for the Water Efficiency Grant Program will be required beyond current levels of \$500,000. In addition, more consistent WEGP funding will be necessary. The use of funds to implement water conservation activities statewide is a wise investment because these are some of the most inexpensive strategies that can be implemented today and will allow local water providers to be more efficient with the water resources they already have.

Market for conserved water:

The State of Colorado should investigate the following points:

- g. Identify and, where possible, resolve legal and administrative barriers to the use of conserved water.
- h. Identify and explore barriers to sharing conserved water.

The use of and sharing of conserved water has been discussed extensively in the IBCC and state water supply planning process. The SWSI 2010 water conservation section stated that even though the section illustrated a range of potential water savings it did not necessarily translate those into closing the gap due to the legal, temporal, or spatial availability of conserved water.

Changing Threshold for Covered Entities:

The CWCB should revise C.R.S. 37-60-126, which defines a covered entity as delivering more than 2,000 acre-feet annually, to reduce the threshold from 2,000 acre-feet down to 1,000 acre-feet. This would increase participation in municipal water conservation statewide as covered entities are required to have a CWCB approved water conservation plan. Any revision to this legislation should be accompanied by more funding for water efficiency grants, including grants to help smaller municipalities develop conservation plans.

Continue implementation of state conservation programs:

- i. Conservation plan review and approval: The CWCB should continue reviewing and approving locally adopted water conservation plans in order to encourage long-term water conservation planning and quantification of water savings, and to ensure that water providers document their water conservation goals.
- j. Water Efficiency Grant Fund: The CWCB should continue using the Water Efficiency Grant Fund to ensure the implementation of water conservation best practices and to assist water providers with targeting their resources as efficiently as possible.
- k. Targeting of communities with strategic conservation potential: The CWCB should focus on opportunities for water conservation planning in areas where there are covered entities or a number of small water providers that can create a regional water conservation plan. This should especially be the case when conservation in such communities could help reduce the M&I water supply gap or lessen the need for agricultural dry-up or impacting nonconsumptive values.

As Colorado looks to the future, water conservation will play an important role in managing our finite water resources. This section illustrates that there are a number of mechanisms and tools that can be employed to create a successful water conservation approach that diminishes the gap between supply and demand. The combination of foundational measures, incentives, regulation, education, and partnerships creates a holistic approach to efficient water resource management that one or two of these approaches by themselves cannot accomplish. By creating a holistic prioritization framework, this management system can define the arena in which water efficiency can take place in the future by creating pricing incentives, monetary incentives, regulations that shape actions and education that transforms Coloradans from water customers into water stewards.

6.3.2 Municipal Reuse

As mentioned in Chapter 5, there are various sources of water that can be reused to extinction such as: water from transbasin diversions, agricultural-municipal water transfers, and nontributary groundwater. Reuse water will have an impact on future demands and the following describes future actions that will benefit Colorado. There are a number of innovative reuse projects already in existence and there are a number of areas in the United States that are exploring future pathways in reuse technologies.

Nationally and internationally, research has begun to focus on potable reuse systems. In Colorado, most reuse systems have been non-potable in nature. However, widespread unintended or “de facto” potable reuse occurs where one community discharges to receiving waters that is used by downstream communities for potable supply. This process is controlled by water quality standards in the receiving waters (which drives discharge permits from water reclamation facilities) and Safe Drinking Water Act requirements for potable treatment. Intentional indirect potable reuse (IPR) projects are increasingly common, such as Aurora’s Prairie Waters Project and Town of Parker’s use of water from its water reclamation facilities to supply Rueter-Hess Reservoir.

Direct potable reuse projects (DPR), with no discharge to receiving waters or “environmental buffers,” have recently been implemented in New Mexico and Texas, while Denver Water pioneered DPR research with its potable reuse demonstration project in the 1980s. Due to severe drought and serious long term water resource challenges, the Colorado River Municipal Water District (water provider for Big Springs, Texas) has undertaken an initiative to “reclaim 100 percent of the water, 100 percent of the time.” This goal is technically feasible today, but more research will be needed to assure regulators and to gain public acceptance.¹⁷²

Recently, the California legislature established statewide goals for the use of recycled water and mandated a feasibility study by 2016 to investigate developing uniform water recycling criteria for DPR. The WaterReuse Research Foundation, with WaterReuse California, created the Direct Potable Reuse Initiative in 2012 to advance DPR as a water supply option in California. The DPR Initiative has raised approximately \$6 million to carry out innovative research, such as public acceptance, critical control points, source water control, and development of an operations plan.¹⁷³ Individual utilities and organizations like the Water Research Foundation are also funding DPR related research. Additionally, the National Research Council has recently published a book outlining fourteen research priorities for reuse water.¹⁷⁴

Widespread development of potable reuse should be an important facet of closing the future water supply-demand gap. CWCB has funded research into zero liquid discharge over the last few years to assess the technology needed to address the challenges associated with managing residuals from advanced treatment of alternative water supplies from lower quality water sources. Most recently, Brighton and La Junta were picked as pilot sites to investigate the feasibility of concentrate minimization and pilot test a concentration minimization/ZLD technology suitable for Colorado. The study found that the technology produced excellent water quality and had a very high recovery rate of 96 percent and 90 percent for the La Junta and Brighton pilot sites, respectively. Although

the technology reduced concentrate and increased water recovery rates, more research must be conducted to reduce costs, increase the reliability of the technology and create a more user friendly technology before widespread adoption can occur in Colorado.¹⁷⁵

On a smaller scale, the governor signed legislation that authorized the CDPHE's Water Quality Control Division (WQCD) to develop Regulation 86 with standards for the use of graywater for consideration by the Water Quality Control Commission (WQCC). Graywater is defined by the bill as wastewater collected within a building from sources other than toilets and urinals, kitchen sinks, dishwashers, and non-laundry utility sinks.¹⁷⁶ Following the promulgation of Regulation 86, counties and municipalities may adopt local legislation to allow graywater use. Graywater use is limited to the uses allowed under the well permit or water right of the original source or sources of the water. As of April 2014, the WQCD is working with the Colorado Plumbing Board to create plumbing design standards for graywater systems before developing treatment and control standards. Graywater could be an important component of new construction.

As briefly described in Chapter 5, Regulation 84 has adapted over the years to accommodate changes and advances in the science of reuse water. Regulation 84 was created in 2000 and has been amended four times since then to add new uses. As Colorado plans its reuse future, continued flexibility will be paramount to addressing water resource challenges. However, Regulation 84 has not been interpreted to be the controlling regulation concerning reclaimed water. Instead, CDPHE has determined water providers using reclaimed domestic wastewater are also subject to numerous other regulations applicable to surface and groundwater discharges, which create administrative and economic burdens. Reuse in Colorado lags far behind many other states, especially considering Colorado's arid climate. Reuse is critical to many municipalities in addressing identified supply gaps in Colorado, but without significant progress on the ease of implementation, the gains forecasted may not be realistic. New use approval is now a process that can take multiple years and thousands of dollars for uses that are common practice throughout the U.S. and the world. Also, new regulations are in effect that were not contemplated in the original Regulation 84 that make storage, distribution, and even basic irrigation problematic for some treaters and users. The application of water quality regulations to reuse water should be examined to identify potential change to foster permanent growth in the reuse of limited water supplies.

Despite momentum toward more reuse planning and implementation in Colorado, barriers such as public acceptance of DPR, costs of treatment for lower quality water sources, and regulatory uncertainties are real issues that must be addressed. Additionally, the issue of reduced return flows has many water providers and agricultural users concerned about downstream impacts of increased reuse of water supplies. Many downstream users are concerned that return flows they have relied upon historically will not be available in the future. Future research should be directed toward the possible impacts on return flows from the reuse of water.

Reuse Projects

There are 25 treating reuse providers of direct nonpotable recycled water in Colorado, referred to as "treaters" in Regulation No. 84. Most of these water providers are on the eastern slope along the

Front Range. In addition, there are numerous examples of indirect reuse through exchange occurring around the state.

As mentioned in the IBCC's No/Low Regrets Action Plan, Colorado examples of direct and indirect reuse projects are:

Colorado Springs Utilities: Colorado Springs Utilities has produced reuse water for over 50 years in the form of direct reuse for irrigation and cooling. Irrigation consists of water to golf courses, parks, campuses, and other properties, while cooling water is used for the cooling towers at the Drake Power Plant. According to Colorado Springs Utilities, this has yielded a savings of 1 billion gallons of drinking water per year.

Aurora Water's Prairie Waters Project: This project is indirect potable reuse where Aurora's fully reusable water is extracted from the South Platte River near Brighton through river bank filtration wells, into aquifer recharge and recovery basins, and then pumped back through 34 miles of pipeline and three pumping stations providing nearly 1000 feet of lift to the Peter D. Binney Water Purification Facility near Aurora Reservoir. The water is partially treated through natural filtration in the RBF wells and ARR basins, and then fully treated at the Binney facility before mixing with existing water resources and distributing to our customers. The current capacity of the system is approximately 10 MGD, expandable to 50 MGD.

Denver Water: Denver Water has an extensive nonpotable water reuse system that serves many large customers such as Xcel Energy, parks, golf courses, and the Denver Zoo. This recycled water system is a direct reuse system and has a treatment capacity of 30 million gallons per day, expandable to 45 million gallons per day. Denver Water continues to add sites to its nonpotable water distribution network towards its goal of 17,500 acre-feet per year of recycled water use.¹⁷⁷

Interbasin Compact Committee (IBCC) No and Low Regrets Actions

In 2013, the IBCC developed the "No and Low Regrets Action Plan" for water reuse.¹⁷⁸ This strategy outlines what minimum level of water reuse should be carried out statewide (Table 6.3.2-2).

Table 6.3.2-2: IBCC No and Low Regrets Actions

Completed and Ongoing Actions	Potential Future Actions
• Continue to support current reuse IPPs. • Continue to incorporate reuse in the state water planning process. • Continue the study of zero liquid discharge reverse osmosis plants through the Water Supply Reserve Account (WSRA) program.	1) Improve Tracking, Quantification, and Planning a) Utilize SWSI efforts to improve reporting of reuse IPPs b) Develop BIPs that incorporate reuse 2) Establish a Statewide Reuse Goal with Intermittent Benchmarks a) Develop general political support for a statewide reuse goal b) Develop statewide agreement tying reuse to new supply development and agricultural transfers c) Encourage relevant local entities to outline and report their own approaches to help achieve the statewide goal 3) Develop New Incentives for Reuse a) Explore funding options in support of the WSRA grant program b) Pursue breakthroughs in research c) Develop incentives 4) Implement Education and Outreach Efforts a) Track public attitudes through baseline and ongoing surveys

Basin Implementation Plans

Reuse of water has appeared in a few Basin Implementation Plan drafts where many basins have created the following draft goals.

Arkansas Basin

The same goals of meeting municipal water needs apply in the reuse section as the water conservation section. The Arkansas Basin has the following four goals for meeting municipal water needs that were identified by the roundtable:

- Meet the municipal supply gap in each county within the basin;
- Support regional infrastructure development for cost-effective solutions to local water supply gaps;
- Reduce or eliminate Denver Basin groundwater dependence for municipal users; and,
- Develop collaborative solutions between municipal and agricultural users of water, particularly in drought conditions.¹⁷⁹

While there are reuse projects occurring now in the Arkansas basin, such as the Southern Delivery system, and other reuse projects by Colorado Springs Utilities and Zero Liquid Discharge research in La Junta, the Arkansas Basin has outlined some of the opportunities and constraints for future reuse development. Some opportunities outlined are the creation of additional storage, including the Long-Term Excess Capacity Master Contract space in Pueblo Reservoir, and new reservoirs, which could include a lined gravel pit reservoir below the confluence with Fountain Creek to capture transbasin return flows not immediately exchangeable to Pueblo Reservoir. Constraints consisted of the difficulties of reusing more water in the already over-appropriated Arkansas River system. The needs will be met from better management of existing supplies that include transbasin water supplies but will need extensive engineering studies and legal support to be done correctly.¹⁸⁰

Colorado Basin

The Colorado Basin is focusing on efforts that include developing water court process recommendations to encourage improvements in efficiency, conservation, and reuse.

This goal is supported by measurable outcomes such as revising Colorado water law to allow more flexibility in promoting stream health through conservation and achieving and sustaining a high level of conservation by all basin water providers. The Colorado Basin identified projects and methods to implement these goals such as comparing Colorado water law and procedures with other Western states to identify alternative practices to facilitate water transfers, and various local water conservation efforts happening today and those planned for the future.¹⁸¹

Gunnison Basin

The Gunnison Basin framed their reuse discussion based on criteria for new supply projects using Colorado River Basin water. Conservation, land use, and reuse are all represented in the criteria. Reuse criteria is stated as, "Entities must first reuse all legally available reusable water supplies to the maximum extent possible prior to further development of Colorado River System water."¹⁸²

North Platte and Rio Grande Basin

Neither the North Platte nor Rio Grande Basin uses reuse as a future strategy to close their supply gaps because of relatively minor water use by municipal users and low population numbers.

South Platte/Metro Basin

The South Platte/Metro Basin has an overarching theme of continuing "its Leadership Role in efficient use and management of water. . . .The State's future, and the future of each of its river basins, depends on efficient, sustainable and collaborative solutions."¹⁸³

The South Platte/Metro Basin is viewing reuse water in the context of the Colorado River. Their initial goals state, "A balanced program to plan and preserve options to responsibly develop Colorado River water to benefit both east slope and west slope consumptive and nonconsumptive water uses is needed to assure that the State's plan has equal focus on the previously identified strategies including: 1) developing IPPs, 2) municipal conservation and reuse, 3) agricultural transfers, and 4) new supply."¹⁸⁴

They also have the following goal and measurable outcomes in relation to reuse. The South Platte River Basin “will maintain and enhance current levels of municipal water reuse and consider studies to quantify the effects of: 1) additional municipal water conservation on water available for reuse, 2) additional municipal water reuse in relation to water available for exchanges, and 3) reuse and successive uses of water downstream including effects on agricultural water shortages.”¹⁸⁵ In relation to non-consumptive needs they will ensure conservation, reuse and drought management plans consider environmental and recreational focus areas and attributes.¹⁸⁶

Basin	Providers	Project	Estimated Yield (AFY)	Estimated Completion Date
Metro	Aurora	Prairie Waters Project Expansion and Storage ¹	TBD	2050
Metro	Northglenn	Northglenn Reuse Plan	700	
Metro	Thornton	Thornton Reuse	2000	2030
Metro	Denver Water	Denver Water Reuse	17500	2023
Metro	Westminster	Westminster Reclaimed Water		
Metro	Denver Water	Downstream Reservoir Exchanges	12000	
Metro	Castle Rock	Alternative Northern Water Supply Project	2500	
Metro	Castle Rock	Plum Creek Diversion and WPF Upgrades	4100	
Metro	ACWWA	Reuse of ACWWA Flow Project Deliveries	3250	
Metro	City of Brighton	South Platte and Beebe Draw Well	3200	
Metro	SMWSA, Denver Water, Aurora	WISE	7225	2021
South Platte	Erie	Erie Reclaimed Water	5390	
		TOTAL:	58,135	

¹The yield of PWP expansion depends on the yield of other projects such as the Eagle River Project, Box Creek and Growth into existing supply, in addition to the future demand scenario used to calculate Aurora's remaining gap.

Regional cooperation on reuse projects, like the Water Infrastructure and Supply Efficiency (WISE) project in the Metro area, can help further stretch locally available supplies. WISE agreements have been executed and deliveries will begin in 2016 and reach a full delivery of 10,000 acre feet/year (on average) by 2021. The project utilizes available reusable supplies from Aurora Water and Denver Water, diverted and delivered through Aurora's Prairie Waters collection and treatment system. However, some municipal supplies, including the Colorado-Big Thompson Project, are single use water supplies and cannot be reused by municipal water users.

The South Platte/Metro Basin did raise some concerns about the limitations of reuse and how reuse affects downstream users. Some of the technical limits of reuse were infrastructure capacities, losses, supply and demand timing, water quality, treatment costs and brine disposal, and regulatory requirements. A major issue is that most reuse will be from reusable return flows and that these flows will be constrained in the future. The amount of successive downstream water use constrains the ability to either exchange water upstream or to convey it back upstream for future water needs.¹⁸⁷ For many of the cities in the South Platte and Metro Basins, achieving higher levels of reuse will require moving to some form of potable reuse, which will require more in energy, treatment, operating, and infrastructure costs.¹⁸⁸

The South Platte/Metro Basin calls for the use of maximizing lower quality sources, such as wastewater. The basin implementation plan calls for looking at Indirect Potable Reuse, Direct Potable Reuse, and Zero Liquid Discharge. Additionally, they call on the state "to continue to evaluate projects and methods that more efficiently use water from all sources, maintaining a proactive role in investigating technologies capable of treating low quality water sources will better inform future water supply decisions. The State needs to direct the Colorado Water Quality Control Commission to look for ways to assist and facilitate reuse."¹⁸⁹

Southwest Basin

The Southwest Basin has a goal to "Support and implement water reuse strategies" using an educational strategy. The basin proposes to implement at least three different informational events around reuse efforts during which they will highlight tasks, tools, and strategies.¹⁹⁰

Yampa/White/Green Basin

The Yampa/White/Green Basin addresses reuse in the context of a trans-mountain diversion to the Front Range and not necessarily as a strategy for the basin to undertake firsthand.

The basin states that "Prior to undertaking development of a new trans-mountain diversion, the Front Range must first integrate all other water supply solutions including conservation, reuse, and maximize use of its own native water resources and existing trans-mountain supplies."¹⁹¹

Actions

Improve quantification, planning and tracking for potential reuse projects:

The State of Colorado should conduct more research on how much water is currently being reused, how much potential there is for reuse, and how much water providers plan to reuse. As a future planning effort, regional reuse plans and projects should be explored to use economies of scale.

Research and development of additional reuse options:

The State of Colorado should encourage and provide incentives for research and development in reuse water for food crop irrigation, indirect potable reuse expansion, and direct potable reuse projects.

Improve the Regulatory Environment:

The State of Colorado should examine the application of water quality regulations to reuse water to identify potential change to foster permanent growth in the reuse of limited water supplies. As Colorado plans its reuse future, continued flexibility will be paramount to addressing water resource challenges.

Explore incentives and funding:

The CWCB should use WSRA grant funds to expand research into areas such as zero liquid discharge, IPR and DPR, examining regional opportunities, and the ability to share reuse water. The CWCB Loan program should be considered for expansion into these types of supply projects and could be used for developing regional reuse projects. Additionally, State Revolving Fund loans, Bureau of Reclamation Title XVI Water Reclamation and Reuse Programs, and other Federal WaterSmart grants could be used to support more reuse development in the future.

Support Reuse Education:

The State of Colorado should support stronger education to describe the benefits of reuse water as an integral part of a water supply system for the potential of reuse to be fully realized. More detail regarding specific education and outreach recommendations are detailed in Section 9.5. Researchers have studied how people understand drinking water reuse in the context of the urban water cycle and whether education would increase acceptance of drinking water reuse projects.¹⁹²

Consider mechanisms to improve the ability to market, sell, and share reusable supplies:

The State of Colorado should investigate incentives that better allow for reuse water to be marketed to water providers outside a service area and could make building a reuse project more desirable.

6.3.3 Land Use

As Colorado grows, land use planning and water planning will become more closely connected through integration of principles from both disciplines. Integration does not mean the dilution of local control. Private property rights, 1041 powers, and local zoning and development control will not be diminished by connecting these planning disciplines. The potential exists for financial incentives, best practices, partnerships, and technical resources to better coordinate and enhance both land use and water planning.

The manner by which Colorado develops into the future will have a strong influence on Colorado's future water supply gap and vice versa. The CWCB began preliminary work in this arena in 2009 by hosting the *Water and Land Use Planning for a Sustainable Future* conference and in 2010 by creating an associated report and density memo describing several actions that bridge land and water issues.^{193 194} Recently, urban land use has been a major discussion point at the IBCC, which incorporated several options into the Water Conservation No and Low Regrets Action Plan. Additionally, at the July 24, 2013 Joint Front Range Roundtable meeting, 92 percent of the participants strongly agreed or agreed to the recommendation that water supply planning and land use planning should be coordinated. At that same meeting, 55 percent of the participants agreed that "coordination of urban land planning and water supply planning" was the most important conservation recommendation to discuss that day.¹⁹⁵

The following projects and initiatives illustrate these recommendations and are occurring today in Colorado.

Net Zero Water

The Colorado Water Innovation Cluster is researching Net Zero Water through a CWCB Water Efficiency Grant and has assembled a large stakeholder group to create a Net zero Water planning template, guidebook and toolkit.¹⁹⁶ Net Zero Water is a water management concept that mitigates the water quantity and quality impacts through best practices incorporated into the development or management of a site. Net Zero Water can be applied to a building site or a more regional scale and connects water management to land use planning. The Net Zero Water Planning Template, including the guidebook and toolkit, will help users quantify their water footprint, evaluate reduction strategies, and recognize financial and environmental benefits from reducing their water use and water quality impacts.¹⁹⁷

Denver Regional Council of Governments Water Conservation Vision, Goal, and Policies

Vision: The Denver metro region will maximize the wise use of limited water resources through efficient land development and other strategies, recognizing that no single strategy will meet the state's water needs and the region will need to pursue a range of strategies concurrently.

Goal: Reduce regional per capita municipal and industrial water use by working with municipalities, counties, water providers, and other stakeholders within the next 6 to 12 months (February 2012) to identify a specific numeric target or measurable benchmark against which to measure progress.

Policies

1. **Regional Collaboration.** DRCOG will bring together local governments, water providers and other stakeholders to facilitate collaborative efforts to promote water conservation.
2. **Best Practices.** DRCOG will work to increase understanding of the link between land development and water demand, and to identify best practices for promoting the efficient use of water resources across the region.
3. **Efficient Land Development.** Compact development, infill and redevelopment consistent with DRCOG's urban growth boundary/area and urban centers policies will help reduce water demand and related infrastructure costs.

Source: DRCOG MetroVision 2035:34

Land Use Leadership Alliance

A recent collaborative effort involving water planners and land use planners from local jurisdictions is moving the dialogue forward. Pace University School of Law's Land Use Law Center brought their Land Use Leadership Alliance training program to Colorado. This training convened land use and water planners along with city managers, city council members, developers, regional government planning groups, and CWCB staff for four all-day sessions focused on the land use and water planning nexus. These sessions proved very productive for developing strategies for better integration of land and water planning, and also assisting in the development of relationships between land and water planners within and between municipalities.¹⁹⁸ This collaboration is a model for integrating local planning efforts within a local government and into regional planning efforts.

Denver Regional Council of Governments MetroVision

The Denver Regional Council of Governments (DRCOG) has also been exploring the nexus between water use and land use patterns in recent years. Adopted in 2011, the latest *Metro Vision 2035* document for the first time includes a section that ties water conservation to land use planning. Denver Regional Council of Governments has a goal of increasing housing density by 10 percent between 2000 and 2035.¹⁹⁹ According to Denver Regional Council of Governments' most recent analysis, the region has increased density by 5.3 percent since 2000. This data suggests that the region is well ahead of reaching the 10 percent projected goal by 2035.²⁰⁰ This 10 percent increase would produce approximately a 5 percent decrease in water use in the residential housing sector. The 5 percent equates to 31,000 to 46,000 acre-feet of savings for the Denver metro area depending on population growth. This includes existing population and new population. At the medium population growth, this is nearly 42,000 acre-feet of savings annually.²⁰¹

Colorado Water and Growth Dialogue

The CWCB is funding a project to estimate the demand reductions from various land use patterns with a WEGP grant that addresses the water and growth dilemma. The Keystone Center secured funding from a number of grantors including the CWCB to complete a two-year dialogue that will bring together water providers, land use planners and developers, public officials, and other key stakeholders. The goal is to identify meaningful strategies, practices, and policies that will help Coloradans achieve a measurable reduction in the water footprint of new development and redevelopment and move closer to a long-term balance between water use and growth. This water and growth project will create a report and roadmap that describes the most promising strategies for addressing the water and growth dilemma in Colorado, along with specific recommendations for implementing and disseminating the strategies.²⁰²

Recent Legislation

In 2008, the governor signed legislation that required that building permit applications for developments of more than 50 single-family equivalents include specific evidence of an adequate water supply, defined as one sufficient for the development through build-out in terms of quality, quantity, and dependability. The developers must submit proof of adequate supply to the local government through a report from a professional engineer or water supply expert that identifies

the water source and the types of demand management appropriate for the site. Under this law, a local government was permitted to make the adequacy determination only once at the beginning of the development permit approval process.²⁰³ In 2013, the governor signed legislation that modified the definition of the term "development permit" to clarify permits may be granted for individual stages in the development permit approval process, rather than for the entire development.²⁰⁴

Basin Implementation Plans

Each Basin Roundtable is formulating their own implementation plan that will include land use goals and activities in addition to already planned projects and methods which are explored throughout Chapter 6.

Arkansas Basin

The Arkansas Basin states that while each community should decide how the conversation between land use and water supply planning should take place, it needs to occur and be detailed and robust.²⁰⁵

The Arkansas Basin references the EPA WaterSense New Home Specification, which is independently certified and uses 20 percent less than a typical home. This is offered as a link between land use and water supply planning that has worked in the Arkansas Basin. Colorado Springs had the first WaterSense home built in Colorado and has been actively working to increase the number of WaterSense homes. The basin implementation plan also points to the need "to provide the educational content needed to elevate the skill sets of landscape practitioners, as well as utility and municipal employees who will evaluate and inspect plans, installation, and maintenance practices."²⁰⁶

Colorado Basin

The Colorado Basin Implementation Plan set a goal, measurable outcomes, and short- and long-term needs, and projects and methods related to land use and that connect to water conservation.

- The goal is to "develop land use policies requiring and promoting conservation." The measurable outcomes associated with this goal include:
- Developing recommendations for city, county, and state governing bodies promoting water awareness and efficiency in land use policy.
- Developing educational material or opportunities for elected and planning officials on water supply issues and conservation options.
- Preserving agriculture by reducing the transfer of agriculture water to municipal use.²⁰⁷

The Colorado Basin also set out short term needs, long term needs, and projects and methods to accomplish this goal. In the short term, they will review existing land use regulations for water conscious development requirements and evaluate potential growth in unincorporated areas and water supplies to those areas. In the long term, they will provide financial support to local jurisdictions to implement water conscious development requirements and draft recommended model basin and Statewide land use planning guidelines that focus on water conservation and

water efficient land use development. As for projects and methods to accomplish the goal, the Colorado Basin suggests that statewide grant opportunities should be created for local jurisdictions to review land use regulations, conduct public outreach, and implement regulations. Additionally, current governmental council should develop model land use regulations and every county and city within the basin should have conservation plans with identified goals. Additionally, the plan also asks that the state land use regulations be evaluated to meet long term exponential state population growth (and water demand) with a limited water supply.²⁰⁸

Gunnison Basin

As with other Basin Implementation Plans, the Gunnison Basin Implementation Plan ties land use to water conservation and demand management. Demand management strategies supported by the Gunnison Basin include growth only in proximity to existing or planned infrastructure, high density versus urban sprawl, and landscape limitations. Development in proximity to existing infrastructure should be encouraged only in non-productive, or the least productive, land to preserve productive agricultural land. The Gunnison Basin believes that land use policies are essential to promoting both water and land conservation. Local land use policies and regulations should discourage sprawl, link water supplies to development, and provide incentives for higher density developments.²⁰⁹

North Platte Basin

Due to low population and little municipal use, the North Platte Basin did not address land use in their plan.

Rio Grande Basin

As stated previously in this chapter, the Rio Grande Basin has a low population and relatively minor municipal water use. The Rio Grande Basin does not address land use the same way the more urban water basins have but instead describes the use of conservation easements to manage land development. The conservation easements preserve agricultural land as well as environmental attributes.²¹⁰

South Platte/Metro Basin

According to the South Platte/Metro Basin, municipal water departments are tasked with meeting a large portion of the water supply needs in the South Platte Basin and are already using programs such as water audits, rebates for efficient water fixtures and appliances, and education to reduce demand. These efforts could be more effective if water departments worked with their respective planning departments to plan and require water efficient usage and land development within their city. For instance a water department can work with its planning department to implement water efficient landscaping codes, subdivision regulations, zoning requirements, and master plans.²¹¹

Nevertheless, the current roles of many water utilities are generally limited to providing for water needs within their service areas and do not cross over to land use authority. The South Platte/Metro Basin discusses the current situation of land use authority and water provider authority, opportunities for collaboration, and examples of current work in this arena. The plan describes the issue that has made collaboration between water and land use planning difficult in

the past. The South Platte/Metro Basin states that, “The primary responsibility held by water utilities is to provide for water needs within communities. Coordinating or integrating the land use and water planning process is a relatively new area being explored for reducing municipal water use. Increasing awareness of limited future water supply opportunities and the potential impacts of climate change helps to spur this integration of planning.”²¹²

- The South Platte/Metro Basin states that there are opportunities that exist today for closer collaboration and reduction in water use through more integrated land use planning. These include:
- Updates to Comprehensive Plans,
- Changes to zoning requirements,
- Revising water/land use subdivision regulations, and
- Using the direction provided by the State Water Engineer and recent legislation.²¹³

As part of the opportunities the plan states that “Increasing residential density has the potential to significantly improve water use efficiency and will continue to result in reduced impacts on natural resources. The highly urbanized areas of the Front Range corridor have many opportunities to redevelop lands for higher population densities.”²¹⁴

A few of the projects highlighted by the South Platte/Metro Basin are the Keystone Center Land Use Study and the Land Use Leadership Alliance Training program (LULA). The Keystone Center project will identify land use patterns across the metro area and find ways to integrate land and water planning more closely. The LULA training program “focuses on finding land use solutions to the challenges posed by growing Front Range populations and Colorado’s limited water resources. The LULA program is designed to help local land use and water leaders create new networks of support, identify successful land use techniques, and develop implementable local strategies that will enable a more ‘water-smart’ future for the region.”²¹⁵

Southwest Basin and Yampa/White/Green Basin

Neither the Southwest nor the Yampa/White/Green Basins described projects or plans for land use in their basin implementation plans.

Actions

Encourage the use of local development tools:

Through technical and financial support, the CWCB, in partnership with other state agencies, will encourage local governments to do the following:

Expedited permitting for buildings and developments with high levels of density that incorporate certain water efficiency measures, such as efficient irrigation systems (with plan check and install check);

Climate appropriate plant lists;

Soil amendments;

Maximum irrigable area or WaterSense certified landscapes;

Tax incentives for developments that incorporate certain water efficiency measures or high levels density;
Structured impact (tap) fees designed to promote water-wise developments and in-fill; and
Water budget rate structures to help maintain initial projected water budgets for a site.²¹⁶

Strengthen Partnerships:

To be successful in integrating land use and water planning, the CWCB will need to partner with many different agencies and groups.

Local Municipalities/Local Water Providers- These entities will carry out water and land use plans. Without their partnership and support of new ideas, comprehensive water and land planning will not succeed.

Department of Local Affairs (DOLA)- DOLA is involved in the land use and local government arena. Like the CWCB, DOLA also has grant funding that could be leveraged for water-land use planning initiatives, such as incentives for incorporating water supply into comprehensive land use planning.

Department of Regulatory Agencies (DORA)- DORA regulates professionals in various industries and works to create a fair marketplace. DORA might focus on the landscape and irrigation industry or the property management industry and could develop certifications for these industries to conserve water.

Home Building/Construction (Home Builders Association, LEED, U.S. Greenbuilding Council).

Non-Governmental (Keystone Center, Alliance for Water Efficiency, Western Resources Advocates, American Planning Association, economic development councils).

Academia (Colorado State University, University of Colorado Boulder, University of Colorado Denver, One World One Water Center-Metropolitan State).

Land Use Leadership Alliance- This organization brings an innovative training model that could change the way Colorado looks at this subject by breaking down institutional silos.

Councils of Governments- These entities make the connection between local and state level.

Funding:

The CWCB should use Water Efficiency Grant funds and Water Supply Reserve Account grant funds to fund aspects of the land use and water planning nexus. WSRA funds could be used for larger regional efforts tied more directly into the Basin Roundtables, while the WEGP funds can be used for smaller more localized efforts.

Education/Training:

The CWCB should provide incentives and technical assistance to develop training based on the Land Use Leadership Alliance model. This would create a culture of collaboration between land use and water supply and demand planning. This is a necessary first step to integrating land use and water supply and demand planning in Colorado.

6.3.4 Agricultural Conservation, Efficiency, and Reuse

Introduction

Recognizing the fact that agriculture uses between 80 to 90 percent of water in Colorado, water managers and policy makers have long discussed the various opportunities for agricultural conservation, efficiency, and reuse to provide new water supplies to meet future needs. In fact this discussion has been going on for decades and has generated a significant amount of research and publications. For example, in 1992 the CWCB reported to the General Assembly on “An Analysis of Water Salvage Issues in Colorado” and Colorado State University did an extensive review of these issues in a 1996 report *“Irrigation Water Conservation: Opportunities and Limitations in Colorado – A Report of the Agricultural Water Conservation Task Force, Completion Report No. 190”*. In 2008, the Colorado State University in partnership with the Colorado Water Agricultural Alliance updated the 1996 report with *“Opportunities and Challenges Associated with Potential Agricultural Water Conservation Measures.”* As observed in those reports discussion of agricultural water use often gets confounded by imprecise use of terms and a poor understanding of agricultural water systems. This section presents a basis for an analysis using a common understanding of terms and hydrologic facts. While consistent use of nomenclature is important, it is essential that discussions of potential changes to agricultural water use include accurate and complete descriptions of the actual increments of water involved.

Background on Agricultural Water Use and Losses

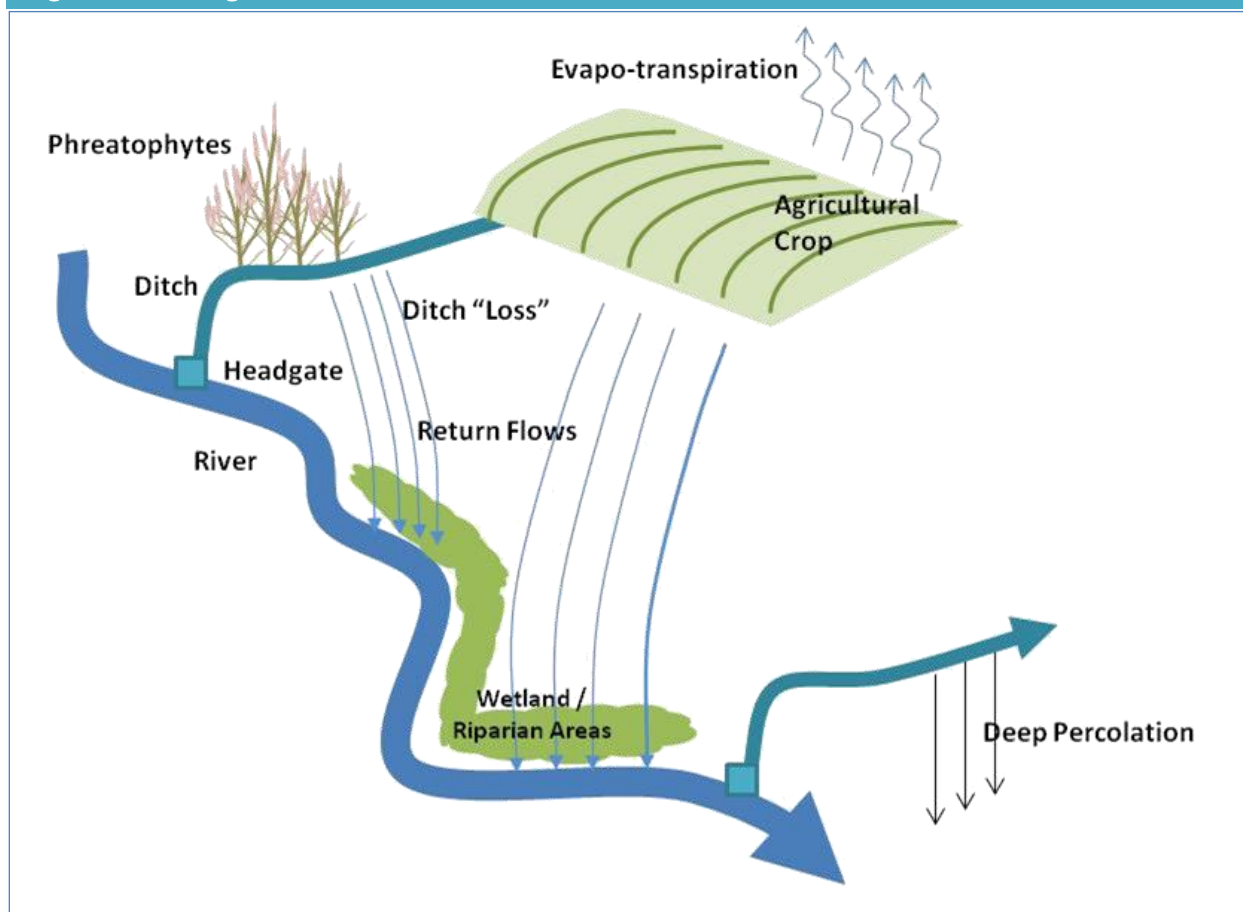
Where rainfall is insufficient irrigation water is diverted from surface water sources via delivery systems and from groundwater aquifers via wells and delivered to fields to meet crop needs. In some cases a deep rooted crop may withdraw water directly from shallow groundwater areas through a natural process known as subirrigation. The goal of irrigation is to provide sufficient water to the crop's root zone to meet crop consumptive use which occurs through evaporation and transpiration (ET, also known as evapo-transpiration) from the growing plants and adjacent soil surfaces. Plants transpire water during photosynthesis and also incorporate a small portion of the water into the plant tissue. Through ET water taken up by the roots of a crop is permanently removed from the local hydrologic system. Crop ET is the measure of the beneficial use of an irrigation water right, however it cannot be readily measured directly. Rather ET is a calculated amount based on the factors that influence ET: crop type, growing season, and daily climatic conditions.

During the process of irrigation some of the diverted or pumped water never reaches the crop and is considered “lost”. Some of these losses are consumptive, others are not. Delivery losses occur through leakage from ditches and canals into the local groundwater system and evaporation from open water surfaces. On-farm losses occur when water is applied to the fields at a rate that exceeds the ability of a given soil type to absorb or hold that water or when moisture is lost through evaporation from the soil surface. Water in excess of a soil's holding capacity will deep percolate below the crop's root zone into the underlying groundwater system and is no longer available for crop use. Deep percolation raises the local groundwater table thereby returning water to the surface system through stream accretions. When the amount of deep percolation exceeds the ability

of an aquifer to transmit water back to the stream groundwater storage occurs. When the rate at which water is applied to a field exceeds the rate at which water infiltrates into a given soil type, surface runoff occurs. Surface runoff is returned to the surface water system via waste ditches and drainage works. Collectively the water diverted but not consumed creates return flows to the stream. Return flows are a critical component of the agricultural water balance and are rigorously protected under Colorado water law for the benefit of other users on the system.

Diversion of water in the stream as a result of return flows is a fundamental element of the water supply in Colorado. A portion of each subsequent diversion provides new return flows for users further downstream allowing multiple diversions of the same water within a basin. In over appropriated basins a molecule of water will be diverted several times before it leaves the State.

Figure 6.3.4-1 Agricultural water use and losses



A portion of the water diverted for crop use may also be consumed and permanently lost from the system. This occurs through evaporation from soil and water surfaces, percolation into perched groundwater zones which are not connected to the surface water system, or consumption by the unintentional growth of vegetation with no economic value. Such permanent losses are frequently referred to as non-beneficial consumptive uses. Interception of return flows by invasive phreatophytes [deep rooted, “water loving plants”] is one highly visible type of non-beneficial consumptive use of agricultural water. Colorado State University estimates that as much as 10

percent of the water lost during irrigation is a result these types of non-beneficial consumptive uses. It is important to note that some of these unintended uses do provide incidental environmental benefits in the form of artificial wetlands and enhanced riparian corridors.

Terminology Related to Agricultural Water Conservation

There are several terms and phrases frequently raised in discussions related to agricultural water conservation. The following definitions are used herein in an effort to provide clarity.

Agricultural Water Conservation: Agricultural water conservation is the water resulting from practices that reduce the amount of irrigation water beneficially or non-beneficially consumed during the production of an agricultural commodity. The amount of such water can be measured as a reduction in historical consumptive use.

Irrigation Efficiency: Irrigation efficiency is the ratio (or fraction) of the total amount of water diverted for an irrigation use to the volume of water actually consumed through evapotranspiration by the crop. Irrigation efficiency may be further refined by looking at the specific water losses that occur before and after the water is applied to the crop. Thus there are often separate calculations of delivery efficiencies and on-farm efficiencies based on the stage in the process in which the losses occur. Since it is a ratio irrigation efficiency may be increased by practices that either reduce the amount of water diverted or increase the amount of crop ET. It is also important to note that the losses effecting irrigation efficiency may be either consumptive [non-beneficial consumptive use] or non-consumptive [resulting in return flows].

Delivery Efficiency: Delivery efficiency reflects seepage and evaporation losses that occur in the canals, ditches and laterals between the point of diversion and the turnout to the farm field.

On-farm Efficiency: On-farm or application efficiency reflects the losses that occur after the farm turnout as water is applied to a crop, including deep percolation, evaporation, and field runoff. Application methods such as flood and furrow have higher losses than more direct methods of getting water to the root zone such as sprinklers and drip.

Salvaged Water: Salvaged water is defined to mean the water resulting from reductions in non-beneficial consumptive uses that occur incidental to the use of irrigation water. Salvaged water can be produced through efficiency improvements that eliminate phreatophyte growth or reduce avoidable ditch and field evaporation. Specifically, salvaged water is defined to be the portion of irrigation losses that were previously consumed.

Saved Water: Saved water is that portion of historical water diversions not consumed either non-beneficially or by crops that can be recovered through efficiency improvements which eliminate or reduce losses due to seepage, deep percolation, and field runoff which previously contributed to return flows. Specifically, saved water is defined to be the portion of irrigation losses that has historically created return flows.

Reuse: Capture and reuse of irrigation water for crop use on the same ground, when consistent with the underlying water right, is frequently done. Since this water is also consumed it does not result in agricultural water conservation, although it may reduce the amount of water diverted. Reuse, when not consistent with the terms of a water right, such as on acres not described in a decree results in “expanded use” which is prohibited. On the other hand, reuse of treated M&I water for an agricultural purpose may have the potential to reduce irrigation diversions by providing the M&I reuse water as an alternate source of agricultural supply. Reuse is more fully explored in subsection 6.3.2.

Waste: Waste is a somewhat pejorative term used to refer to water diverted but not beneficially consumed. It is frequently used in expressions such as, “by eliminating agricultural waste we can meet future needs” or “one man’s waste is another man’s water supply.” “Beneficial use” is legally defined to be the amount of water that is reasonable and appropriate under reasonably efficient practices to accomplish without waste the purpose for which the appropriation is lawfully made²¹⁷. The State Engineer has authority to curtail truly wasteful practices and in fact there is little waste occurring in agricultural water use [DWR Synopsis, 2011]. Some elements of water use that might otherwise be considered waste are in fact important to agricultural production. For instance water is occasionally diverted into ditches and immediately returned to the stream to sluice sediments from diversion and conveyance works. Excess water is also applied to fields to leach harmful salts from the crop root zone through intentional deep percolation into the underlying water table.

“Use it or lose it”: This oft repeated phrase is actually a misnomer. A water right can be abandoned or lost due to non-use for a long period of time, but only if the non-use is indicative of an actual intent to give up the water right permanently. The more common usage of the phrase is associated with the incorrect belief that by maximizing the amount of water diverted the magnitude of a water right can be enhanced or preserved. This notion is incorrect since the true measure of the water right is actual historical beneficial use, which in the case of an irrigation right is crop ET. Thus there is no real incentive under law to divert more irrigation water than the crop can consume.

Efficiency and Conservation / Salvaged and Saved Water

Since long before Statehood, and certainly within the last 50 years, agricultural producers have sought to improve the efficiency of their irrigation systems with the goal of meeting more of their crop consumptive needs with the available water supply. The majority of agriculture in Colorado operates with a water deficit, meaning that the available supply at any given time is less than the amount needed to fully meet crop consumptive needs. Thus the primary incentive for making efficiency improvements has always been to get more of the diverted irrigation water to the crop through elimination of delivery system losses and on-field losses, resulting in increased crop yields. With technological advances there are many effective ways to improve irrigation efficiency such as lining or piping ditches and conversion from flood to sprinkler or drip application methods. There are also non-structural ways to improve irrigation efficiency through soil moisture monitoring and irrigation scheduling, generally referred to as Irrigation Water Management (IWM). For those

systems with storage facilities there also significant benefits to be realized from retaining water made available through efficiency improvements to meet critical stages of crop needs and for late season irrigation deliveries. However, the intended result is increased crop production which in most circumstances requires increased consumptive use, not less.

An ancillary benefit from improved irrigation efficiency is improved water quality. The process of deep percolation results from delivering more water into the root zone than a crop can consume at any given time. This water migrates into the groundwater system, often dissolving natural [salt, uranium, selenium] and manmade [fertilizers and pesticides] contaminants from the soil. These contaminant loads eventually reach the stream system, and in some cases seriously degrade surface water quality. Recognition of water quality benefits has resulted in significant amounts of federal funding for irrigation efficiency improvements, which over the last several decades has rapidly accelerated the historically slow trend toward improved irrigation efficiency.

Another potential benefit of improved irrigation efficiency results when an adequate water supply already exists and crops normally receive a full supply that meets 100 percent of ET requirements. In these site-specific and limited instances, improved efficiency without an attendant increase in consumptive use, provides the opportunity for saved water through reduced diversions. Since the beneficial use of meeting crop consumptive needs has already been fully satisfied, this saved water becomes available for use by others under their own water right priorities. In some cases this could be upstream diverters with junior priorities who are relieved from a portion of a downstream senior call and benefit from an improved legal supply, or downstream users who now see more physical supply in the river. While water made available from foregone diversions might be considered a form of water conservation, under Colorado law it is well established that such “saved water” cannot be transferred to a new use, primarily due to return flow maintenance requirements. Even though this water cannot be transferred there may a potential for local instream flow benefits from saved water left in the reach of the stream between the historic point of diversion and the location where return flows reenter the stream.

Recent cases where agricultural producers in Colorado have improved efficiencies provides context to the descriptions of the agricultural efficiency concepts described above:

- The Uncompahgre Valley Water Users Association has converted portions of its open-ditch delivery system to pipelines through the Colorado River Basin Salinity Control Program, thereby reducing seepage and delaying storage releases to better meet late season crop needs. This has had the added benefit of reducing salt loading or salt concentrations to the Colorado River thereby improving downstream water quality.
- Farmers in the Arkansas Basin have converted 1000's of acres from furrow and flood irrigation to sprinkler and drip application methods to stretch limited water supplies in a severely over-appropriated basin through the USDA's Environmental Quality Incentives Program (EQIP). Water quality benefits are also achieved through the reduction of deep percolation and associated salt loading resulting from these practices. A word of caution applies to efficiency programs in the Arkansas River basin due to the unique terms of Article IV.D. of the Arkansas River Compact. Article IV.D expressly prohibits any improvements to

irrigation systems that cause increased depletions at the Stateline. Thus, producers who have installed sprinklers and drip systems in the Arkansas basin have been required to fully replace the increased depletions that would have been otherwise been caused by the increased consumptive use achieved through modernization.

- The Grand Valley near Grand Junction is an area with adequate senior water rights, where crops have generally had a full supply. Headgates and delivery systems were modernized allowing reduced diversions and producing saved water which provided enhanced flows in the Colorado River below those headgates to the help satisfy the needs of the endangered fish species.

While there are numerous reasons and methods to improve irrigation efficiency there are limited opportunities for true agricultural water conservation for the purpose of creating new supplies. These methods rely on either reducing crop ET or salvaging water through reduced non-beneficial use and can be achieved by:

- Switching crop types to those with lower ET requirements. The variation in ET needs between crops can be large, with beans and small grains requiring 20 inches or less per year and corn, beets and alfalfa needing 30 or more inches.
- Intentionally supplying less water to a given crop than its historical irrigation requirement through deficit irrigation. Deficit irrigation must result in lower crop yields to generate any salvaged water.
- Reducing soil evaporative losses through improved cultivation methods such as mulching, drip irrigation, and “soil health” practices.
- Temporarily and entirely removing a crop from the ground through fallowing.
- Permanently and entirely removing a crop from the ground through land retirement.

While these techniques have been used in Colorado to address some fairly specific situations, it is there are legal, technical, and financial barriers that often prevent them from providing long-term new water supplies. Section 6.4 discusses how some of these techniques can be used as alternatives to traditional permanent dry up of irrigated lands. Some examples are:

- Use of alternate crops and fallowing in the Rio Grande²¹⁸ and Republican River Basins to maintain a sustainable agricultural community in the face of an imbalance between legally available water supplies and current levels of water use.
- Consideration of deficit irrigation in the South Platte Basin where many junior priority wells have been shut down for lack of a legal water supply.
- Drought driven temporary lease-fallow arrangements between the City of Aurora and the Rocky Ford Highline Canal.
- Recent efforts to develop pilot projects under the CWCB’s Alternative Agricultural Transfer program, include the Colorado River Water Bank Working Group. This Working Bank Working Group is notably exploring options for reducing irrigation demands through deficit irrigation, temporary forbearance, or other means, in order to avoid, delay, or limit the

likelihood or negative impacts of a compact curtailment. The Water Bank Working Group work is further described in Section 6.4.

- Implementation of soil health practices such as low tillage, mulching, and cover crops in many locations which have improved the water holding capacity of the soil and reduced soil surface evaporation, thereby reducing crop consumptive use.
- The conversion of agricultural rights to municipal use through “buy and dry”.

State of Knowledge on Agricultural Conservation and Efficiency

To summarize, there are many agricultural interactions and uses, and are reflected in the types of agricultural conservation and efficiency. Essentially two major concepts affect agricultural conservation. The first is whether a use is consumptive or not. If it is consumptive, then reducing the consumption of water may yield useable water that could be used by another user. However, legal limitations may prevent transfer to that new use. The other concept is whether the water can be used as a “beneficial use” or not. If the water is used as a “beneficial use” then it can have a water right associated with it. Agricultural conservation and efficiency measures have the potential to alter return flows and to alter basin hydrology, or the needs of downstream users.

The transfer of salvaged water (with the exception of phreatophyte removal which has been expressly prohibited as a source of a transferable right) has not yet been tested in water court or addressed by the legislature. Conserved water generated by one of several approaches, such as deficit irrigation; rotational fallowing; or a transition to cool season crops, is the subject of Alternative Agricultural To-Urban Transfer Methods and will be further explored in Section 6.4 of Colorado’s Water Plan. It is important to note the volume of water resulting from any individual efficiency improvement is relatively small and difficult to precisely quantify since it cannot be measured directly. This makes reliable management and administration of exchanges and transfers of salvaged water extremely complex and time consuming for DWR personnel.

Basin Implementation Plans

For 2014, each basin roundtable is formulating their own implementation plan, and several include agricultural water conservation and efficiency goals and activities.

Initial drafts of the Basin Implementation Plan goals for most of the roundtables indicate that they plan on increasing efficiencies and modernizing agricultural infrastructure. Several examples of these are below:

- Arkansas Roundtable: Provide increasing quantities of augmentation water for increased farm efficiencies.
- Colorado Roundtable: Improve agricultural efficiency, preservation, and conservation.
- Gunnison Roundtable: Restore, maintain, and modernize critical water infrastructure, including hydropower.
- North Platte Roundtable: “Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies.”

- Rio Grande Roundtable: Operate, maintain, rehabilitate, and create necessary infrastructure to the Basin's long-term water needs, including storage.
- Southwest Roundtable: Developed a draft goal to "Implement efficiency measures to maximize beneficial use and production".
- Yampa/White/Green Roundtable: Restore, maintain, and modernize water storage and distribution infrastructure.

Interbasin Compact Committee (IBCC) Actions

As part of the IBCC's ongoing work, the IBCC is recommending that "Colorado will continue its commitment to improve conservation and reuse." As part of this draft work, recommendations for agricultural conservation and efficiency improvements for current and future agriculture were developed, which are incorporated into the recommendations below.

Recent and Past Legislative Actions

There are some existing legislative exceptions to the aforementioned limitations which are applicable in narrow instances, such as:

HB 05-133 stated that an owner would not be deemed to have abandoned their water right if certain conditions were met. Two conditions refer to "a water conservation program approved by a state agency and a water banking program as provided by law." These don't go as far as allowing sharing but it does state that an owner of a water right won't lose the right if non-use stems from water conservation activities.

HB 13-1130 allows a water right owner with an interruptible water supply agreement (IWSA) to request up to two additional ten-year periods for the IWSA. IWSAs enable water users to transfer a portion of their water right, called the historical consumptive use, to another water user on a temporary basis, without permanently changing the water right.

SB 13-019 restricts a water judge from determining a water user's historical consumptive use based on water use reductions resulting from the enrollment in a federal land conservation program, participation in certain water conservation programs, participation in an approved land fallowing program or to provide water for compact compliance, or participation in a water banking program. Some water users may wish to reduce their water consumption in order to limit the effects of drought on stream flows. However, under current law there is a disincentive that penalizes appropriators who decrease their consumptive use of water.

This section will be updated pending any changes to the law in the future.

Actions

Opportunities for transferring a portion of agricultural water to other uses, without complete impairment of the agricultural uses, exist but they are limited. The following points related to the implementation of agricultural conservation and efficiency measures are presented as a starting point for further discussion.

1. CWCB will work in partnership with the basin roundtables and Colorado State University's extension program to educate farmers on available incentives for on-farm implementation of agricultural conservation measures²¹⁹. Examples of incentives that should continue to be supported include low interest loans offered by the CWCB's loan program, Water Supply Reserve Account Grants, and the Regional Conservation Partnership Program. The Natural Resources Conservation Program and the System Conservation Agreement that was entered into between Denver Water, the U.S. Bureau of Reclamation, and other parties offer additional opportunities. Some of these programs are more fully described in Section 6.4 (alternatives to agricultural dry up).
2. Many of the Basin Implementation Plans are looking to find the explicit interconnections between agriculture and nonconsumptive uses. In addition, several are looking to decrease agricultural shortages. As part of this work, CWCB will encourage each basin to promote agricultural water conservation by following the guidelines outlined in the Colorado Agricultural Water Alliance 2008 agricultural conservation paper, which include reducing soil moisture loss where practical through soil health activities, drip irrigation, or mulching²²⁰.
3. CWCB will continue to support the modernization of high priority diversions and ditches and identification of increased storage opportunities. Headgate improvements are an important tool in generating saved water, and lining ditches is an important tool in reducing seepage losses. Both of these should be encouraged in appropriate areas. Additional storage could help eliminate existing agricultural water shortages and provide additional environmental or recreational benefits²²¹.
4. CWCB will continue to support the management and removal of invasive phreatophytes through its grant program and seek additional incentives. Phreatophyte control presents one of the best opportunities for reducing non-beneficial consumptive use and should be pursued aggressively, although balancing this with nonconsumptive needs can be challenging²²². Incentives for landowner control of phreatophytes, given savaged water legal limitations, could be still be developed²²³.
5. CWCB will explore additional incentives for implementing agricultural conservation measures. The cost of these measures could be borne by the beneficiaries of the re-purposed water. Agricultural users are unlikely or unable to bear the costs if benefits only accrue to improved stream flows, water quality, or the basin as a whole²²⁴. Additional incentives could be developed to assist basins in implementing, where appropriate, agricultural efficiency and conservation practices and changing crops type to a lower water use crop²²⁵. These incentives should first be explored through water conservation demonstration and pilot projects²²⁶.
6. New agricultural lands (currently identified in the North Platte and Yampa Basins) should be designed to either use best management practices with regard to agricultural conservation and efficiency, or, alternately, be measurably and explicitly multi-purpose by meeting identified nonconsumptive needs²²⁷.
7. The state will consider the development of administrative means to track and allocate conserved water and ensure compliance, although it is possible that the cost of this

administration if fully protective of all other users could exceed the value of the water at issue²²⁸.

8. Projects and Methods that support agricultural efficiency, modernization and conservation presented in Basin Implementation Plan recommendations should be supported.

6.3.5 Self Supplied Industrial Conservation and Reuse

Introduction

Self-supplied industrial (SSI) water is a term used to describe those industrial users that have developed their own independent water supplies. This includes users such as beer producers, power plants, mining industry, and the ski industry that uses water for snowmaking purposes. However, this section will focus on the thermoelectric generation and energy extraction sectors within SSI. While SSI represents a small proportion of the water used statewide, it can be a significant amount of water in some local areas including communities that are home to thermoelectric power generation plants or have a significant energy extraction presence, as these are the two major SSI water users. As a result, SSI water use is often addressed as part of the energy-water nexus. "The water-energy nexus is a term used to describe the interaction and interdependencies between water and energy resources. Understanding the dependencies, synergies, conflicts, and trade-offs between these two critical resources is necessary to identify and implement mutually beneficial strategies for their management and use."²²⁹

Water Use in Energy Production and Extraction

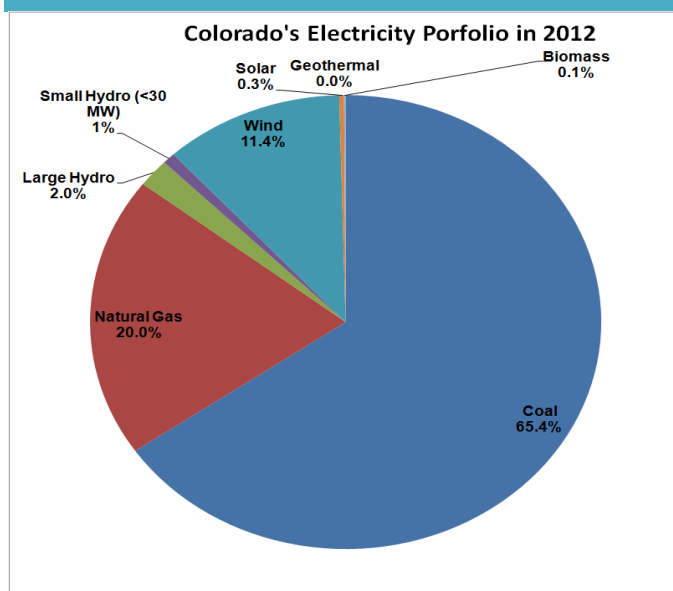
Electricity Generation

Electricity generation in Colorado totaled 53,524,000 megawatt-hour (MWh) in 2013. The demand for power requires an annual consumptive use of just over 55,000 acre-feet, which represents 1 percent of Colorado's consumptive use (Colorado Energy Office calculations based on utility resource plans). Overall, electricity demand has slowed over the past half century and increased demand has been largely offset by gains in energy efficiency. Currently, the U.S. Energy Information Administration (EIA) projects relatively flat electricity load growth over time at 0.9 percent per year nationally).²³¹

Thermoelectric Power

In 2012, thermoelectric facilities generated over 85 percent of Colorado's electricity. Thermoelectric power generation heats

Figure 6.3.5-1: Colorado's 2012 Electricity Portfolio²³⁰



water to produce steam that powers turbines to create electricity. While a variety of fuel types can be used to heat the water in thermoelectric power generation, the primary fuel sources in Colorado are coal and natural gas. Additionally, water is used to condense steam for reuse or discharge. The cooling process accounts for 95 percent of the consumptive use in electric generation.²³²

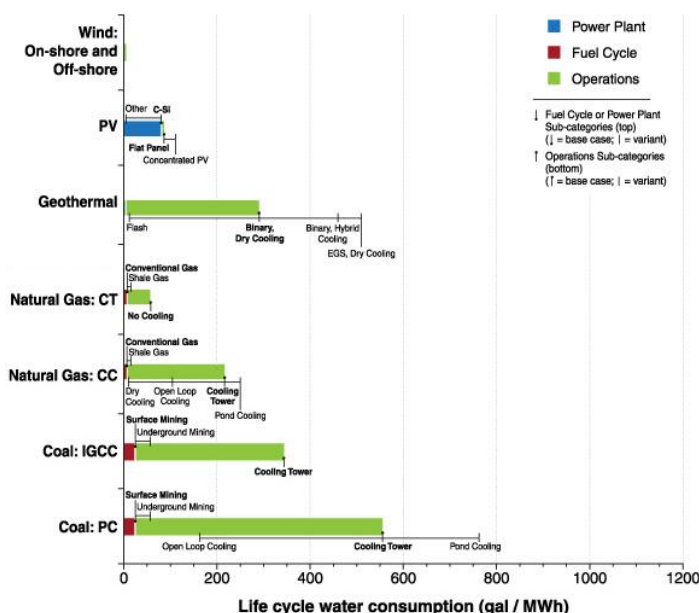
A variety of cooling techniques can be used in plant design based on process efficiency and an economic cost-benefit analysis. These techniques include once-through cooling, closed-loop, hybrid methods, and dry cooling.

Once-through cooling systems typically require the greatest withdrawal, but have lower consumptive use because the water passes through a singular cooling process that absorbs heat and is then discharged. Historically, this was often the least expensive and most used method nationwide, but it can have a greater ecosystem impact because of warm water discharge. Once-through cooling systems are not used in Colorado.

Alternatively, closed-loop cooling systems use cooling towers to condense the steam. This requires comparatively lower withdrawal, but because of recirculation has a higher consumptive use rate. Many of Colorado's electric generating units use this method, including Xcel's Arapahoe Station, Comanche Station Units 1 and 2, Cherokee Station, and Tri-state G&T's Craig Station.^{234 235} Some facilities minimize freshwater consumption by using treated closed-loop systems. For example, the Platte River Power Authority's Rawhide coal generator relies on 87 percent treated effluent water and their natural gas turbines use closed-loop glycol cooling systems.

Two other cooling systems are being researched and employed, in an effort to reduce water consumption, that use ambient air cooling called dry cooling. Dry cooling uses only ambient air to condense steam, it has lower plant efficiency, it has a greater land footprint, and it requires a higher electric load which increases the expense of this method. However, hybrid air and water systems that employ both techniques in concert are becoming more prevalent such as Xcel's Unit 3 at the Comanche Station.

Figure 6.3.5-2: Life Cycle Water Consumption for various methods of energy production²³³



While coal and natural gas are the primary fuel sources for electricity generation in Colorado accounting for 65 percent and 20 percent in 2012, respectively (Figure 6.3.5-1), each requires different amounts of water for their process (Figure 6.3.5-2). Coal plants consume on average roughly 40 percent more water per MWh

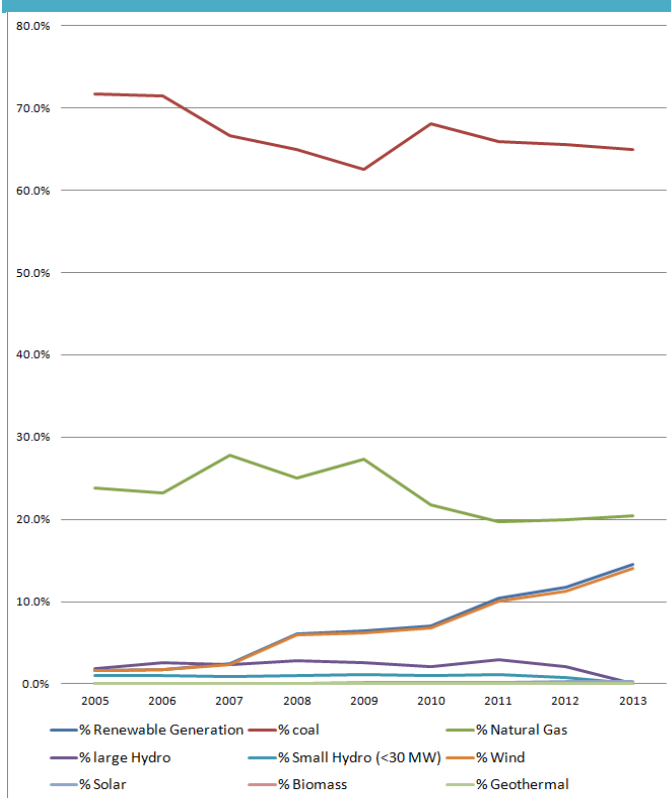
produced when compared to combined cycle natural gas plants when controlling for all cooling system types.²³⁶ However, the cooling techniques employed at each facility are the primary source of consumption regardless of the fuel source. Outside of the generation requirements, both fuel types also require minimal amounts of water to extract and deliver the resource to the plant.

Renewable energy generation can have consumptive water use depending on the technology, but overall renewable energy requires significantly less water than fossil fuel generation. In 2004, Colorado voters passed Amendment 37, establishing a Renewable Electricity Standard requiring utilities to generate a portion of their electricity from renewable sources. The legislative declaration for Amendment 37 specifically included language, among other public policy goals, that the measure would “minimize water use for electricity generation.”²³⁸ Currently, Colorado’s renewable electricity standard requires 30 percent generation for investor-owned utilities, 20 percent for co-ops, and 10 percent for municipal utilities, all by 2020. Additionally, in 2010, Colorado’s legislature passed the Clean Air Clean Jobs Act which sought to reduce emissions from power plants by retiring, retrofitting, or repowering some power plants owned by Xcel Energy and Black Hills Energy. Due to these state-level policies, a variety of EPA regulations and increasingly competitive wind and solar prices, Colorado is likely to reduce water use in electricity generation as Colorado’s generation portfolio trends toward a larger mix of natural gas and renewable generation. In fact, generation from wind has grown the fastest of any fuel source as a percentage of the overall portfolio, over 12 percent from 2005 to 2012, and represents both the state’s largest renewable energy generation source and the utility-scale source of electricity with the least consumptive use of water.

Public Disclosure and Resource Planning

Colorado’s investor-owned utilities, Xcel & Black Hills, report their water consumption when filing resource plans with the Public Utilities Commission (PUC). The PUC is also allowed to consider water use in addition to fuel costs, construction costs, conventional operating costs, and transmission costs when evaluating resource selection. Investor-owned utilities in Colorado are also permitted to use water consumption as a factor while prioritizing and evaluating competitive solicitations for renewable energy.²³⁹ Tri-State G&T provides water consumption data to the PUC as part of their public resource planning process.

Figure 6.3.5-3: Colorado’s Electricity Portfolio (Net Generation)²³⁷



Hydroelectric Power Generation

Currently, hydropower provides around 4 percent of Colorado's electricity, generated from over 60 hydropower facilities throughout Colorado. With a combined installed capacity of 1162 megawatts (MW), the hydroelectric facilities produce roughly 1 million MWh of electricity annually. Colorado's hydro plants range in size from 5 kilowatts to 300 MW and include three pumped storage facilities. While Colorado has an arid climate, the state has potential to further develop hydroelectric resources.

Colorado's hydroelectric resources can be categorized into three areas; large hydro, small hydro, and agricultural hydro. Each project category has unique characteristics and effect water consumption in different ways. Typically, larger hydroelectric projects (generating capacity) have larger evaporative losses because of the need for sizable dams and reservoirs. While Colorado has 6 projects classified as large hydro (over 30 MW), these projects are still relatively small in size compared to others around the country. While there is no widely accepted definition of "small hydro," small hydro projects in Colorado are typically 2 MW or smaller in size.

Agricultural hydro includes a variety of system types, including pressurized irrigation systems. There are roughly 2.7 million acres of land under irrigation in Colorado. A Colorado Department of Agriculture analysis found that 7 percent of these lands, or approximately 175,000 acres, are candidates for pressurized irrigation systems. Of those candidate lands, 13 percent are already sprinkler irrigated and would have the lowest development cost. The remaining 87 percent are predominantly flood or furrow irrigated and would have a higher cost for agricultural hydro development because of the necessary redesign and retrofits.²⁴⁰

Gravity-pressurized irrigation systems, e.g., a center pivot sprinkler, have potential to generate electricity if there is either excess flow or excess pressure available, or if the center pivot system currently relies on diesel generators or the electrical grid. The hydroelectric generating potential (in excess of the power needed to pressurize the irrigation systems themselves) of Colorado's pressurized irrigation systems was estimated at 30 MW. Depending on the situation at a given parcel, excess hydroelectric power could be used to offset other electrical loads or to mechanically drive the sprinkler system itself.²⁴¹

Various organizations, including federal agencies, have explored the hydropower potential of existing agricultural dams. There are over 2000 dams in the State of Colorado, a large number of those dams are very small or only hold water for a very short period of time. A Colorado Department of Agriculture (CDA) study into the use of small dams excluded dams that were not related to agriculture, on federal lands, or were so small that they were very unlikely to hold potential. The CDA study found 102 small dams statewide with the technical potential to generate hydroelectricity. Twenty-three sites were found to be economically feasible and could break even within 20 years. Those 23 economically feasible sites total approximately 40 MW of capacity, 25 MW of which are currently under development (6 projects). This leaves about 15 MW of untapped, economically feasible potential throughout the state.²⁴²

Opportunities for additional large hydro projects in Colorado are limited as most of the ideal sites have already been developed. However, small hydro and agricultural hydro systems have better outlooks for future growth. According to the Bureau of Reclamation, Colorado currently has over

30 potential hydropower sites at Reclamation facilities with the potential to produce over 105,000 MWh annually.²⁴³ A U.S. Department of Energy report estimates an additional 11 potential sites with the potential to produce over 632,000 MWh annually.²⁴⁴ Between these two studies, Colorado's estimated untapped hydropower energy potential is over 737,975 MWh annually. If Colorado were to use this full potential, it could power over 65,000 homes a year using new hydropower.

Oil and Gas Production

There are over 52,000 active oil and gas wells in Colorado. Oil and gas development accounts for less than one tenth of 1 percent of the overall water usage in the state. The primary uses for water are in the drilling and completion phases. This includes cooling the drill bit and bringing drill cuttings to the surface as well as the hydraulic fracturing (fracking) process. During hydraulic fracturing, water mixed with sand and chemicals is pumped down the wellbore under high pressure to create tiny fractures in the rock that release oil and gas. Water usage for oil and gas operations varies, depending on the type and location of the well and whether or not the well is hydraulically fractured. Vertical and directional wells use less water than horizontal wells because they are not as long and require lower pressure. Vertical and directional wells typically use between 100,000 – 1,000,000 gallons of water, depending on the depth of the well. Horizontal wells typically use between 2,000,000 - 5,000,000 gallons, depending on the depth and length of the well.

The Colorado Oil and Gas Conservation Commission (COGCC) began requiring oil and gas operators to report the volume of fluids used in hydraulic fracturing in June 2012. In 2012, approximately 7.3 billion gallons of water was used for 2294 well starts, including 664 horizontal wells. Of this total volume, about 3.8 billion gallons (53 percent) were reported to be recycled fluids. So far in 2014, approximately 4.2 billion gallons of water has been used for 1,609 well starts, including 1081 horizontal wells. Of this total volume, about 1.2 billion gallons (29 percent) were reported to be recycled fluids.²⁴⁵

COGCC does not formally track reuse of produced water. Anecdotally, the most significant reuse of produced water is for hydraulic fracturing. Since the produced water contains chemicals and naturally occurring hydrocarbons, its use off of the wellsite is tightly controlled by COGCC and Colorado Department of Public Health and Environment regulations. Operators are currently testing and implementing new treatment technologies to allow for the reuse and recycling of produced water for other purposes.

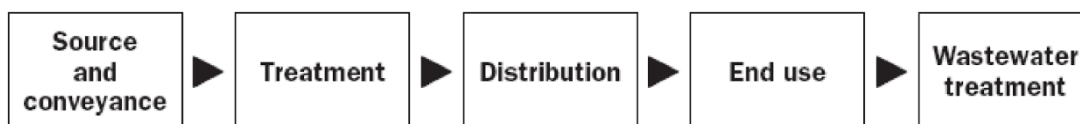
Coal Extraction

There are nine actively producing coal mines in Colorado. Most of the water in coal extraction is for mining, washing, and transporting coal, including dust suppression efforts. Consumptive water use at these coal mines ranges from 26-320 acre-feet per year, with an average of 165 acre-feet (1,000,000 gallons = 3 acre-feet).²⁴⁶ A few mines are implementing water efficiency measures. For example, the West Elk Mine in Delta County uses a closed loop system, pumping all surface runoff into the mine for use in its wash plant and dust suppression efforts. The mine only rarely pumps water from the North Fork of the Gunnison River and discharges back to the river have been minimal and rare.

Energy Use in Water Conveyance

The other piece of the energy water nexus is the energy that is required for water conveyance, water treatment, water distribution, and wastewater treatment. The 2009 study, *Water Conservation = Energy Conservation: A Report for the CWCB*, stated that, “Energy is embedded in water. Water utilities use energy to pump groundwater, move surface water supplies, treat raw water to potable standards, and distribute it to their customers. Customers use energy to heat, cool, and pressurize water; and wastewater treatment plants use energy to treat wastewater before discharging it (Figure 6.3.5-1).”²⁴⁷

Figure 6.3.5-1. Energy is used to pump, treat, distribute, and use potable water, and to treat wastewater²⁴⁸



Concerning domestic water, the energy and water nexus is centered on water conservation measures that can be employed to lessen the energy intensity of water use. Water supplies carry vastly different energy intensities depending on where they originate and how they are conveyed. Some water supplies are almost purely conveyed using gravity, while other supplies are very energy intensive requiring a large amount of electricity to pump water from deep underground.

Water conservation and energy efficiency can play synergistic roles in lessening the impacts of the other. Through more efficient changes in water treatment, distribution and end use, energy use can be made more efficient and vice versa. This can extend back to saving energy in the Self Supplied Industrial area of energy production, thus saving water that would normally go into the process of producing this energy.

Energy and Water Efficiency Tools

Many of Colorado’s efficiency programs include savings from water with energy savings. Although reducing water use alone can save energy, Colorado’s efficiency programs generally focus on improving water efficiency and energy efficiency during a complete facility renovation.

Energy Performance Contracting is a tool that allows public facilities to finance capital improvements, including upgrades to efficient equipment. EPCs allow the facilities to contract an energy service company to conduct investment-grade audits to facilities and obtain prioritized lists of facility improvement measures. By pursuing those measures through a performance contract, energy service companies guarantee that the facilities will realize energy, water, and associated operations and maintenance savings from the proposed improvements. In Colorado, Energy Performance Contracting has been used to finance \$447.4 million in facility investments. Those investments provide guaranteed annual savings of 141.8 million kWh of electricity, 9.95 million therms of heating fueling, 467,200 kgal of water, and \$30.9 million annually.

The Colorado Energy Office also manages an Energy Savings for Schools Program that helps lower energy, water use, and costs in K-12 school districts, while improving building performance and

comfort. The services and resources of this program are designed to cover the variety of energy efficiency and energy management needs of schools. Colorado schools located in rural or lower income districts are particularly affected by high energy costs and are a high priority for engagement through the Colorado Energy Office's energy efficiency programs.

There is also significant potential for efficiency savings among agricultural communities. The Department of Agriculture is working with agricultural producers in Colorado to reduce energy and water costs. Some of these efforts also reduce thermoelectric energy use with its concomitant water savings. Projects include locally-sited micro hydro, solar, and wind power generation.²⁴⁹ In addition, the Colorado Energy Office developed an agricultural efficiency pilot with dairy farmers, which focused on energy efficiency improvements but could be further developed to include water efficiency measures.

Through Senate Bill 14-171, the Colorado legislature expanded another energy efficiency program to water use savings last year. Commercial Property Assessed Clean Energy Bonds previously allowed commercial building owners to arrange financing, secured by a lien, for the installation of energy efficiency improvements. Senate Bill 14-171 allows water conservation fixtures to be included in the improvements, so that buildings can benefit from both energy and water efficiency.

Actions:

1. Examine the feasibility of Water/Energy Nexus programs that conserve both water and energy. Some concepts to further explore include:
 - Joint water and energy home or commercial audits
 - Joint rebate programs, which combine water and energy utility rebates to most effectively incentivize customers to purchase a specific energy/water efficient appliance
 - Treat water utilities as a large customer of the energy utility and explore system-wide water/energy reducing measures, such as reducing distribution system leaks.
2. When exploring new water supply projects, opportunities for renewable energy to meet the increased demands should be considered.
3. Outreach to energy companies to encourage and promote the most water efficient technologies for energy extraction.
4. Colorado's energy office will continue to support energy saving associated with on-farm agricultural practices that also reduce water use.
5. CWCB will work with Colorado's energy office and local agricultural producers to financially and technically support a pilot that combines renewable energy development with an alternative agricultural transfer to lessen the potential economic impacts to the local community.
6. CWCB will encourage energy companies to continue collaborating with agricultural and environmental interests when managing their water portfolio.
7. The state will help to protect critical infrastructure by working with power providers to identify areas of their systems prone to failure or impact during water shortages and natural disasters.

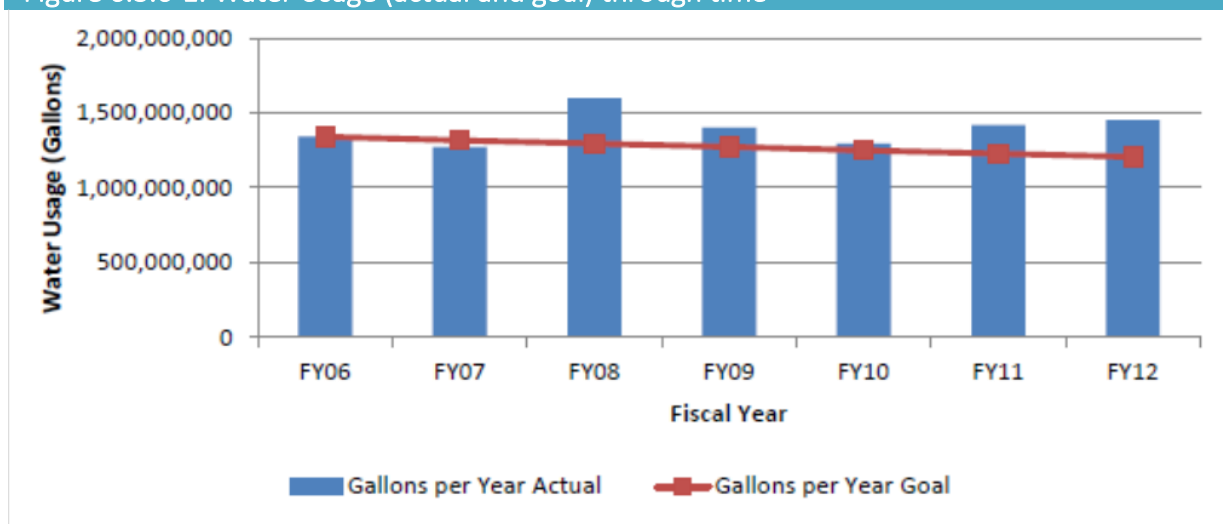
8. The state will work with power providers to mitigate for the possibility of curtailment in severe droughts and diversify their water rights portfolio.
9. Encourage demand-side management,
 - Through continued support of research into innovative ways to reuse produced water.
 - Decrease vulnerability during times of water shortages.
10. Encourage technologies that reduce water use in energy extraction processes.

6.3.6 State Agency Conservation

The State of Colorado plans to increase conservation efforts within state facilities to help demonstrate the ability to save water. The Colorado Energy Office has been facilitating the Greening Government initiative since Governor Bill Ritter issued Executive Orders D 0011 07 and D 0012 07. The Executive Orders mandated State agencies to reduce water consumption by 10 percent by FY 2012 over the baseline usage of FY 2006.^{250 251} State agencies have reduced their water consumption by various methods such as installation of efficient plumbing fixtures, advanced lawn irrigation controls, and taking advantage of re-use water.

The following is taken from the 2012 Greening Government Annual Report Card.²⁵² The State has seen an increase of 8.4 percent (112.5 million gallons of water) in water use. Each agency individual provided the following data and it reflects their best attempt to record all water purchases between FY'06-FY'12 in EnergyCAP. Water usage has not been normalized for the increase in state employees, increasingly hot weather, or new water-intensive industries. Of the 14 agencies and departments with owned square footage, six reduced their water use by more than 10 percent, four reduced their water use by less than 10 percent, and four increased their water use.²⁵³

Figure 6.3.6-1: Water Usage (actual and goal) through time



Exemplary State Agency Projects

Colorado Department of Health and Environment has decreased its water use by 11 percent since 2005. They replaced 2 acres of bluegrass lawn with xeric grass species which is saving over 2.5

million gallons per year. They also replaced high flushing urinals with 0.5 gallons per flush urinals and installed waterless urinals.

Capitol Complex facilities personnel have conducted some notable efforts over the last few years. They worked with Denver Water to audit all cooling towers for the Capitol Complex and can reduce consumption by almost 500,000 gallons per year. Additionally, they can now take advantage of Denver Water incentives. Another example that is not captured in this annual report is a landscape transformation initiative that is taking place on the Capitol grounds. A collaborative group from the Governor's Office, CWCB, Denver Water, the Denver Botanic Gardens, Colorado Nursery and Greenhouse Association, and Capitol Complex Facilities is working on plans to reduce water consumption and demonstrate the benefits of water wise landscaping on the Capitol building grounds. This high profile project will highlight to the public what can be done with Colorado appropriate landscapes.

Recommendations from Annual Report Card

Continue requiring water reductions by all state agencies.

Require agencies to take advantage of free or reduced cost water audits by their water utility, if applicable.

Look into bulk purchasing of water efficient appliances for state agencies.

Continue educating Council about the Energy/Water Nexus

Research and identify alternative ways to provide sufficient funding for water efficiency.

Continue encouraging agencies to use their water rights.

This water use is an important standard to strive for in that the State should lead by example in its own facility water use. This idea ties back to the philosophy of the SWSI Levels Framework where water providers should prioritize their foundational activities first and then focus on what they have direct control over within their own facilities. While much has been done at state facilities, better tracking and quantification could take place to normalize the data for weather, number of employees, and any new intensive uses that have come online.

6.4: Alternative Agriculture to Urban Transfers

Colorado's Water Plan will respect property rights and the contributions of the agricultural industry by maximizing options for alternatives to permanent farmland dry-up.

Background

Agriculture uses the largest amount of water in Colorado and is the economic backbone for many rural communities. It supports important environmental attributes, strengthens Colorado's food security, and upholds our cultural identity. Approximately 66.3 million acres of land in Colorado is farm and ranch land, of which 10.6 million acres are cropland and 2.6 million acres are irrigated.²⁵⁴ Global, national, and state population growth will place additional pressure on our food sources, which means that the long-term economic viability of agriculture is strong.²⁵⁵ Local economies in rural areas depend on wholesale, retail, banking, and support services related to agricultural production. When farmers stay in agriculture, cash flow related to their operations can increase the

vitality of their communities. Agriculture is an important contributor to Colorado's economy as a whole, which is further discussed in Chapter 5.

Pressures at the state, national, and international level threaten to reduce agricultural lands in the short-term. Future municipal water demands contribute to an increasing pressure to transfer agricultural water rights to help satisfy urban demands and other non-agricultural water needs across the state.²⁵⁶

Agricultural interests are concerned about the possibility of drying up more agricultural lands in the future.²⁵⁷ If Colorado continues down its current path, the South Platte River Basin could lose 40 percent of today's irrigated land by 2050.²⁵⁸ The Arkansas River basin has already lost approximately 80,000 acres of irrigated lands, roughly 15 percent of the total, and could lose another 10 percent.²⁵⁹ The main stem watershed area of the Colorado River Basin could also lose another 20 percent of its irrigated lands.²⁶⁰

The Statewide Water Supply Initiative (SWSI) estimates that by 2050, Colorado may lose 500,000 to 700,000 acres of currently irrigated farmland to meet municipal growth demands. The Interbasin Compact Committee (IBCC) and basin roundtables conclude that the current buy-and-dry path is not the best path for Colorado. Across the state, water stakeholders want to minimize buy-and-dry in a way that respects property rights, recognizes the importance of agriculture in Colorado, and supports a sustainable agricultural industry, while identifying solutions to provide water for municipal needs. As indicated by numerous groups, including the Colorado Agricultural Water Alliance and the IBCC, there are a variety of alternative options that have the potential to appreciably decrease the projected permanent losses of irrigated acres in Colorado.

These options are referred to as alternative transfer methods (ATMs). ATMs do not limit the choice of private water right owners to permanently sell their water rights. ATMs offer tools for both farmers and urban water providers to voluntarily depart from the status quo. In addition, ATMs can be used to support the environment, recreation, and groundwater sustainability and used as water banks to reduce demands on a water system.

Scenario planning, discussed in section 6.1, indicates that approximately 50,000 acre-feet, or enough water to serve as many as 350,000 people, is the minimum amount of water needed from ATMs. Currently, ATMs are more expensive and legally burdensome than traditional buy-and-dry approaches, making it difficult to obtain this amount of water from existing alternatives. There are a number of creative and cutting edge alternatives as shown in table 6.4-1. These alternatives can help decrease permanent reductions in irrigated acreage.



Table 6.4-1: Types of ATMs promoted in Colorado

Rotational fallowing – Rotational fallowing keeps land in irrigated production mode while systematically fallowing specific plots. A rotation occurs to systematically fallow each plot in successive crop seasons. It allows leased water to become a base supply for a municipality, while keeping a majority of the farming operation in production. Revegetation protection of the fallowed plots is an important consideration for this type of ATM.

Interruptible supply agreements – This type of ATM is between non-agricultural water users and farmers, shareholders, or a ditch company. Water is temporarily transferred from agricultural use to another use, such as municipal. Farms are fallowed during specific periods of time, and water is leased to the end user based on the historical consumptive use portion of the water right. These arrangements are done through contractual agreements that satisfy the authorizing statutes. This could also include water conservation easements. See examples below.

Municipal-Agricultural Water Use Sharing – This concept embodies a complex array of options based on continued farming operations for all lands associated with the sharing arrangement. Methods are used to reduce the consumptive use of crops, which makes water available for municipalities by sharing the historic consumptive use amount. Two main sub-categories are continued farming and deficit irrigation. In deficit irrigation, crop watering is strategically limited to save water for other uses. Plants are typically stressed, but production and crop yield still occur.

Water cooperatives – This concept identifies periodic excess water supplies that can be used for optimization in the system. It includes use of surplus augmentation water and other supplies. The framework for moving water from one use to another involves mutually beneficial transactions that work within the existing system of water rights so that no injury occurs.²⁶¹ The Lower South Platte Cooperative is a current working example of this type of ATM.

Water banks – A water bank acts as an intermediary or broker based on water supply arrangements with owners of certain water rights. The bank could be used to avoid or endure a compact curtailment, for example.²⁶² Irrigators would be paid to reduce their consumptive uses, which could trigger fallowing of agricultural lands or deficit irrigation practices on a temporary basis. The saved water could be banked in a reservoir for later release into the system. This approach is being regularly discussed and studied in the Colorado River Basin.

Flex markets – These ATMs are defined as voluntary agreements between municipal and industrial water users, agricultural water users, and environmental/conservation water users.²⁶³ The idea is to change the use of a senior irrigation right to include multiple end uses in addition to irrigation. Flex markets establish trading platforms to help provide water used by all participants. The goal of this approach is to allow part of the senior right to be used by cities and towns and for environmental purposes based on contractual arrangements. The economic benefit of the senior water right is kept in place by maintaining enough agricultural water to sustain robust farming operations.

Goals of ATM Programs

Short-term or long-term temporary water transfer alternatives provide options that address concerns about permanent agricultural buy-and-dry. Program goals related to ATMs are aimed at specific objectives for various regions across Colorado. It is highly unlikely that any one concept will be universally accepted in every basin. The goal of alternative water transfers is to benefit the agricultural community, as well as cities and towns that are seeking viable sources of water supply to keep up with demands. The state has learned important information about developing, evaluating, and monitoring ATMs from pilot and demonstration projects, but has more to learn to fully understand the potential of ATMs.

To achieve widespread implementation of ATMs across the state, researchers need to build a deeper understanding of their challenges and opportunities. To do so, the state needs more data and measurements on the outcomes from actual case studies. Researchers need to collect more information to be able to quantify results and inform decisions. In addition, there are significant legal, technical, and financial barriers to implementing ATMs. An in-depth look at existing ATMs and future project models will help identify program constraints and how to address them. There is the potential for tremendous local, statewide, and regional benefits, but stakeholders need further information to expand their knowledge and ability to implement projects.

Potential Impediments to ATM Success

Executing ATMs can be difficult because of institutional, legal, financial, and court-related barriers. Some legal impediments include long standing water court procedures that change water rights and legal requirements for ATM applications to prevent injury to other water rights. New and creative ATM ideas face many challenges because they do not fit into the historic way of dealing with water rights.

Other obstacles to success include irrigators' concern regarding the outcome of historic consumptive use analyses and the potential for expanded uses of changed water rights. Cities and towns wonder if temporary supplies will actually be available when needed over the long haul.²⁶⁴ Another impediment is the lack of necessary infrastructure for water transfers and the inability to form agreements depending on the seniority of water rights or productivity of the lands involved.²⁶⁵ Transaction costs tend to be relatively high, which can discourage potential water transfers. Further, we need to assess infrastructure that may be needed to store ATM water.

Colorado's Water Plan encourages all interested parties to openly and constructively find ways to adapt to changing times. Colorado's Water Plan recognizes that water-sharing agreements between municipalities and agricultural interests for water transactions, such as the sale or lease of surplus water and use of excess return flows, can be an important tool in moving forward to meet supply gaps. To alleviate water supply pressures, stakeholders need to find solutions to reduce barriers to implementing ATMs for enhanced success. Any suggestions for future legislation related to ATMs will be discussed in Chapter 10 of Colorado's Water Plan.

Examples of Alternative Transfer Methods

There are a variety of existing examples of how ATMs work in Colorado. A few are illustrated below.

- *Morgan Ditch Company & Xcel Energy* formed a voluntary lease arrangement in the South Platte River Basin. For more than 20 years, a separate water company developed under the Morgan Ditch Company has provided firm yield supply to Xcel Energy's Pawnee power station. It is located conveniently near the ditch system on the eastern plains south of Brush, which allows for several options to physically deliver the water to the power station. While a traditional water court process was used to codify the legal ability to transfer water from agricultural use to industrial use, the arrangement has built-in flexibility to handle wet, average, and dry years. The dry year deliveries typically involve temporary dry-up (fallowing) of sufficient farmland under the ditch to meet delivery requirements to Xcel. It also means that remaining farmland is fully irrigated with senior direct flows or senior reservoir rights. In those cases, the system does not operate in a deficit irrigation mode to apply water to all lands during the really dry years. The mutually beneficial agreement is desirable in the eyes of those in the system and has a proven track record of success, providing an example of how industrial interests and farmers can continue to operate.
- *Lower Arkansas Valley Water Conservancy District* provided an economic and engineering analysis of the Lower Arkansas Valley Super Ditch Company (Super Ditch). The Super Ditch allows irrigators under a group of ditch companies to collectively lease agricultural water for other uses, including municipal use. The Super Ditch acts as a negotiating entity for irrigators who are interested in leasing water for temporary use by cities, towns, water districts, and other users.²⁶⁶ The farmers still retain ownership of their water, keeping farms in operation for agricultural sustainability.
- *The Water Bank Working Group* consists of the Colorado River Water Conservation District, the Southwest Water Conservation District, the Front Range Water Council, the Nature Conservancy, the Colorado Water Conservation Board (CWCB), and other interested parties. The working group is investigating the feasibility of a water banking program within the Colorado River Basin. In the short-term, the water bank could operate as part of the demand management component of the state's contingency plan to prevent Lake Powell from dropping below critical levels. In the long-term, a water bank could help prevent shortages under the Colorado River Compact and help Colorado water users during regional shortages. The Water Bank Working Group engages with agricultural users to gauge interest in participating in the program and to identify potential costs or compensation for involvement. The "Colorado River Water Bank Feasibility Study," released in March 2012, details potential uses for such a program as well as potential sources of supply. The preliminary study modeled the potential frequency of situations where a water bank would be useful. The study examined several scenarios that showed water bank annual use estimates and an estimate of the number of irrigators willing to participate. The CWCB is examining additional studies about the water bank.
- *City of Aurora & Rocky Ford Ditch* partnered for a creative water transfer arrangement to allow continued farming. Aurora invested to help purchase highly efficient irrigation equipment (e.g. drip or sprinkler technology) for farming operations. Farmers also received augmentation water from Aurora to supply new wells for irrigation rather than using water

directly from the Rocky Ford Ditch. Several farmers have maintained strong agricultural production by using augmentation supplies for depletions from the well use on their farm. The farmers have reduced their consumptive use by switching to crops that need less water. This arrangement still maintains a healthy agricultural operation. For successful outcomes, municipalities offer strong financial commitments and the farmers offer willingness and flexibility to modify their traditional practices.

- *City of Aurora & Rocky Ford Highline Canal* partnered for a water leasing agreement in 2004 and 2005. Farmers under the Rocky Ford Highline Canal directly leased water to the City of Aurora. Coming to an agreement took a substantial amount of time and included complex contracts between the City, individual farmers, and the canal company. It also required approval of a substitute water supply plan from the Division of Water Resources at that time. However, newer statutory authorizations for interruptible water supply agreements assist in the implementation of these types of ATMs. Intermittent leases of this nature are used to fill a specific need including drought relief and the recovery of reservoir levels following drought. They could also supplement base water supplies during dry periods.
- *Ducks Unlimited* partnered with Aurora Water and Colorado Corn Growers Association to develop augmentation ponds that support water fowl.
- *Metropolitan Water District of Southern California & Palo Verde Irrigation District* agreed to a land fallowing, crop rotation, and water supply program.²⁶⁷ They began the 35-year agreement for voluntary water transfers in 2004 to help to meet California's urban water demands through a mutually beneficial partnership. The program is designed to supply 25,000 to 118,000 acre-feet annually by temporarily drying up 7 to 28 percent of the irrigated farmland in the Palo Verde Valley.²⁶⁸

Alternative Transfer Methods Grant Program Overview

Colorado's Water Plan encourages alternatives to permanent dry-up. One way Colorado continues to address ATMs is through the CWCB's long-standing grant program. Colorado Senate Bill 07-122 authorized the ATM grant program, which applies to a wide array of issues related to lease-fallowing, pilot projects, flex market studies, demonstration efforts, and other alternatives for a variety of beneficial uses of agricultural water supplies. Nearly two dozen grants have been awarded, ranging from approximately \$8,000 to almost \$500,000 each. The program was initially funded with a total of \$4 million, with an additional \$750,000 approved in the CWCB 2015 Projects Bill (Colorado House Bill 14-1333). Detailed summaries of the program and awarded grants are available from the CWCB.²⁶⁹ The ATM grant program assists in developing and implementing creative alternatives to the traditional purchase and permanent transfer of agricultural water.

Figure 6.4-1: Rotational Fallowing

Once farmed, certain plots of land are systematically fallowed to provide temporary water that is leased to municipalities. The fallowed plot can be planted with non-irrigated vegetation to prevent blowing soils.



Photo courtesy of the Natural Resources Conservation Service.

ATM Related Legislation

State legislation influences the availability of tools necessary for the further facilitation of ATMs. One important legislative bill related to a fallowing-leasing pilot program is discussed here as a relevant tool for this section. Colorado House Bill 13-1130 enacted legislation for Interruptible Water Supply Agreements. The associated statute supplemented or amended previous authorizations. This legislation allows for a temporary change of an absolute

water right for a new use once approved by the Colorado Division of Water Resources, or the State Engineer's Office.²⁷⁰ The statute does not require the arrangements to go through a typical water court process. See table 6.4-1 above for a general description of this type of ATM.

The Fallowing-Leasing Pilot Program authorized by Colorado House Bill 13-1248 (HB13-1248) was signed into law by Governor Hickenlooper on May 13, 2013. It allows for a pilot program to test the usefulness of fallowing-leasing as an alternative to permanent agricultural buy-and-dry.²⁷¹ The pilot program may include up to 10 separate pilot projects statewide; however, no more than three are allowed in any single river basin. Each pilot can operate for up to 10 years in duration.

In HB13-1248, the Colorado General Assembly declared its commitment to develop and implement programs to advance various agricultural transfer methods as alternatives to permanent agricultural dry-up. It further stated that Colorado needs to evaluate whether fallowing-leasing is a practical alternative to traditional "buy-and-dry" methods.²⁷² The General Assembly designated the CWCB as the appropriate state agency to test the efficacy of implementing fallowing-leasing.

HB13-1248 charged the CWCB, in consultation with the State Engineer, to establish "criteria and guidelines" for the application, selection, and approval process for pilot projects. A set of criteria and guidelines was developed through the cooperation and collaboration of the CWCB, the State Engineer's Office, and the public in accordance with that legislative directive. They assist the CWCB and interested parties with carrying out the spirit and intent of HB 13-1248.²⁷³

Colorado's Water Plan recognizes the need to increase flexibility within Colorado's system of water law, while respecting individual property rights. ATMs could provide a viable option for municipal water providers now and in the future. HB13-1248 allows fallowing-leasing pilot projects to be tested in an effort to overcome challenges and to develop and demonstrate opportunities for temporary agriculture-to-municipal water transfers.

The Lower Arkansas Valley Water Conservancy District and the Lower Arkansas Valley Super Ditch Company, Inc. formally submitted a proposal to CWCB staff on July 14, 2014 for a fallowing-leasing

pilot project under the auspices of HB13-1248 and the CWCB's Criteria and Guidelines for the Fallowing-Leasing Pilot Projects. At its September 2014 board meeting, the CWCB approved the proposal to move forward on the full application. The sponsors then submitted an application, which involves transfers from certain shares of agricultural water from farmland irrigated by the Catlin Canal, within Otero County, for temporary municipal uses by the Town of Fowler, City of Fountain, and the Security Water District. The project proponents aim to carry out the pilot operation beginning in the 2015 irrigation season.

Basin Implementation Plans

Basin Implementation Plans were submitted to the CWCB in July 2014 and provided valuable information regarding each basin's plans for agricultural needs, which are summarized below.

The Arkansas Basin Implementation Plan has three goals associated with ATMs. First, "Develop collaborative solutions between municipal and agricultural users of water, particularly in drought conditions" by continuing the ATM process of engineering, public policy, and pilot projects.²⁷⁴ Second, "Provide increasing quantities of augmentation water for increased farm efficiencies" by establishing long-term sources of augmentation water through leasing, water banks, or interruptible supply agreements.²⁷⁵ Third, "Develop a workable rotating fallow and/or leasing program between agriculture and municipal interests to address drought and provide risk management for agriculture" by 1) completing the ongoing technical studies and engineering to facilitate temporary transfers; 2) defining and quantifying potential third-party impacts to shareholders within a ditch system engaged in a fallow program by providing funding in support of an economic study; and 3) minimizing permanent dry-up.²⁷⁶

The Arkansas basin has completed some ATM projects and others are still in progress. Future ATM projects will be identified using stakeholder input and current pilot project data.²⁷⁷

The Colorado Basin Implementation Plan notes the difficulties associated with ATMs. The main obstacles for alternative transfer methods are loss of income, lost market share, and the lack of expertise in farming new crops. The plan also states that problems need to be addressed on a broad scale as they occur in each basin across the state.²⁷⁸

The Gunnison Basin Implementation Plan did not specifically identify ATMs as a method to meet its future needs. However, the Gunnison BIP does state that the roundtable is committed to the voluntary preservation of agriculture. The measurable outcome for this goal is to maintain the existing 50,000 acres of protected agricultural land, and to expand this acreage by 5 percent by 2030.²⁷⁹

The North Platte Basin Implementation Plan, like the Colorado and Gunnison BIPs, does not include ATMs as a means to achieve the goals and measurable outcomes of their basin. The plan does include agricultural use for the basin: "Describe and quantify the environmental and recreational benefits of agricultural use." The measurable outcome for this goal is to complete at least two new multi-purpose water projects by 2025 that meet multiple needs identified in the plan.²⁸⁰

The Rio Grande Basin Implementation Plan listed ATMs as a way to meet 8 of the 14 goals for the basin and states that more detailed accounts of ATM projects will be included in future iterations of the BIP.²⁸¹

The South Platte/Metro Basin Implementation Plan identifies successful implementation of ATMs as one of the measurable outcomes for their plan's agricultural goal.²⁸² The joint plan also lists maximizing the use of ATMs as one of the ten key elements to their plan, as the use ATMs plays a key role in the South Platte/Metro's B and C portfolios for meeting 30,000 acre-feet of their future water demands.²⁸³ The plan also recognizes the need to study ATMs in order to fully understand their efficacy, and specifically recommends the continued research, testing, and documentation of implementing ATMs.²⁸⁴ Through the CWCB's Alternative Agricultural Water Transfer Methods Grant Program, the South Platte/Metro Basin has completed and is currently working on several studies regarding the challenges and benefits of implementing ATMs. The plan would like to see future pilot projects developed under this grant program to test current ATM concepts.²⁸⁵

The Southwest Basin Implementation Plan listed the implementation of ATMs as a means to preserve agriculture, while addressing other water use needs, as one of their measurable outcomes.²⁸⁶

The Yampa/White Basin Implementation Plan mentions ATMs as a process to achieve their goal to "Protect and encourage agricultural uses of water in the Yampa-White-Green Basin within context of private property rights." Part of this goal is not only to preserve current protected agricultural acreage, but to expand it as well. The plan specifically states that a process for this goal is to "Identify projects that propose to use at-risk water rights, alternative transfer methods, water banking, and efficiency improvements that protect and encourage continued agricultural water use."²⁸⁷ The plan currently has not identified any specific ATMs to meet this goal.²⁸⁸

[Interbasin Compact Committee Low and No Regrets Action Plan](#)

The IBCC developed several ATM recommendations as part of the no and low regrets action plan, as summarized in Table 6.4-2.²⁸⁹

Additional details regarding IBCC low and no regrets information pertaining to alternative agricultural transfer methods can be found in the latest version of IBCC No and Low Regrets Action Plan.

Table 6.4-2 Completed and Ongoing Actions	Potential Future Actions
• Implement ATM Grant Program • Ongoing CWCB and IBCC support	1) Develop an Incentives Program a) Financial incentives b) Streamlining approval processes c) Selective and systematic considerations 2) Establish ATM Demonstration Projects a) Overlay district or authority b) Storage and other infrastructure c) Multi-purpose objectives d) Adequate measurement and monitoring 3) Establish Basin Goals and Track Ongoing Progress 4) Implement ATM Program 5) Analyze Infrastructure Needs for Storage of ATM Water <i>[See Section 6.3]</i>

Actions

The following is a list of action steps needed to help ensure that alternatives to permanent farmland dry-up are more attainable:

- CWCB will monitor current and future legislation necessary for the implementation of ATMs, including enhanced sharing opportunities and system flexibility.
- CWCB will encourage funding grants that focus on implementing on-the-ground ATM projects, data collection, flexible administration practices, ATM affordability, basin-specific ATM projects, and infrastructure modernization.
- CWCB will support appropriate fallowing-leasing pilot projects by responding to and processing applications in a timely manner under HB 13-1248 (2013).
- CWCB will continue to provide ATM leadership as well as technical and financial support to the basin roundtables in the development of their BIPs as they relate to ATMs.
- CWCB will assess quantitative information related to agricultural dry-up in the next version of the Statewide Water Supply Initiative, including lessons learned and monitoring the effects of ATMs in reducing permanent agricultural dry-up.
- As part of the funding section in 9.2, CWCB will explore financial incentives through a stakeholder process. These incentives or subsidies could include the new and ongoing revenue stream or tax incentives at the local or state level. CWCB will explore the potential use of conservation easement tax credits coupled with ATMs.
- CWCB will explore the formation of pilot mutual management entities with municipal and agricultural stakeholders in the South Platte Basin. This body would allow farmers to retain ownership of their water rights while permanently ensuring supply for municipalities through contracts.
- CWCB will seek to help stakeholders understand the benefits and social barriers of ATMs and how they can function under existing and future law.
- The state of Colorado should consider the following legislative options:
 - Provide flexibility for certain agricultural water rights to be used for multiple purposes.
 - Broaden HB 13-1248 to include additional objectives, such as pilot projects to demonstrate agricultural transfers that meet environmental or compact needs.
 - Reduce barriers, such as high transaction costs associated with water right transfers and water rights accounting uncertainties.

- Protect existing municipal owners of transferred water rights if they choose to go through the court process to stipulate that their permanent agricultural transfers can be operated as ATMs. Such legislation would ensure that if a water rights holder went through the court process and it should be unfavorable to them, that they could retract the case and return to their previous stipulations.

6.5 Municipal, industrial, and agricultural infrastructure projects and methods

Colorado's Water Plan encourages the use of grassroots efforts to identify and implement projects and methods to meet community and agricultural water needs throughout Colorado and achieve the following statewide long-term goals:

- Use water efficiently to reduce overall future water needs.
- Establish a process to identify the projects and processes to meet the water supply gap for communities while balancing the needs of agriculture, the environment, and recreation across the state.
- State encouragement and assistance in the development of balanced and appropriate storage that can meet multiple benefits, including instream flow and augmentation needs.
- Meet community water needs during periods of drought.

There are a number of identified projects, storage, other infrastructure, and methods, in addition to conservation, reuse, and alternative agricultural transfers, that are needed to meet future municipal, industrial, and agricultural needs. This section discusses the different types of projects that need to be implemented to meet Colorado's growing needs, how the basin roundtables identified these projects and methods, and what needs to be done to support them.

6.5.1 Overview

The draft Basin Implementation Plan (BIP) process produced a compendium of projects and methods to meet Colorado's future water needs, which are the foundation of this section. In developing their respective lists of projects and methods, the basin roundtables relied upon previously developed Identified Projects and Processes (IPPs), conducted interviews with water providers, and solicited public input to update existing IPPs and identify additional projects and methods. For the purposes of Colorado's Water Plan, the term *projects and methods* includes IPPs and additional efforts featured in the BIPs to close the municipal and industrial (M&I) gaps and reduce agricultural shortages.

The basin roundtables vetted these proposed projects and methods to develop a draft list for their respective BIPs. Some roundtables vetted the preliminary list through the entire roundtable, while others reviewed projects and methods by subcommittees. In the end, each roundtable reviewed or adopted the draft BIPs. In addition, many of the roundtables tiered or prioritized their projects and methods to assist with future implementation.

The goal of developing lists of projects and methods is to meet Colorado's future water needs. In addition, this work will help calculate the remaining M&I water supply and demand gaps; determine residual agricultural shortages; estimate the costs of implementing the proposed projects and methods; identify the potential for intra-basin and inter-basin collaboration on

proposed projects and methods; and identify the interrelationship and the potential for collaboration between consumptive and nonconsumptive projects and methods.

The BIPs proposed over 400 projects and methods. Although some of the proposed projects and methods are designated primarily as single-purpose, many are multi-purpose. The multi-purpose projects could benefit agricultural, municipal and industrial interests. Alternatively, these projects could benefit the environment or expand recreational opportunities while meeting municipal or agricultural needs. Those projects and methods that intentionally target consumptive and nonconsumptive benefits are categorized as *multi-purpose*.

The BIPs projects and methods aim to close the M&I gaps, reduce agricultural shortages, or both, and have financial expenditures attached. Many roundtables included implementation cost estimates, although some did not. Proposing a project or method is one component of implementation, while developing cost estimates and financing mechanisms is another. Many proposed projects and methods are well developed and currently in the permitting stages; however some are conceptual in nature, with uncertain or no stated cost estimates. The validity of cost estimates varies greatly across proposed projects and methods and across BIPs. With that caveat, individual project and method implementation costs range from \$50,000 to \$211 million. It should also be noted that some proposed projects or methods are multi-year efforts, with a wide array of implementation strategies and approaches. Identified cost estimates to implement the proposed projects and methods range from \$12 million to \$589 million per BIP, with a statewide preliminary total of approximately \$690 million. Many BIPs have not yet determined costs for their projects and most have not done so on a consistent basis. Therefore, this number represents a minimum financial need.

Another consideration for the identified projects and methods in the BIPs is their estimated yield, which affects the calculated M&I gaps and agricultural shortages. The yield is subject to some variability and further refinement by basin roundtables and through potential project permitting and financing. However, the estimated yield of the proposed projects and methods ranges from 18 acre-feet per year of new supply to 90,000 acre-feet per year. Similarly, the range of yield reflects the level of participation of project sponsors and project beneficiaries. Some projects and methods have multiple sponsors, ranging in size from small localized water providers, to regional water providers, such as conservancy and conservation districts, or cities. Furthermore, some projects are sponsored by a single entity while the associated beneficiaries are many. In other cases, a proposed project or method is sponsored by a single entity and has only one beneficiary. The BIPs propose many combinations of project sponsors and project beneficiaries, reflecting the collaborative nature of the BIP process and the anticipated results. This section takes a more in-depth examination of each BIP.

Finally, the section discusses the IBCC's No and Low Regrets Action Plan and actions as part of Colorado's Water Plan.

6.5.2 New and Emerging Water Supply Projects and Methods

As the state of Colorado and the basin roundtables move towards executing BIPs and Colorado's Water Plan, innovative and creative solutions are needed to meet future demands, given the

opportunities for funding and the nature of limited water resources. There is not a perfect solution, but these emerging trends add to the suite of options that the state and the basins can implement.

Aquifer Recharge

Aquifer Recharge is the process of infiltrating water to an aquifer through ponds, basins, canals, or wells.²⁹⁰ Artificial recharge to the alluvial aquifer is most commonly used for purpose of stream flow augmentation in Colorado. A majority of these alluvial recharge projects for augmentation occur in the South Platte basin, outside of the Designated Basins.²⁹¹ Permanent artificial recharge projects, outside of the designated basins, must ultimately receive a decree through water court and operate within confines of Colorado's prior appropriation system. Additionally, a protocol for alluvial recharge within the South Platte River Basin is available.²⁹²

Aquifer Storage and Recovery (ASR)

ASR uses aquifer recharge or injection to achieve the storage of water in the aquifer during times of low demand and high water supply and later recovered by pumping when demand exceeds surface supply.²⁹³ In an alluvial aquifer, recharge for the purpose of ASR is accomplished by allowing water to seep into underlying aquifer. For confined aquifers, ASR uses wells to inject the water at pressures greater than what exists in the aquifer. Colorado's Denver Basin Bedrock aquifers have been used by several water providers for the storage of water over the past several decades. The Denver Basin aquifers are confined bedrock aquifers and they are not considered tributary to the stream system. The water in these aquifers is appropriated under a separate legal framework based on overlying land ownership. Additionally, ASR projects utilizing these Denver Basin aquifers are governed by specific rules. Although the majority of ASR projects use the Denver Basin aquifers, there are also two ongoing ASR projects in Colorado that involve utilization of alluvial aquifers.

Collaborative Management Solutions

These sort of projects and methods frequently cross basin boundaries, and consist of multiple parties working together to achieve often disparate goals. Several examples of these solutions are found in section 9.2, where entities representing many uses come together for creative water management. Examples include the Colorado River Cooperative Agreement (CRCA), the Arkansas River Voluntary Flow Agreement, and the WISE Partnership. In these solutions, a host of different needs can be met by creative collaboration and the involvement of many stakeholders throughout the entire agreement process.

Alternative Agricultural Transfer Methods

For much of Colorado's water history, the agricultural water user has been faced with two options: continue operations as normal, or sell water rights to an interested party, often a municipality seeking to firm up supply. Under potential alternatives to agricultural transfer, interested parties seek to provide a third option, within the boundaries of Colorado's prior appropriation system. Though the viability of certain types of alternative transfers are still under review, this option should be a manner by which Colorado seeks to meet future needs, as opposed to the permanent "buy-and-dry" of agricultural lands. Agricultural transfer methods (ATMs) are discussed in more detail in Section 6.4.

6.5.3 Basin Implementation Plan Identified Municipal, Industrial, and Agricultural Infrastructure Projects and Methods

The types of projects and methods, which could potentially be implemented, are as varied as the needs in each basin and statewide. While projects and methods generally fall into two generic categories (structural and non-structural), this overview of the draft BIPs warrants a more specific categorization. In these summaries, projects will be tallied by type and use identified in the BIP, even though many projects may have multiple benefits.

Statewide Water Supply Initiative (SWSI) 2010 identified several categories of IPPs, which have been consolidated into the following:

- Agricultural water transfers (including ATMs)
- Reuse of existing fully consumable supplies
- Growth into existing supplies
- In-basin projects
- New transbasin projects²⁹⁴

The majority of the projects identified in the BIPs fall into the category of “In-Basin Projects”. For the purposes of this summary, in-basin projects could align with the following descriptions:

- Collaborative Management
- Storage Improvements & Expansion
- New Storage
- Ditch & Diversion Improvements
- Monitoring, Assessment, and Planning Efforts
- Municipal Infrastructure
- Energy
- Aquifer Storage and Recovery
- Water Rights and Supply
- Multi-purpose

This section examines the “primary message” of each BIP, summarizing the prioritized projects and how the projects or methods align with basin goals and measurable outcomes. This section summarizes the process each basin used to garner public input, demonstrating how basins generated project lists.

Finally, this section describes highlights of the projects and methods and identifies the acre-feet of development and costs when available. These bulleted summaries address the **most common** types of projects and methods identified in the BIPs, thus the summary may not match the **total number** of projects and methods identified in the BIPs.

In the basin summaries, project costs and associated identified acre-feet come from material provided in the BIPs. Each basin conducted outreach and assimilated and evaluated projects in a manner unique to the respective basins. As the basin roundtables further refine the BIPs and projects and methods move to implementation, project information, costs, and associated acre-feet will become clearer. Basins with less extensive project lists may further refine the available information or augment their lists before finalizing the draft.

Arkansas Basin

Primary Message: The basin roundtable identified additional storage as a primary goal of the implementation plan. Roundtable members believe that traditional storage is the best avenue to meet the basin's supply needs, for both consumptive uses, as well as environmental and recreational. Additional methods the basin roundtable identified include aquifer storage and recovery projects, as well as alternatives to ATMs. Moving forward, the roundtable plans to focus efforts on a disaggregation of the basin gaps, to identify more localized needs, at the county level. The roundtable will also take a closer look at identified projects and methods, to prioritize available funding and resources. In project implementation, the roundtable identified compact compliance issues as a key challenge, with a critical gap also represented by the replacement of nonrenewable groundwater, and sustainability of designated basins.²⁹⁵

Process: The roundtable reviewed the SWSI 2010 IPP list, and held 17 public outreach meetings where over 100 Input Forms were submitted.²⁹⁶ These forms proposed projects, methods, and potential policy implementation. The roundtable will review and rank these input forms, with some proponents invited to attend roundtable meetings and present on the identified project, method, or suggestion. The current project list consists of projects and methods from the existing IPP list, or those funded via the WSRA Grant Program. Further vetting and ranking will take place during Phase two of the BIP process.

Arkansas Basin at a Glance

10 projects identified

\$2,058,587 in total identified costs for 9 projects

36,400 total acre-feet identified for 2 projects

Projects and Methods Summary: The roundtable identified a total of 10 projects and methods that meet municipal, industrial, or agricultural needs.²⁹⁷ The most commonly identified projects and methods were:

- 3 Storage Improvements & Expansion projects,
- 3 Ditch & Diversion Improvements,
- 3 Monitoring, Assessment, or Planning efforts

Six of these projects were classified as potentially multi-purpose.

Three of the storage improvements & expansion projects provide for municipal and industrial use, with one providing for agricultural and nonconsumptive uses. Two of the three are reservoir rehabilitation projects. The projects primarily seek to improve or expand existing infrastructure, including reservoirs, canals, and ditches, rather than new storage.

Colorado Basin

Primary Message: The Colorado Basin roundtable is focused on completing a basin-wide stream management plan, with more in-depth analysis and understanding of the amounts of water necessary to maintain environmental and recreational attributes. The basin roundtable expressed concern about the uncertainty about the ability of current water supplies to meet in-basin consumptive use, as well as environmental and recreational needs, for future projects and methods. The basin emphasized the need for more in-depth studies and work on the effects of climate change

on water supplies and the variability of wet and dry years. The roundtable stated: “the most prudent planning approach... is to assume that there is no more water to develop for export from the Colorado Basin.”²⁹⁸ The extensive public outreach undertaken by the basin, as described below, resulted in a comprehensive list of potential identified projects and methods, which make up a suite of options for the basin to meet their future needs.

Process: The roundtable members divided into Project Leadership Teams (PLTs), which focused on particular subject matter areas within the BIP. The consumptive PLT worked to identify projects within the basin that would meet future water supply needs. The PLT interviewed water providers throughout the basin, in person or through a standardized questionnaire. These information gathering efforts focused on existing and forecasted supply, as well as projects and methods to meet demands. Existing studies or reports were also analyzed for planned projects. The basin held town

hall meetings and roundtable members and consultants traveled to a number of meetings, such as county commissions and city councils, to gather information.

Projects and Methods Summary: The roundtable identified a total of 92 projects and methods meeting municipal, industrial, or agricultural needs, with associated acre-feet or costs.²⁹⁹ The most commonly identified projects and methods were as follows:

- 17 of these projects were Storage Improvements & Expansion
- 9 projects were identified as New Storage

Over 25 projects were identified as multi-purpose, while many others could have multiple benefits.

Future efforts of the basin will focus on prioritization of projects and methods, with potential modeling, to further understand potential constraints and opportunities within the river system.

Gunnison Basin

Primary Message: The primary goal of the Gunnison Basin is to “Protect existing uses in the Gunnison Basin.”³⁰⁰ With that overarching goal in mind, other goals promote the continued importance of agriculture, the protection of environmental and recreational uses, and the maintenance of infrastructure within the basin. Agricultural shortages and methods to deal with this need are a primary focus, as projects and methods are identified and prioritized with this goal in mind. Municipal and industrial needs, as quantified in the BIP, are expected to be met with currently existing supplies, and the implementation of currently planned projects and methods. Projects and potential constraints were modeled in the BIP, to evaluate the potential impacts to supply and water rights from project or method implementation. This modeling effort provided a cursory feasibility analysis for projects at a basin-wide scale, taking into account water availability,

Colorado Basin at a Glance

92 projects identified

\$10,000,000 in total
identified costs for **10** projects

513,005 - 543,003 total acre-
feet of development identified
for **54** projects

irrigation decrees, agricultural impacts on streamflows, and instream flows. Projects and methods identified in the basin were evaluated and put into tiers by the roundtable.

Process: The roundtable members and consultants conducted a series of targeted technical outreach meetings throughout the basin, working with water management agencies and stakeholders to identify projects and methods intended to meet future needs within the basin. A list of current projects was created, intended to represent the state of water planning at the time of BIP publication. Projects identified through the outreach process were compared to the Basin Goals, and evaluated by their timeline for completion. With these two criteria in mind, the BIP committee approved three “tiers” of identified projects and methods:

- **Tier 1:** implementation likely feasible by 2020; project does excellent job of meeting Basin Goals.
- **Tier 2:** implementation likely not feasible by 2020; project would excel at meeting Basin Goals. Project may also have important conditional water rights and/or completed planning efforts.
- **Tier 3:** implementation likely not feasible by 2020; project in preliminary stages of planning and/or may meet Basin Goals to lesser degree.³⁰¹

Modeling analyses also informed the tiering process, identifying projects and methods with multi-purpose uses, as well as the selection of agricultural projects which most effectively address shortages. As stated, the project list is intended to be a “snapshot” of current planning efforts, and future updates and additions to the BIP may affect the current prioritization or update information on projects and methods.³⁰² Future studies may also affect the prioritization, as supplies, demands, or processes are updated and refined.

Projects which were classified as Tier 1 were analyzed in “Project Summary Sheets” created by the roundtable. These sheets provide a more in-depth look at the projects and methods, with information such as project yield, sponsor, and a detailed look at how the project may meet basin goals. Projects which were classified as Tiers 2 or 3 were briefly outlined in a table, as well as inventory projects, which will further examine regional projects and methods.

Projects and Methods Summary: The roundtable identified a total of 85 projects and methods meeting municipal, industrial, or agricultural needs.³⁰³ The most commonly identified projects and methods were as follows:

- 22 projects identified were Storage Improvements & Expansion
- 24 projects for Ditch & Diversion Improvements
- 11 Monitoring, Assessment, or Planning Efforts

A great number of the Gunnison roundtable’s identified projects have an agricultural benefit, to be expected in this largely agricultural area. 6 projects were also identified proposing new storage.

Gunnison Basin at a Glance

85 projects identified, **38** classified as **Tier 1**

\$414,205,952 in total identified costs for **34** Tier 1 projects

125,071 total acre-feet of development identified for **18** Tier 1 projects

North Platte Basin

Primary Message: The Basin Goals established by the North

Platte Basin roundtable are intended to maintain historical water uses within the basin, as well as provide a look forward at the future of development. Chief concerns in this particular basin are the Equitable Apportionment decree, and the depletion allowance of the Three State Agreement.³⁰⁴ Agricultural needs related to shortages are paramount, as well as infrastructural storage and water delivery concerns. A list of “potential basin solutions” was created, including both structural projects and methods for water management.

Process: Similar to the Gunnison Basin roundtable, the North Platte process was driven by identification of projects, and comparing those projects to Basin Goals. Targeted technical outreach was conducted by the roundtable, reaching out to water managers and other stakeholders. Modeling analyses were performed within the basin, to identify challenges to implementation, as well as to examine the effects of specific projects. As projects were reviewed, potential multiple use projects were highlighted, and potential water availability constraints were called out. With the basin roundtable focus on agricultural needs, a shortage analysis was performed to identify projects and methods which most effectively addressed shortages.

The list of solutions was prioritized by conformity with the Basin Goals, as well as timeline for potential implementation. Some projects were selected to receive additional analysis in the form of a project summary sheet, for these reasons:

- The project, and associated analysis herein, is representative of other projects on the list, such as the case with the Proposed Willow Creek Reservoir and the Hanson and Wattenberg Ditch Acreage;
- Implementation of the project is currently being pursued, such as the case with the Protocols and MacFarlane Reservoir; or
- Implementation of the project is potentially more feasible than projects on the following list because of limited constraints or challenges or more support from the Basin Roundtable, as with the Canal Maintenance and Improvements project.³⁰⁵

The project summary sheets provide a more extensive analysis of project or method information, such as “project constraints, implementation strategies and how well the project meets the Basin Goals.”³⁰⁶ 27 projects and methods were identified in the Draft BIP, with 14 receiving a project summary sheet analysis.

Projects and Methods Summary: The roundtable identified a total of 27 projects and methods meeting municipal, industrial, or agricultural needs.³⁰⁷ The most commonly identified projects and methods were as follows:

- 10 identified Ditch & Diversion Improvements
- 5 New Storage projects
- 5 Monitoring, Assessment, or Planning Efforts

North Platte Basin at a Glance

27 projects identified, 14 analyzed in summary sheets

12,197 acres of new irrigation for 9 projects

12,000 total acre-feet of development identified for 6 projects

The majority of the projects and methods identified serve an agricultural benefit. The most numerous projects are agricultural improvements, and many of the new storage projects will need further study to refine acre-feet projections.

Rio Grande Basin

Primary Message: The Rio Grande Basin roundtable identified 14 different goals, with central tenets of “a resilient agricultural economy, watershed and ecosystem health, sustainable groundwater resources, the encouragement of projects with multiple benefits, and the preservation of recreational activities.”³⁰⁸ Additionally, the preservation of the agricultural economy, which represents 99% of the basin’s water use, is identified as an overarching goal. Through public outreach and the work of roundtable subcommittees, projects were identified which met Basin Goals. Projects and methods which meet multiple benefits and uses were identified as desirable, and would stand a greater chance of receiving funding. In future planning efforts, the roundtable plans to develop project ranking criteria, and continue to identify projects and methods which meet Basin Goals.

Process: Through the subcommittee and stakeholder outreach process, 18 projects were initially identified which the roundtable chose for a more in-depth analysis through project fact sheets.³⁰⁹

These fact sheets provided more information about each project, such as sponsor, location, estimated project costs, and the comparison of the project outcomes with Basin Goals. A matrix was also generated which displayed each project, the needs met by the project, and which Basin Goals would be met through project implementation. 16 of these projects were site-specific, and cost estimates were provided through the year 2020.³¹⁰

29 additional projects and methods were identified by the roundtable for future consideration and discussion. These projects were not analyzed at the fact sheet level because of time constraints and available information, but the roundtable believes that they could be beneficial to meeting basin needs and Goals. In the future, fact sheets will be completed, and cost estimates developed, as available. The basin intends for this plan to remain dynamic, with projects and methods added as additional needs, methodologies, and focus areas are identified.

Projects and Methods Summary: The roundtable identified a total of 47 projects and methods meeting municipal, industrial, or agricultural needs.³¹¹ The most commonly identified projects and methods were as follows:

- 9 Monitoring, Assessment or Planning Efforts
- 5 Storage Improvements & Expansion projects identified
- 4 Ditch & Diversion Improvements

The Rio Grande Basin roundtable identified many projects related to Monitoring, Assessment, and Planning, in line with their Basin Goals related to Water Administration. The Basin Roundtable also puts a particular emphasis on multi-purpose projects, with a majority being classified as such.

Rio Grande Basin at a Glance

47 projects identified

\$40,498,900 in total identified costs for 16 site-specific projects

59,500 total affected acres identified in Storage Improvements & Expansion projects

South Platte Basin (including Metro)

Primary Message: The South Platte and Metro Basin

roundtables, worked together on a joint BIP, and sought for water supply solutions to be “pragmatic, balanced, and consistent with Colorado water law and property rights.”³¹² Multi-purpose projects are emphasized, with the following three objectives specifically identified. “Projects and methods should be configured to meet multi-purpose objectives that balance:

- a) Consumptive with environmental and recreational needs;
- b) Surface and groundwater utilization and storage; and
- c) Current versus potential future needs and values.”³¹³

This BIP specifically referenced the “Four Legs of the Stool”, a result of IBCC work which identifies four key tactics for meeting future water supply.

The South Platte / Metro BIP identifies three categories of water development to meet future uses within the basin: 1) Water use efficiency improvements and water sharing strategies including conservation, reuse, ATMs and system integration; 2) Supply development involving new storage and conveyance systems and investigating, preserving, and developing Colorado River options; and 3) Watershed health and water quality management.³¹⁴ The BIP examines both larger scale concepts, such as transmountain diversions, and smaller scale projects and methods, such as storage and reuse projects. Project concepts identified in the joint BIP are primarily geared toward meeting municipal, industrial, and agricultural needs. These concepts are further divided into project categories such as reuse, agricultural transfers, aquifer storage and recovery, and transmountain diversions.

Process: Like some other basins, the South Platte / Metro joint effort began with the IPP list identified through the SWSI 2010 process. Potential project sponsors (water conservancy districts, municipalities, counties) were interviewed via project summary sheets, gathering basin project information such as sponsor and estimated cost. Project summary sheets which were gathered through the outreach process were reviewed by the Executive Committee of the Metro roundtable, and the South Platte’s Rio Chato Committee. For inclusion in the BIP, projects or methods were then reviewed by both roundtables in full.

Projects and Methods Summary: The basin roundtables identified a total of 42 projects and methods meeting municipal, industrial, or agricultural needs.³¹⁵ The most commonly identified projects and methods were as follows:

- 10 projects identified as Storage Improvements & Expansion
- 12 Reuse projects identified
- additional categories of projects such as Agricultural Transfers, ASR, and transmountain diversions

Future efforts of the basin will focus on identification of additional projects and refining of cost estimates.

South Platte / Metro Basins at a Glance:

42 projects identified

No cost estimates provided in the Draft BIP

252,315 total acre-feet of development identified in planned projects and methods

Southwest Basin

Primary Message: The Southwest Basin takes the approach that all needs should be viewed equally, be they agricultural, municipal, industrial, environmental, or recreational. 21 goals and 30 measurable outcomes were adopted by the roundtable in their BIP, with water supply needs as the focus.³¹⁶ Since SWSI 2010, the roundtable has identified the completion of 55 projects within the basin. Through the basin's outreach process, conducted in support of the BIP, 75 new projects were added to the list, totaling 130 IPPs. Of these identified projects and methods, "about 50% of the IPPs are for needs such as agricultural, municipal, and industrial"³¹⁷ The BIP is intended to serve as a living guidance document for basin water supply planning, with projects, methods, and goals continuing to be refined as needs evolve.

Southwest Basin at a Glance:

97 projects identified

\$60,000,000 in total identified costs for 1 site-specific project

245,687 total acre-feet of development identified

Process: Themes, goals, and measurable outcomes identified by the basin are geared towards identifying and meeting water supply gaps. Themes B and C directly address the matter: "B) Maintain Agriculture Water Needs, C) Meet Municipal and Industrial Water Needs."³¹⁸ With these overarching themes in mind, the roundtable conducted outreach across the basin, contacting water managers and other stakeholders to identify potential new projects and methods which had arisen since SWSI 2010. Public workshops were also conducted by roundtable members and consultants, to inform the public about the BIP and Colorado's Water Plan process, and to elicit information about potential projects or methods. The listing of projects in the BIP began with the SWSI 2010 identified projects, and then roundtable members and consultants contacted potential project proponents, gathering project and methods information in the form of a questionnaire. Project questionnaires were vetted by the roundtable, and projects or methods were adopted by inclusion in the BIP.

Projects and Methods Summary: The roundtable identified a total of 97 projects and methods meeting municipal, industrial, or agricultural needs.³¹⁹ The most commonly identified projects and methods were as follows:

- 19 projects were identified as Ditch and Diversion Improvements
- 13 projects involved Collaborative Management
- 10 Monitoring, Assessment, and Planning Efforts

The Southwest Basin roundtable will continue to evaluate projects and methods, and refinement of project information will provide more detail on cost estimates and new acre-feet. The new acre-feet total above does not include an amount of new storage and expansion projects included in the BIP.

Yampa/White/Green Basin

Primary Message: In the Yampa/White/Green Basin Implementation Plan, the roundtable focused on two main concepts, regarding implementation of projects and methods for municipal, industrial, and agricultural uses. First, the roundtable seeks to provide sufficient supply of “local water resources for existing uses and future development.”³²⁰ Also identified was the need for implementation of projects and methods which are “appropriately located, sized, and operated...to protect important water uses and the environment.”³²¹ The Basin roundtable also discusses the importance of the Colorado River Compact, and the need to keep compact concerns in mind when planning for the implementation of projects and methods. With these overarching themes in mind, the Basin roundtable adopted eight primary basin goals, with meeting existing and anticipated future uses within the basin as the chief concern.

Yampa/White/Green Basin at a Glance:

21 projects identified

No cost estimates provided in the Draft BIP

252,315 total acre-feet of development identified in projects and methods

A list of Projects and Processes was developed by the roundtable, in consultation with basin water managers and other stakeholders. The list is intended to remain dynamic; to be updated as basin needs, the understanding of river operations, and potential project proponents may be updated and refined. The Projects and Processes identified stem from information provided through basin studies, such as SWSI 2020, and the 2014 Project and Method Study funded by the roundtable. 21 projects were identified by the roundtable as meeting basin goals, and appropriate for implementation. The majority of the projects identified are new storage projects, with municipal, industrial, and agricultural needs being met by implementation.

Process: The roundtable undertook a public outreach process throughout the basin, to engage stakeholders and gather input on the BIP, as well as Colorado’s Water Plan. Projects and Processes identified through SWSI 2010 were updated, and the most up-to-date project information was identified in the 2014 Project and Method Study (P&M Study)³²². With the basin goals in mind, the roundtable gathered information from project proponents and stakeholders. Surveys distributed throughout the basin at public information meetings or through individual contact by members of the BIP Committee were intended to identify projects which were not included in SWSI or the P&M Study.

Projects and Methods Summary: The Draft BIP identified a total of 21 projects and methods meeting municipal, industrial, or agricultural needs.³²³ The most commonly identified projects and methods were as follows:

- 9 projects identifying New Storage
- 2 Ditch and Diversion Improvement
- 2 Storage Improvements & Expansion

Ongoing studies in the basin will inform additional acre-feet yield, and project costs can be fleshed out by project proponents during the permitting and financing stages.

6.5.4 Interbasin Compact Committee (IBCC) No and Low Regrets Actions

In 2014, the IBCC developed the “No and Low Regrets Action Plan” to have a high success rate for Identified Projects and Processes and implement and assess storage and other infrastructure. These strategies outline what minimum level of efforts should be carried out statewide on these topics.

Table 6.5-1 explores potential future actions agreed upon by the IBCC to develop a high success rate for Identified Projects and Processes. Statewide, the no and Low Regrets indicates that on average 80% of the yield identified in these projects needs to be implemented. This is equivalent to 350,000 acre-feet. Many of the IBCC's requests are underway through the Basin Implementation Plan and Colorado's Water Plan processes.

Table 6.5-1. No and Low Regrets Action Plan Summary to Have a High Success Rate for Identified Projects and Processes

Completed, Existing, and Ongoing Actions	Potential Future Actions
• Make policy recommendations in support of IPP implementation through the 2010 "Letter to the Governors" • Establish the CAWS group to improve communication among state and federal agencies about permitting issues • Support key IPPs (e.g., the Chatfield Reallocation Project; Water, Infrastructure, and Supply Efficiency (WISE); the Colorado River Cooperative Agreement) • Coordinate DNR responses to IPPs through the DNR Executive Director's Office • Provide technical and financial support to project proponents through Water Supply Reserve Account (WSRA) grants	1) Support Local Implementation of IPPs a) Provide technical and financial support, including facilitation, to BIPs b) Support the conversion of single-purpose IPPs into multi-purpose IPPs when requested by a project proponent c) Streamline state permitting processes for IPPs that meet values of the CWP d) Continue state coordination with the federal permitting entities e) Encourage cooperative projects through BIPs f) Support local permitting authorities to identify, as requested, multi-purpose components up front in a project planning to incorporate county and local concerns 2) Update Tracking and Data Collection via the Basin Needs Decision Support System (BNDSS) a) Support basin roundtables in providing updated IPP data as part of their BIPs b) Track and analyze impacts of IPPs on the projected water supply gap 3) Optimize Funding Sources for IPPs a) Assess funding needs b) Target existing funding sources towards IPPs c) Identify new funding sources for IPPs 4) Generate Political Support for IPPs a) Facilitate and encourage regular, active communication about IPPs between CWCB, IBCC, and Basin Roundtables b) Upon request of a project proponent, convene a

	facilitated dialogue among stakeholders, project proponents, and state agency representatives if there is disagreement about a proposed project or process c) Conduct outreach and education about IPPs and the state water planning process d) Develop an approach for determining whether a project meets the values of the CWP and has broad stakeholder support e) Upon request of a project proponent encourage legislative resolutions in support of IPPs that meet the values of the CWP f) Publicly advocate for IPPs that meet the values of the CWP and have stakeholder support

The IBCC defined storage and other infrastructure as a critical cross-cutting topic. Storage can help water users maximize supplies by re-timing water availability. This allows users to capitalize on average and wet years and may increase the possibility of sharing water resources when possible. Storage and infrastructure are also important for minimizing agricultural losses, maximizing the use of conservation and reuse savings, and allowing for additional new supplies. In addition, storage can play a critical role in supporting the environment, particularly in support of endangered and threatened species recovery programs. Moreover, storage is an important element in protecting Colorado's interstate water rights pursuant to its compacts and equitable apportionment decrees. As Colorado plans for its water future and looks ahead to a projected 2050 supply gap, new storage and infrastructure will be needed to share, transfer, store, and convey water for the benefit of all. Additionally, new opportunities for existing storage and infrastructure should be explored to provide maximum utilization for all purposes and ensure compact compliance.

While this section discusses new storage, it is not meant to include storage that would increase transbasin diversions. Therefore, concerns related to new supply development are not included here.

Table 6.5-2. No and Low Regrets Action Plan Summary to Implement and Assess Storage and Other Infrastructure

Completed and Ongoing Actions	Potential Future Actions
• Identify needed storage	1) Manage and Develop Strategic Storage and Infrastructure a) Identify storage and other infrastructure opportunities through BIPs b) Manage and improve storage and infrastructure to effectively use conserved water c) Prepare for uncertainty in hydrology and climate change d) Explore and implement aquifer storage and recovery e) Explore and implement storage and other infrastructure to support meeting Colorado's compact obligations 2) Identify and Prioritize Multi-purpose Storage and Infrastructure Opportunities

	a) Manage and improve storage, infrastructure, and reservoir operations to benefit environmental and recreational values b) Support Basin Roundtables in identifying feasible multi-purpose projects c) Prioritize implementation of multi-purpose projects that meet values of the Colorado Water Plan (CWP) d) Identify partners for permitting, funding, and constructing multi-purpose projects e) Manage and improve storage, infrastructure, and reservoir operations to benefit agriculture f) Manage and improve storage, infrastructure, and reservoir operations to benefit municipal and industrial uses g) Manage and improve storage, infrastructure, and reservoir operations to support hydropower production 3) Analyze Infrastructure Needs for Storage of ATM water a) Analyze existing storage and infrastructure for opportunities to increase exchange capacity b) Develop water quality treatment infrastructure c) Manage and improve agricultural storage and infrastructure, including support of single-purpose projects as needed

6.5.5 Maintenance of Existing Projects and Methods

New projects and methods will be critical for meeting Colorado's water supply needs. However, existing infrastructure and currently operational projects and methods require maintenance and upkeep, which are just as important as bringing new methods online. In evaluating funding mechanisms for future projects, many proponents will include operations and maintenance costs within the proposed budget. For many federal projects, maintenance costs are included in repayment contracts, or are associated with power revenues. For many municipal projects, maintenance costs are passed on to the ratepayer. Funding mechanisms through entities such as the CWCB, as discussed in section 9.1, are available for the costs associated with maintenance, repair, and improvements.

Every Draft BIP includes goals to modernize water infrastructure or improve agricultural efficiencies. Through the BIP process, many basins also identified operations, maintenance, and improvements as part of their plan for future needs. For example, the North Platte Basin had ten projects which identified ditch and diversion improvements as their primary benefit. In these agriculturally focused basins, improvements to conveyance systems will be of high importance when planning for future needs.³²⁴ The Gunnison Basin Roundtable identified 22 projects classified as storage improvements and expansion: either maintaining existing reservoirs or planning for more storage.³²⁵ The Colorado Basin similarly listed many projects associated with storage expansion, and also plans for improving or updating existing municipal infrastructure.³²⁶ In this manner, the basins are preparing for new projects and methods, while maintaining the existing supply systems.

6.5.6 Actions

To support projects and methods that meet future municipal, industrial, and agricultural needs, several next steps are necessary.

1. Continue to support and assist the Basin roundtables in moving forward the municipal, industrial, and agricultural projects and methods identified in their BIPs through technical financial and facilitation support when requested by a project proponent.
2. Incorporate the potential effect of climate change on municipal, industrial, and agricultural projects and methods.
3. Support an integrated approach to understanding how environmental and recreational projects and methods may interact with municipal, agricultural, and industrial projects and methods. In so doing work with local stakeholders and project proponents to explore multi-purpose projects and convert existing and planned single-purpose projects and methods into multi-purpose ones.
4. Continue to track municipal, industrial, and agricultural projects and methods.
5. Continue to support and implement state programs that contribute to implementing municipal, industrial, and agricultural projects and methods. These include loan and grant programs, as well as ongoing studies such as the Statewide Water Supply Initiative.
6. As discussed in Section 9.2, strengthen funding opportunities for municipal, industrial, and agricultural projects and methods by:
 - a. Coordinating current funding
 - b. Assessing funding needs
 - c. Exploring additional funding opportunities
7. Assess storage opportunities to determine where existing storage can and should be expanded, is needed to prepare for climate change, can be used to better improve sharing and use of conserved water, and can help meet Colorado's compact obligations. Furthermore, support the use of aquifer storage and recharge where it is practicable.
8. Consider prioritizing support to focus on multi-purpose projects and those that modernize and make more efficient or build new critical infrastructure for agriculture, municipal and industrial uses, hydropower production
9. As discussed in 9.4, refine the permitting process to make it more effective and efficient.

6.6 Environmental and Recreational Projects and Methods

The policy of the state of Colorado is to identify and implement environmental and recreational projects to achieve the following statewide long-term goals:

- Promote restoration, recovery, and sustainability of endangered, threatened, and imperiled aquatic and riparian dependent species and plant communities
- Protect and enhance economic values to local and statewide economies derived from environmental and recreational water uses, such as fishing, boating, waterfowl hunting, wildlife watching, camping, and hiking
- Support the development of multi- purpose projects and methods that benefit environmental and recreational water needs as well as water needs for communities or agriculture
- Understand, protect, maintain, and improve conditions of streams, lakes, wetlands, and riparian areas to promote self- sustaining fisheries and functional riparian and wetland habitat to promote long-term sustainability
- Maintain watershed health – protect or restore watersheds that could affect critical infrastructure and/or environmental and recreational areas

The importance of Colorado's natural environment and recreational opportunities to its quality of life and to its economy cannot be overstated. Outdoor recreation (including hunting, fishing, biking, hiking, skiing, golfing, wildlife watching and many other types of outdoor activities) significantly contributes to Colorado's economy, with nonconsumptive water-based recreation an important part of that economy. Healthy watersheds, rivers and streams, and wildlife are vital to maintaining Colorado's quality of life and a robust economy. Section 5 of Colorado's Water Plan contains more information about the economic benefits that recreational activities provide to the state.

This section details the projects and methods by which nonconsumptive river-based environmental and recreational water needs have been protected in the past, as well as how these values may be maintained in the future. This will be accomplished by describing the benefits of such projects and methods, and providing existing examples. The section contains several subparts: 1) an overview of existing tools for assessing environmental and recreational needs; 2) an account of knowledge gaps; 3) an overview of environmental and recreational statutes and recent legislation; and 4) a description of projects and methods contained in the eight Basin Implementation Plans.

While water is vital to many kinds of recreation, including skiing and sports that require grassy areas, like soccer, golf, and baseball, this section focuses on recreational uses of water in Colorado's streams and rivers, defined by roundtables as primarily nonconsumptive. Section 5 of Colorado's Water Plan addresses the importance of recreational water needs that involve consumptive uses of water primarily associated with municipal or self-supplied industrial uses (e.g., irrigation of parks and golf courses, snowmaking).

6.6.1 Overview

Water is a crucial element in maintaining the environmental and recreational values important to Coloradans. Adequate streamflows support the outstanding fisheries in the upper Arkansas River, rafting through Glenwood Canyon, snowmaking for world-class ski areas, and maintaining habitat for the water-dependent natural environment. In addition, a healthy environment depends upon good water quality, connectivity of streams, and robust instream and riparian habitats. Careful water management and dedication of significant resources have also resulted in progress towards recovering threatened and endangered species.³²⁷

Meeting environmental and recreational needs must be included as an important piece of comprehensive water planning, along with agricultural, municipal, and industrial needs. The IBCC's draft conceptual agreement supports this concept and states,

Colorado's Water Plan, BIPs, and stakeholder groups across the state should identify, secure funding for, and implement projects that help recover imperiled species and enhance ecological resiliency whether or not a new [transmountain diversion] is built. This could create conditions under which future projects may be possible.... These existing environmental and recreational gaps should be meaningfully addressed in the near term.³²⁸

Projects and methods that maintain or improve Colorado's environmental and recreational values are an important part of Colorado's water future. To the matter of ecological resiliency, planned projects and methods should incorporate the potential stressors of climate change, including decreased supply and changes in runoff timing.

The challenges faced by environmental and recreational project proponents in the future include making the most of limited funding opportunities. Environmental and recreational needs have a host of non-governmental proponents; however, funding opportunities are minimal when compared with existing programs for municipal, industrial, or agricultural uses.³²⁹ In addition to strengthening existing and exploring additional funding opportunities for environmental and recreational projects and methods, strategic partnerships also will play an important role in such projects and methods. Those seeking to fund additional storage or a new diversion may find that working with a diverse group of stakeholders from the beginning will make the process more successful. The draft BIPs have identified new multi-purpose projects or methods as desirable. Working towards an environmental or recreational use to be associated with the project will garner support of a wider range of stakeholders. For example, if a new storage project could identify a potential associated recreational opportunity, such as boating or fishing, a greater range of advocates can be counted on to support the project through permitting and financing.

This sort of strategic cooperation on environmental and recreational projects and methods has proven to be a successful mechanism in the past, as will be examined later in this section and further discussed in Section 9.3. In planning for this sort of multi-purpose project or method, proponents should take into account the watershed nature of projects and methods, and the manner by which they influence more than just one particular stream reach.³³⁰ With an eye to serving multiple purposes, proponents may also consider a project or method that meets multiple environmental and recreational purposes in a reach where it has the most beneficial outcome.

With multi-purpose projects in mind, it is important to note that many environmental and recreational attributes benefit from more traditional existing consumptive uses. Although there can be impacts to the environment and recreational interests from municipal or agricultural projects, these uses can also provide benefits. A reservoir provides wildlife and fish habitat and recreational opportunities for visitors, and provides a mechanism for beneficial management of stream flows. Agricultural water uses also provide these types of benefits. The cultivation of crops around the state provides habitat and open space for many species, and the agricultural tourism sector has boomed in Colorado, with wineries and orchards around the state bringing visitors and development to agriculturally-centered communities. While these direct benefits are obvious, agricultural diversions also offer some indirect benefits. Diversions that occur in the irrigation season come back to the stream in the form of return flows. These late-season return flows that occur in early fall provide a boost to stream flows that would otherwise not be present. These retimed flows benefit riparian health and provide instream habitat.

6.6.2 Existing Environmental and Recreational Projects and Methods

Recognizing the value of a robust recreational economy and the obvious benefits of healthy ecosystems, Colorado has implemented programs and invested in projects to protect and improve these attributes. Below are some examples of these types of programs and projects.

Colorado's Instream Flow and Natural Lake Level Program

In 1973, the Colorado legislature recognized the need to “correlate the activities of mankind with some reasonable preservation of the natural environment” and passed Senate Bill 73-097, creating the State's Instream Flow and Natural Lake Level Program.³³¹ This program, one of the first of its kind, vested the Colorado Water Conservation Board (CWCB) with exclusive authority to protect streamflow through a reach of stream rather than just at a point, and to protect levels in natural lakes. Before this law was passed, all appropriations of water in Colorado were required to divert water from its natural course in the stream.³³² Senate Bill 73-097 removed the diversion requirement for the CWCB and allowed the Board to appropriate water instream between specific points on a stream, and for levels on natural lakes.³³³

Any person or entity may recommend streams and lakes for appropriation to preserve the natural environment. The CWCB also is required to request recommendations from Colorado Parks and Wildlife, the U.S. Department of Agriculture, and the U.S. Department of the Interior.³³⁴ The CWCB uses a public notice and comment procedure in determining whether to appropriate instream flow water rights.³³⁵ Before applying to water court for an instream flow water right, the CWCB must determine that: (1) there is a natural environment that can be preserved to a reasonable degree with the instream flow water right; (2) the natural environment will be preserved to a reasonable degree by the water available for the appropriation; and (3) such environment can exist without material injury to water rights.³³⁶ Once decreed by the water court, instream flow water rights are administered within the State's water rights priority system like any other water right in the state. The CWCB has legal standing in water court to protect instream flow water rights from injury at any point within an instream flow reach.

The CWCB also can acquire water, water rights, and interests in water to preserve and improve the natural environment on a permanent or temporary basis from willing water rights owners. The acquisition process includes a biological analysis by Colorado Parks and Wildlife, CWCB consideration of several factors related to the transaction, and opportunity for public input.³³⁷

Since 1973, Colorado has appropriated instream flow water rights covering over 9200 miles of stream and natural lake level water rights on 486 natural lakes.³³⁸ This protection represents approximately 30 percent of the perennial stream miles in the state. Instream flow water right appropriations: (1) protect healthy native and sport fish populations, aquatic insects, and rare and distinctive riparian vegetation communities; (2) achieve federal agencies' resource protection goals through a state-held water right; (3) are a key element of a stakeholder group plan developed as an alternative to suitability for Wild and Scenic designation of three reaches of the Colorado River; and (4) provide numerous other benefits to the citizens of Colorado. See Appendix C for some specific examples of instream flow water right appropriations. The CWCB has encouraged entities who recommend instream flow appropriations to focus on streams that provide habitat for threatened, endangered and imperiled native species.

In addition, the CWCB has completed 26 water acquisition transactions, including acquisitions to protect critical habitat for endangered species on the Yampa River, to improve³³⁹ the natural environment of the Blue River downstream from Dillon Reservoir, to restore native flows to a degraded stream system near Silverton, Colorado, and to re-water a historically dried-up stream in

Crested Butte, Colorado.³⁴⁰ See Appendix B for some specific examples of water acquisitions for instream flow use.

Recreational In-Channel Diversions

Colorado is one of several states that authorize the appropriation of water rights for recreational boating purposes within a natural stream. However, Colorado is the only state that allows for the appropriation of water rights for recreational boating uses associated with man-made whitewater parks, specifically requiring structures in the stream that create recreational experiences. These water rights are known in Colorado as recreational in-channel diversions (RICDs).³⁴¹ These water rights allow water to be called for recreational boating purposes when in priority. The size and magnitude of river flows called by RICD water rights have the potential to restrict future upstream development potential and may reduce the flexibility that Colorado has to manage its water resources. Colorado law limits RICDs to the minimum stream flow necessary for a reasonable recreational experience and must be diverted through a control structure, often a whitewater park itself.³⁴² Only a local governmental entity may apply for a RICD.³⁴³ The statutes require that any application to water court for an RICD must be considered by the CWCB after deliberation in a public meeting to determine whether the proposed RICD will:

1. Promote the maximum beneficial use of waters of the state;
2. Impair Colorado's ability to fully develop and use its compact entitlements; and
3. Cause material injury to CWCB instream flow water rights.³⁴⁴

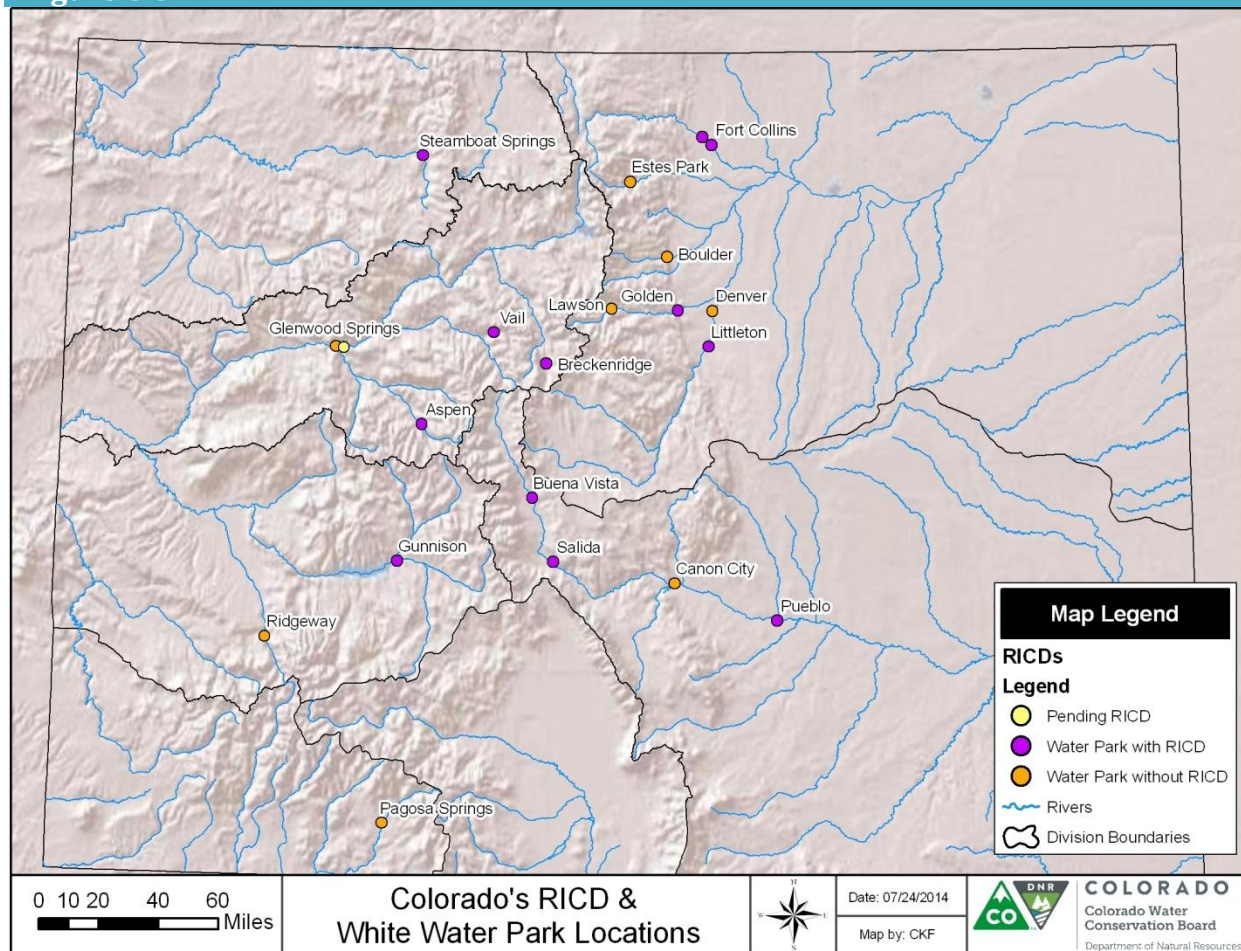
To ensure that a proposed RICD adequately meets these requirements, the CWCB has encouraged applicants to include specific provisions within their proposed water court decrees. These specific provisions have included concepts such as "carve-outs" and "no-call provisions". Examples of these specific provisions may be found in the CWCB's past findings of facts located at <http://cwcb.state.co.us/environment/recreational-in-channel-diversions/Pages/PendingandDecreedRICDs.aspx>.

The CWCB then provides its findings to the water court for consideration. The water courts must also consider whether:

1. The water right sought is the minimum necessary for a reasonable recreational experience;
2. The RICD is accessible to the public; and
3. The RICD includes only that stream reach that is appropriate for the intended use.³⁴⁵

In Colorado, there are twelve existing whitewater parks with RICD water rights and eight existing whitewater parks that operate without an RICD water right. Colorado's existing and planned whitewater parks are illustrated in the map below (Figure 6.6-1).

Figure 6.6-1



Endangered Species Recovery Programs

Many of Colorado's water projects are likely to have what is known as a "federal nexus." A water project is considered to have a federal nexus if it involves federal funding, federal permitting or licensing, use of federal lands, or a federal program. The existence of a federal nexus often triggers the need for consultation under Section 7 of the Endangered Species Act.³⁴⁶ The result of a Section 7 consultation is a biological opinion that states whether a project is likely to jeopardize the continued existence of listed threatened or endangered species or result in the destruction or adverse modification of critical habitat.

To mitigate these effects, Colorado participates in three cooperative programs to protect and recover stream-dependent species in various river basins. The Upper Colorado, San Juan, and Platte River Recovery Programs provide organized collaboration between states, Federal agencies, local agencies, water users, water providers, power providers, and environmental organizations. The Three Species Agreement differs from these programs, as described below. The goal of the programs is to recover the endangered species while allowing water use and development to continue, in compliance with all applicable state and federal laws and interstate compacts.

Funding and resources from participants are dedicated to activities that benefit the species.

Collaboration and focus on recovery activities are intended to

- maximize benefit to the species and the environment from the funding and resources expended,
- minimize resources spent on adversarial activities, including litigation,
- provide Endangered Species Act compliance for water users,
- streamline Section 7 consultations for water users and Federal agencies
- reduce uncertainty and delays in planning and permitting processes
- reduce likelihood of jeopardy opinions

Upper Colorado River Recovery Implementation Program

The Upper Colorado River Recovery Implementation Program was established in 1988 as a unique partnership of various interests in Colorado, Wyoming and Utah working towards recovery of four endangered fish species: humpback chub, bonytail, razorback sucker, and Colorado pikeminnow. These species are long-lived warm-water fish endemic to the Colorado River Basin. Recovery efforts focus on creating self-sustaining populations of native fish through restoration and management of habitat, propagation and stocking of hatchery-raised fish, and management of certain deleterious non-native fish species throughout the mainstem Colorado, Gunnison, Yampa and White and Green River Basins.

The Upper Colorado River Recovery Implementation Program provides Endangered Species Act compliance for over 2050 water projects with more than 2.5 million acre-feet of existing water use and over 300,000 acre-feet of new development. No lawsuits have been filed regarding the Endangered Species Act compliance of any of these water projects. Procedures, projects, and agreements have been established to provide streamflow protection, voluntary flow augmentation during critical spring peak and late summer time periods, habitat management and improved habitat access, genetic propagation, hatchery and stocking operations, non-native fish control efforts, and research and monitoring. The cooperative nature of the program has led to multiple successes and cost-efficiency, and the program has become a model for other endangered species recovery programs.³⁴⁷

San Juan River Recovery Implementation Program

The San Juan River Recovery Implementation Program was established in 1992 for this major tributary to the Colorado River. The Navajo Nation, Jicarilla Apache Nation, Southern Ute Indian Tribe, and Ute Mountain Ute Indian Tribe are active partners in this collaborative effort to recover the razorback sucker and Colorado pikeminnow within the San Juan River Basin in Colorado and New Mexico.

The San Juan River Recovery Implementation Program provides Endangered Species Act compliance for over 340 water projects using over 880,000 acre-feet of water in the San Juan River Basin. Major accomplishments include extensive research in biology and geomorphology, and the establishment of procedures and agreements to provide streamflow augmentation and protection, habitat management and improvement, genetic propagation, hatchery and stocking operations, non-native fish control, and continued research and monitoring.³⁴⁸

Platte River Recovery Implementation Program

During the early 1990s, all Endangered Species Act Section 7 consultations conducted on Platte River projects received jeopardy biological opinions, which meant that these water projects could not proceed. In response, Colorado, Nebraska, Wyoming, and the Department of the Interior entered into a collaborative conservation partnership with many other stakeholders now known as the Platte River Recovery Implementation Program.³⁴⁹

The Platte River Recovery Implementation Program is now working to recover four threatened and endangered species (the whooping crane, interior least tern, piping plover, and pallid sturgeon) in Nebraska, which in turn, allows water use and development to continue on the Platte River. This program involves the states of Wyoming, Nebraska, and Colorado, federal agencies, and many water, power, and environmental interests. This Program provides Endangered Species Act compliance for water projects and fully complies with the participating states' water law as well as existing interstate river compacts and decrees. The program is being implemented in an incremental manner, with the first increment programmatic biological opinion covering the 13-year period from 2007 through 2019.

The Platte River Recovery Implementation Program has been officially in place since 2007, and has provided 237 successful streamlined Section 7 consultations using the programmatic biological opinion for any entity that joins the South Platte Water Related Activities Program. The preceding Cooperative Agreement, signed in 1997, resulted in bridge measures to allow for Endangered Species Act compliance for approximately 120 Platte River basin consultations while negotiations were underway.

Through 2019, South Platte water users will pay more than \$13 million and the State of Colorado will pay \$24 million (accordint to 2005 inflation rates) for Platte River Recovery Implementation Program. However, the program is thought to be well worth the cost when compared to the untold cost that water users would likely face without the program, including:

- Undergoing uncertain, individual Section 7 consultations including bearing the risk of receiving jeopardy biological opinions,
- Potentially being required to replace past and future depletions on a one-to-one basis, which will likely add additional pressure to dry up agriculture,
- Delays in the planning and permitting process, and
- The risk of having existing programmatic biological opinions challenged in court.

Three Species Agreement

Colorado Parks and Wildlife, five other Colorado River Basin state wildlife agencies, the U.S. Forest Service, Bureau of Land Management, Bureau of Reclamation, and sovereign tribes are parties to a multi-state, multi-agency, rangewide conservation and strategy agreement that provides the framework for conservation actions designed to preserve three declining native fish species: roundtail chub, bluehead sucker, and flannelmouth sucker, across their historic range³⁵⁰. Noting rangewide declines of these species, the Three Species Agreement addresses the species' potential for listing by the U. S. Fish and Wildlife Service as threatened or endangered under the Endangered Species Act of 1973, as amended. The U.S. Fish and Wildlife Service relies on implementation of the

multi-state Three Species Agreement to protect and conserve these three native warm-water species.

The Three Species Agreement provides that within their jurisdictional authorities, signatories are responsible for taking action to conserve native fish, coordinating status assessments, developing and maintaining data sets on occupancy and genetics, and documenting conservation measures taken on behalf of the three species. It encourages all signatories to cooperate on science, research, education and outreach to send a clear and consistent message about conservation of these species. The agreement is predicated on the concept that collectively, local, state, and federal agencies, and other willing partners can work together with the communities most affected by a potential listing to develop and implement voluntary actions that pre-empt the need for federal listing of any of these species under the Endangered Species Act. Establishment of instream flow protection for streams known to provide habitat for the three species is identified as a priority conservation action under this agreement. Colorado Parks and Wildlife and Bureau of Land Management have recommended that the CWCB appropriate instream flow water rights to preserve the habitat of the three species. A recent example of such an appropriation is an instream flow water right on the San Miguel River from Calamity Draw to the confluence with the Dolores River, decreed in May 2013.

Wild and Scenic Rivers

The National Wild and Scenic Rivers Act requires federal land agencies (including the Bureau of Land Management, National Park Service, U.S. Forest Service, and U.S. Fish and Wildlife Service) to identify and evaluate rivers that may be “eligible” and “suitable” for designation as a wild and scenic river, through their land and resource management planning processes.³⁵¹

To be eligible, a river, stream, or segment must be free-flowing and must possess at least one Outstanding Remarkable Value, including scenic, recreational, geologic, fish and wildlife, historic, cultural, or similar values. Once eligibility is established, those rivers or river segments are then evaluated for their suitability for designation as a wild and scenic river.³⁵² Many factors are considered in the suitability evaluation, including whether there is a demonstrated commitment to protect the river and its Outstandingly Remarkable Values by nonfederal entities who may implement protective management.

River segments found suitable may be recommended for designation as a Wild and Scenic river. However, designation may only be done by an act of the Secretary of the Interior (upon request by a Governor) or by an act of Congress.

If a river is designated as a Wild and Scenic river, a federal reserved water right is created for a quantity of water necessary to achieve the Act’s purposes, including protecting the values for which a river is designated. Further, any water projects with a federal nexus that exist in, above or below a designated reach could be prohibited through the Section 7 consultation process if they would “invade the area or unreasonably diminish the Outstandingly Remarkable Value.”³⁵³ Also, the Federal Energy Regulatory Commission may be prohibited from issuing a new license if a project is “on or directly affecting” a designated river. Additionally, the federal land agencies, to the extent of their authority, may also protect the free flow, water quality, the classification and Outstandingly Remarkable Values for candidate (eligible and suitable) Wild and Scenic Rivers. These protections implemented by the federal land agencies may also impact potential water projects.

In 2009, Colorado's General Assembly established the Colorado Water Conservation Board Wild and Scenic Rivers Act Alternatives Fund to support cooperative and collaborative processes that are committed to exploring alternative avenues for resource protection.³⁵⁴ These processes typically consist of stakeholder groups aimed at protecting the Outstandingly Remarkable Values associated with rivers within Colorado, while protecting Colorado's ability to fully use its compact and decree entitlements through finding alternatives to Wild and Scenic designation that satisfy the federal agencies' requirements to protect the Outstandingly Remarkable Values. Representatives of diverse interests, including state agencies, local governments, conservation groups, and recreation groups, and individuals participate in these stakeholder groups, each bringing a different perspective to the group's work.

The Cache La Poudre River is the only river in Colorado currently designated as a wild and scenic river.³⁵⁵ However, several river segments in Colorado are currently being evaluated for wild and scenic eligibility and suitability by the Bureau of Land Management and U.S. Forest Service as part of their current land and resource management planning processes. Currently, there are three active stakeholder groups utilizing the Wild and Scenic Fund to develop alternative ways of protecting the Outstandingly Remarkable Values identified by these federal agencies: the Upper Colorado River Wild and Scenic Stakeholder Group, the River Protection Workgroup, and the Dolores River Dialogue's Lower Dolores Plan Working Group. Additionally, the South Platte Enhancement Board has been active since 1997 to implement its alternative plan to a possible designation under the Wild and Scenic Rivers Act.³⁵⁶

6.6.3 State of Knowledge

As part of the process established in 2005 by the Colorado Water for the 21st Century Act, the nine basin roundtables and the CWCB have worked to identify Colorado's environmental and recreational water needs, also referred to as nonconsumptive needs. Below is a brief description of some of the resources that have been developed so far. Nevertheless, it is apparent that there is additional work that can be done to develop common metrics for environmental and recreational attributes and to develop focused, basin-specific knowledge of environmental and recreational needs.

Statewide Water Supply Initiative (SWSI) Phase 1 – Nonconsumptive Mapping (2010)

As part of the nonconsumptive needs assessments, each basin roundtable mapped where important nonconsumptive attributes exist. These reaches or watersheds are known as "focus areas." Each focus area is associated with one or more attributes such as imperiled fish species, important boating and fishing areas, important water fowl hunting areas among others.³⁵⁷ Environmental attributes identified by the roundtables include federal and state threatened, endangered, and imperiled species (e.g., piping plover, greenback cutthroat trout, boreal toad, bluehead sucker); significant riparian wetland plant communities; and special value waters (e.g. CWCB instream flow water rights, eligible Wild and Scenic rivers).³⁵⁸ Recreational attributes identified by the roundtables include whitewater and flatwater boating; cold and warm water fishing; Audubon important bird areas; waterfowl hunting and wildlife viewing.

SWSI Phase 2 – Nonconsumptive Projects and Methods (2010)

Phase 2 determined where planned and existing nonconsumptive projects and methods, also known as identified projects and processes, are located in relation to the focus areas developed in Phase 1. This information can be used to determine where known nonconsumptive identified projects and processes offer direct or indirect protection for a specific attribute, and equally as important, where there are no known protections for a given focus area. For example, based upon this information, important riparian and wetland areas cover 18,767 stream miles statewide.³⁵⁹ Of those miles, existing and planned projects and processes provide or will provide direct protection to 2 percent, a combination of direct and indirect protection to 2 percent, and indirect protection to 23 percent. 73 percent of those stream miles currently have no known protection in place. The survey information was organized in a database along with Phase 1 information and was summarized in maps created using geographic information system.³⁶⁰ The maps include a list of planned nonconsumptive projects and methods, and show: 1) where planned and existing projects and methods overlap with the nonconsumptive focus areas and 2) where there are no known projects that support those reaches.

Watershed Flow Evaluation Tool

CWCB partnered with The Nature Conservancy and CDM Smith to pilot a tool known as the Watershed Flow Evaluation Tool (WFET). The WFET provides a framework for examining the risk of ecological change related to stream flow alteration at a watershed or regional level. On the other hand, site-specific quantification applies standard techniques to develop reach-based flow quantification based on historic data collection efforts. The WFET can help identify reaches where the historical alteration of stream flow has either increased or decreased risk to a given attribute, such as a cold water fishery, warm water fishery, and riparian vegetation. The WFET can also be used to project ecological responses to future streamflow scenarios resulting from new water development projects, a compact call, or climate change. To date, the Colorado and Yampa-White Basin roundtables have applied the WFET to their basins.

It is important to note that the WFET and site-specific flow quantification techniques each have different capabilities and limitations and therefore complement each other. For example, the WFET can be used to target areas that may need further site-specific studies to quantify flow needs, and site-specific quantification can help refine risk level categories identified by the WFET.³⁶¹

Conclusion

While this body of work represents an increase in the understanding of Colorado's nonconsumptive needs, there is more work that needs to be done towards understanding and quantifying recreational and environmental needs. Additionally, information is needed on whether existing nonconsumptive identified projects and processes are sufficient to protect the targeted environmental and recreational attributes of the identified projects and process. Based upon the above-described information, Colorado can work on developing a strategic approach to meeting its nonconsumptive needs to provide meaningful protection to environmental and recreational attributes.

6.6.4 Existing Environmental and Recreational Legislation

Instream Flow Legislation

Colorado's General Assembly established the Instream Flow and Natural Lake Level Program in 1973, recognizing "the need to correlate the activities of mankind with some reasonable preservation of the natural environment."³⁶² This legislation vested the CWCB with exclusive authority "on behalf of the people of the state of Colorado, to appropriate or acquire...such waters of natural streams and lakes as may be required to preserve the natural environment to a reasonable degree."³⁶³ Over the years, the General Assembly has amended and clarified aspects of this legislation. Highlights of recent legislation are set forth below.

In 2002, Senate Bill 02-156 authorized CWCB to use acquired water rights to improve the natural environment to a reasonable degree.³⁶⁴ In 2003 and 2005, the General Assembly responded to the 2002 drought conditions by allowing temporary changes of water rights to instream flow purposes with State Engineer approval.³⁶⁵ In 2007 and 2008, the General Assembly established protection for water rights owners who lease water to CWCB for instream flow use by providing that a lease to CWCB will not reduce the historical consumptive use of a water right, and eliminates the presumption of abandonment for water rights that have been used nonconsumptively by the CWCB.³⁶⁶

In 2008, the General Assembly authorized an annual appropriation of \$1 million from the CWCB Construction Fund for costs of acquiring water for instream flow use.³⁶⁷ That same year, the General Assembly authorized an annual appropriation of \$0.5 million from the Species Conservation Trust Fund for the costs of acquiring water for instream flow use to preserve or improve the natural environment of species that have been listed as threatened or endangered under state or federal law, or are candidate species or are likely to become candidate species.³⁶⁸ In 2009, the General Assembly established a tax credit that created a market-based incentive for voluntary donation of water rights to the CWCB for instream flow use.³⁶⁹

Recreational In-Channel Diversion Legislation

In 2001, the General Assembly established authority and procedures for local government entities to apply for and hold in-channel water rights for recreational uses, referred to as recreational in-channel diversions.³⁷⁰ The legislation charged the CWCB with making findings of fact and submitting recommendations to the water court on RICD water court applications, and authorized the CWCB to hold hearings on such applications if requested by any party. In 2006, the General Assembly updated the procedures for RICD water rights applications and clarified the role of the CWCB's administrative process and determination of findings of fact to submit to the water court.³⁷¹

6.6.5 Basin Implementation Plan Identified Environmental and Recreational Projects and Methods

As part of the Basin Implementation Plan (BIP) process, the basin roundtables identified projects and methods that could assist in meeting environmental and recreational needs within their basins. The process for identifying these projects and methods was unique to each basin, with roundtables

collecting and organizing information through public outreach, input solicitation, and review by committees or the full roundtable. As a result, because these processes were different in each basin, the manner in which the draft BIPs present these projects and methods varies, with some basins identifying reaches of concern, and others consolidating existing compilations of project information.

This section examines and summarizes the work of the basin roundtables, focusing on a brief description of the process used by each basin, a general overview of projects and methods identified, and the path forward as basins move to meet their goals and measurable outcomes. For more information on the BIP process and how each basin collected and organized its environmental and recreational projects, refer to the individual BIPs, available on the Colorado's Water Plan website.³⁷²

Arkansas River Basin

The Arkansas Basin roundtable undertook an ambitious public outreach process, hosting meetings around the basin to gather input and suggestions from residents. One of the hallmarks of this process was the input form designed by the roundtable, encouraging basin residents to submit ideas and projects for the roundtable's consideration. The roundtable also considered the list of identified projects and processes (IPPs) from SWSI 2010, as well as focus areas or areas of concern identified by the Nonconsumptive Needs Committee³⁷³.

The roundtable has gathered project lists from several sources, including SWSI 2010, The Nature Conservancy, Colorado Parks and Wildlife, and others. The draft BIP also identifies projects funded by the roundtable through the Water Supply Reserve Account program. Through this inventory of potential projects, the roundtable seeks to prioritize available Water Supply Reserve Account funding, and demonstrate the type of projects that the roundtable believes conform to the basin goals and measurable outcomes.³⁷⁴

The roundtable's Nonconsumptive Needs Committee has identified 25 projects.³⁷⁵ These projects line up with the basin's environmental and recreational goals of maintaining and improving key attributes. Several of the identified projects concentrate on the protection and restoration of key habitat through diversion replacement, wetland improvement, and reoperation of currently existing storage rights. Three of the identified projects were associated with some aspect of instream habitat restoration. Two projects identified by the Committee focus on recreational needs, through activities such as boat chute improvement, restoration of campsites, and reservoir renovation with recreational needs in mind.

Moving forward, the Arkansas Basin roundtable plans to delve deeper into the public input received through its outreach program. The roundtable will establish tiering criteria by which projects and methods can be measured against basin goals and ranked accordingly. Projects that meet basin

Arkansas Basin at a Glance

25 projects identified

3 stream miles identified for protection through **1** project

10,000 acres of avian area identified for protection

\$445,000 in total identified costs for **2** projects

3 instream habitat projects

3 water quality projects

5 projects to protect and restore healthy streams, rivers, lakes, and riparian areas

goals may lead to a proponent being invited to a roundtable meeting to present on their project, and potentially work with the roundtable to meet funding needs. The roundtable plans to take a holistic view of projects and methods, including concepts such as watershed health, as it moves forward to maintain an updated inventory of activities within the basin. Geographic Information System mapping of needs is a priority of the basin, supporting the BIP efforts and identifying areas of concern. This path forward is planned to complement the pending update to SWSI, with projects and methods that meet the definition of an IPP specifically identified.

Colorado River Basin

The Colorado Basin roundtable also began with an extensive public outreach campaign, as consultants interviewed water providers throughout the basin and hosted many town hall meetings and opportunities for BIP input. This outreach process yielded a comprehensive list of projects, organized by basin themes and geographical location. Similar to the Arkansas Basin approach, the roundtable believed that a comprehensive inventory of projects and methods would serve the basin well as a suite of options for moving forward and meeting their future water supply needs. Projects and methods from existing sources such as SWSI 2010 were also compiled into this inventory.

The Colorado Basin roundtable established several themes to sum up and organize the input received from basin stakeholders. Theme #1 is: "Protect and Restore Healthy Streams, Rivers, Lakes, and Riparian Areas."³⁷⁶ In its inventory of projects, the roundtable identified a number of projects that complement this basinwide theme. Central to this theme is the roundtable's goal of establishing a basinwide stream management plan. Data gaps for environmental and recreational needs are a key issue of concern for this basin. The roundtable would like to see more progress statewide in scientifically quantifying the amounts of water necessary to maintain or improve these attributes

Colorado Basin at a Glance

90 projects identified
32 stream miles identified for protection through **3** projects
\$16 million in total identified costs for **12** projects
26 water right acquisitions or flow related protection
18 water quality projects
8 watershed health projects

The roundtable's inventory of projects and methods includes many with an environmental or recreational focus. Keeping with the basinwide theme, most of the identified projects and methods were related to watershed health. 79 projects and methods with an environmental purpose were identified, and 11 were specifically recreational.³⁷⁷ The most common type of project involves acquisition of water rights to restore or protect streamflow, or flow-related recreational protection. The needs of endangered species in the Colorado basin are called out in the goals and measurable outcomes of the draft BIP, with species recovery as a measurable outcome to be achieved through habitat improvement and addressing invasive species. Recreational projects and methods include protection of flows in 28 identified popular reaches, the development of recreational in-channel diversions, and the aforementioned stream management plan.

Moving forward, the roundtable plans to begin organizing the inventory of projects for potential implementation. To prioritize the projects and methods, the roundtable will examine each through the lens of the basinwide themes and will identify the projects that may serve multiple purposes or

meet basin goals. Many of the water management related projects and methods may already be in the planning stages, such as some associated with the Colorado River Cooperative Agreement, or projects funded by the roundtable that contemplate multiple phases.³⁷⁸

Gunnison River Basin

The Gunnison Basin roundtable identified two basin goals that address environmental and recreational water needs and then identified projects and methods within the basin that could assist in meeting those needs.³⁷⁹ The roundtable compiled this inventory of projects and methods through outreach within the basin and participation by stakeholders in the BIP process. The roundtable also convened a group of environmental and recreational advocates, including staff from state and federal agencies, to provide input and assist in identifying focus reaches. As part of the BIP process, the roundtable approved the use of “project summary sheets,” used to break down elements of projects and methods such as project proponent, project cost, and effectiveness at meeting basin goals.³⁸⁰

In organizing its projects and methods inventory, the roundtable established three tiers of projects, with timeline and effectiveness of meeting basin goals as the two criteria for tiering. The basin roundtable also identified 29 target stream reaches within the basin as areas where environmental and recreational projects and methods could be beneficial. While identifying potential projects and methods, the roundtable called out a series of ongoing efforts involving environmental protections and monitoring that help to maintain these attributes within the basin.

The Gunnison Basin roundtable defined Tier 1 projects and methods as those whose implementation is likely feasible by 2020 and do an excellent job of meeting basin goals.³⁸¹ 11 of the 30 projects classified as Tier 1 are associated with the basin goal “quantify and protect environmental and recreational water uses.”³⁸² These projects are mostly focused on improving or restoring stream channels within the aforementioned target stream reaches, or improving native trout populations. Many projects identified as Tier 1 projects are multi-purpose projects that include an environmental or recreational benefit. The roundtable also identified 13 projects as meeting another basin goal: “Describe and encourage the beneficial relationship between agricultural and environmental and recreational water uses.”³⁸³ These projects are chiefly multi-purpose projects for agricultural uses with environmental and recreational benefits identified, in line with this basin goal.

Gunnison Basin at a Glance

30 projects identified
\$79 million in total identified costs for **16** projects
7 projects to protect or restore riparian, wetland, or overall stream habitat
8 water right acquisitions or flow-related protections
4 water quality projects

The Gunnison roundtable also established some measurable outcomes for its environmental and recreational goals that are based in project implementation. Moving forward, the roundtable aspires to develop 10 projects from the list of recommended solutions by 2030. Additionally, the roundtable included a more comprehensive inventory of environmental and recreational projects as a method in the list of recommended solutions, and hopes to see this “Identification and Inventory” completed by 2020.³⁸⁴

North Platte River Basin

The North Platte Basin also had two primary goals related to environmental and recreational uses and needs.³⁸⁵ The BIP process was informed by the public outreach and education process that the roundtable had been doing up to that point, engaging stakeholders within the basin as well as

a more technically-based outreach to identify specific projects and methods. Similar to the Draft Gunnison BIP, the North Platte Basin Roundtable identified one goal associated with the maintenance of healthy rivers and wetlands, and one geared toward the nexus with agricultural water use. For both of these goals, the BIP's measurable outcomes are based on project implementation, with an inventory of potential projects and methods that serve as "recommended solutions."³⁸⁶

The projects and methods identified in the draft BIP complement the roundtable's previous work, which prioritized environmental and recreational attributes within the basin. The roundtable applied the previous prioritization of attributes to the inventory of recommended solutions, and set out a process for identifying locations where these needs are not being met, and finding solutions. Measurably, the roundtable plans to develop three projects from the inventory of solutions by 2020.³⁸⁷ Regarding the goal of supporting environmental and recreational benefits through agricultural projects, the roundtable plans to complete at least two multi-purpose projects by 2025.³⁸⁸

North Platte Basin at a Glance

49 projects identified

37 projects to protect or restore riparian, wetland, or overall stream habitat

36 projects protect or restore instream habitat

24 water quality projects

In its inventory of recommended solutions, the roundtable identifies 50 environmental and recreational projects. 37 of these projects are classified as restoration of wetlands, riparian or stream projects.³⁸⁹ These projects identify specific species for protection and habitat restoration, and many are also associated with water quality or watershed health. The North Platte Basin roundtable has a particular emphasis on wetlands protection and restoration, so amphibians and waterfowl are identified as direct beneficiaries of implementation projects. Ten of the basin projects are focused on habitat restoration through projects that will improve livestock grazing management through fencing. The focus in this basin, as is evident by its goals and implementation based outcomes, is multi-purpose projects and methods.

Through implementation of these projects and methods, the roundtable hopes to accomplish incremental increases in recreational activities within the basin. Specifically, the basin aspires to a 5 percent increase in waterfowl hunting and viewing days by 2020, as well as a 5 percent increase in fishing user days in the same time period.³⁹⁰ Moving forward, the basin will use its existing prioritization system to evaluate funding for projects and methods in this inventory of recommended solutions.

Rio Grande River Basin

The Rio Grande Basin roundtable, like others around the state established a set of basin goals, and then examined potential projects with these goals in mind. The roundtable compared its basin goals with basin needs and came up with a multi-purpose focus, as 13 out of 14 goals had a nexus with environmental and recreational needs.³⁹¹ The roundtable gathered and consolidated projects and methods through its public outreach process, and through the work of subcommittees led by the BIP Steering Committee. The roundtable has identified eighteen projects and methods to date, described in detail in “Project Fact Sheets,” which were preliminarily evaluated by basin goals.³⁹²

The roundtable assessed the projects and methods identified in the draft BIP as multi-purpose projects, with all eighteen identifying some nexus with environmental and recreational needs.³⁹³ Additionally, the basin compiled a list of additional projects and methods that may merit future consideration, but were not considered in this iteration of the basin implementation plan because of time constraints. This additional section identified seven projects and methods that would meet an environmental or recreational need, often as part of a multi-purpose project.³⁹⁴

In keeping with the goals and measurable outcomes of this roundtable, many of the identified projects and methods have a focus on riparian restoration and watershed health. Projects that fall into these categories include projects intended to improve fish habitat, restore headwaters, and result in comprehensive watershed planning. Identified storage projects are viewed as potential sites for wildlife habitat and recreational opportunities, such as angling and boating. Other projects fall into the category of water management, with studies planned on hydrology within the basin, examinations of post-fire conditions, and potential streamflow optimization.

Moving forward, the roundtable has estimated costs for 16 of the 18 projects that were examined in Project Fact Sheets. These 16 projects total an estimated financial need of over \$54 million through the year 2020.³⁹⁵ As the roundtable moves forward with the basin planning effort, it will explore funding avenues, and may refine the list of identified projects and methods. The roundtable will do more analysis of the supplementary list of projects and methods, and as it measures these potential recommendations the basin goals, may prioritize some of them. Similar to the Colorado Basin roundtable, the Rio Grande roundtable has identified the need to fill information gaps regarding environmental and recreational needs and to find ways to better understand how water may be managed to maintain and protect these attributes. The BIP provides a list of projects and methods that would address these information gaps, and provide guidance to the roundtable as it moves forward on project funding and implementation.³⁹⁶

Rio Grande Basin at a Glance

39 projects identified

2.5 stream miles identified for protection through **1** project

\$54.4 million in total identified costs for **15** projects

1 water quality project

13 watershed health projects

10 projects to protect or restore riparian, wetland, or overall stream habitat

South Platte River Basin (including Metro)

The joint BIP prepared by the South Platte Basin and Metro area water roundtables required a large amount of outreach throughout the basin, as the most populous area in Colorado. The roundtables chose to outline a series of goals and measurable outcomes specifically for environmental and recreational needs. These “nonconsumptive measurable outcomes” outlined the roundtables’ priorities for environmental and recreational uses for the future.³⁹⁷

The South Platte/Metro team, similar to other basins, chose to create an inventory of projects and methods to serve as a suite of options for fulfilling these nonconsumptive measurable outcomes. A great deal of the projects listed for environmental and recreational projects came from the SWSI 2010 Nonconsumptive Needs Assessment. Beyond these identified projects, the roundtables also created an inventory of “Additional Identified Environmental and Recreational Projects.”³⁹⁸ The roundtables identified these projects through the public outreach process, through proponent submission, or as active projects in progress that the roundtables chose to identify as steps toward meeting the nonconsumptive measurable outcomes.

Beyond the inventory of SWSI and additional environmental and recreational projects, the roundtables also identified specific examples of projects that they believe meet their measurable outcomes, and would be good models to follow in the future. Existing multi-purpose projects throughout the basin were specifically highlighted in line with goals and measurable outcomes. These goals focus on endangered and threatened species, the economic value of environmental and recreational uses, and the sustainability of water-dependent areas. Following these goals, the roundtables categorized many of projects identified beyond the SWSI Needs Assessment as wetlands restoration, riparian restoration, and stream habitat projects. Measurably, the roundtables identified the recovery of key species of trout and native plains fish as important. Serving as a snapshot of the current state of affairs in the basin, this list identifies projects that are proposed, planned, completed, and ongoing.

The draft BIP also includes an analysis of the benefits to environmental and recreational needs that multi-purpose projects can provide. Examples include the potential for installation of environmentally-friendly passages after flood events, coordinated reservoir operations, and recharge projects.³⁹⁹ Moving forward, the roundtables will continue to identify projects and methods that match up with their identified measurable outcomes, and seek to identify projects that may meet multiple needs.

South Platte/Metro Basin at a Glance

78 projects identified
2.5 stream miles identified for protection through **2** projects
21 projects to protect or restore riparian, wetland, or overall stream habitat
7 water quality projects
5 watershed health projects
25 projects to protect or restore instream habitat

Southwest River Basin

The Southwest Basin roundtable completed an extensive public outreach process, to provide a comprehensive update to the SWSI 2010 IPP list. Through a series of public meetings, newspaper articles, and conversations with water management entities within the basin, the roundtable created a complete inventory of new IPPs within the basin. Additionally, the roundtable identified “Conceptual IPPs,” which have no active sponsor, but are ideas for projects and methods within the basin that may conform to basin goals and measurable outcomes.⁴⁰⁰ The Southwest Basin roundtable, similar to the Rio Grande, evaluates any project or method for potential multiple uses and benefits, so many projects identified have a potential environmental and recreational nexus.

The goals identified by the roundtable specifically identify the benefit to statewide and local economies that environmental and recreational values provide. The roundtable’s measurable outcomes include the maintenance, protection, and enhancement of these uses, as well as species recovery and watershed health. The inventory of projects and methods lists 67 environmental and recreational projects.⁴⁰¹ 24 of these projects and methods are related to wetland, stream, or riparian restoration.⁴⁰² Additionally, the inventory identifies projects that pertain to invasive species removal, native revegetation, hydroelectric projects, natural disaster mitigation, habitat protection and restoration for trout and warm water fish, appropriation of instream flows, habitat assessments, and fish passage projects..

The roundtable identifies some storage projects that would have an environmental or recreational nexus, providing a cost estimate for one off-stream water storage facility, and identifying another reservoir that could potentially provide water supply to valuable fisheries. In line with the basin’s measurable outcomes relating to the “condition and natural function of streams, lakes, wetlands, and riparian areas,” riparian restoration projects are planned for key reaches of the La Plata, the Dolores, the Navajo, and the San Juan rivers.⁴⁰³ On the Florida River, livestock fencing is identified as a means to protect a riparian buffer zone.

The identified projects that specifically call out stream miles would total around 192 miles. Moving forward, the basin will continue to consider all proposed IPPs equally, and evaluate each one for potential multiple uses and benefits. In the text of the draft BIP, the roundtable considers the opportunities for funding available, and explores the concept of “bundling” a package of proposals, and how such an approach may be a way to make the most of limited funding.⁴⁰⁴ The Southwest Basin roundtable, similar to the Rio Grande and Colorado, identifies the data gaps in environmental and recreational water needs as a priority moving forward. The roundtable discusses identification and evaluation of gaps in this body of knowledge, and believes that by addressing these gaps, planning for the water supply future of the basin will be more reliable and project implementation can be made more efficient.

Southwest Basin at a Glance

67 projects identified

192 stream miles identified for protection through **8** projects

\$60 million in total identified costs for **1** project

24 projects to protect or restore riparian, wetland, or overall stream habitat

17 water quality projects

6 watershed health projects

Yampa/White/Green River Basin

The Yampa/White/Green Basin roundtable drew from two different sources to compile an inventory of projects and methods within the basin. First, the roundtable conducted an extensive outreach process, with several public meetings, information in local publications, and surveys. Also, the roundtable had previously begun the Projects and Methods Study, which identifies projects and methods within the basin, as well as comparing certain IPPs against potential future hydrological scenarios.⁴⁰⁵

The roundtable identified two main inventories of projects with an environmental and recreational nexus. Many of the projects and methods listed in the inventory of “Current M&I, SSI, Agriculture, and Multi-Purpose IPPs” have an identified or potential benefit for environmental and recreational needs, some of which were modeled.⁴⁰⁶ Additionally, some of the identified projects are the subject of ongoing feasibility studies that could potentially identify environmental and recreational benefits to be realized through project implementation. The roundtable identified a collection of projects with primarily environmental and recreational benefits, drawn from interviews and information provided by basin stakeholders. Most of these projects and methods are located within focus areas identified by the roundtable. This collection identifies 21 projects and methods. Several of these projects have a completion date before 2020, with others classified as ongoing through 2020.⁴⁰⁷

Yampa/White/Green Basin at a Glance

21 projects identified
\$5.3 million in total identified costs for 4 projects
9 water right acquisitions or flow-related protections
3 water quality projects
4 watershed health projects
12 recreational projects

The list of Environmental and Recreational Identified Projects and Processes focuses heavily on the improvement of existing river conditions to restore and improve environmental and recreational attributes. Several projects identify specific reaches to modify for the benefit of endangered fish or for recreational access. Other projects seek to restore and preserve the natural state of the river for watershed health and erosion control. Other proposed methods would study potential solutions to identified challenges such as flow regimes for endangered fish or potential augmentation of instream flow shortages. However, the roundtable emphasizes that the current inventory is not exhaustive, and that other projects and methods will be necessary to fully address the environmental and recreational needs located within focus segments or otherwise. As planning efforts continue within the basin, the roundtable will identify projects and methods to meet these needs.

Like other basin roundtables, the draft Yampa/White/Green BIP stresses the need for accurate information and analysis of data gaps for environmental and recreational needs. To that end, the roundtable plans to use studies and modeling efforts already completed or underway to fully assess the effects of projects and methods. The roundtable will use these analyses to determine which type of project or location would be the most beneficial regarding stream conditions and hydrologic impact.

6.6.6 Interbasin Compact Committee (IBCC) Actions

In 2013, the IBCC developed the “No and Low Regrets Action Plan” to implement environmental and recreational projects and methods. This strategy outlines what should be carried out in the near term statewide. The IBCC reached consensus on the need to implement the actions summarized in Table 6.6-1 regardless of the future scenario.

Completed and Ongoing Actions	Potential Future Actions
• Implement Endangered Species Act recovery programs • Implement basin nonconsumptive projects • Develop draft Nonconsumptive Toolbox • Put Wild and Scenic alternatives in place • Implement CWCB ISF Program • Implement Colorado Watershed Restoration Program • Implement Species Conservation Trust Fund • Implement Colorado Parks and Wildlife Management Plans	1) Develop statewide goals and measurable outcomes to be considered for incorporation into BIPs a) Develop goals and measurable outcomes for federally-listed endangered and threatened species b) Develop goals and measurable outcomes for imperiled species c) Develop goals and measurable outcomes for economically important nonconsumptive uses d) Develop goals and measurable outcomes for multi-purpose projects and methods 2) Pursue projects and methods to meet nonconsumptive needs as part of the Basin Implementation Plans a) Develop basinwide goals b) Develop measurable outcomes c) Identify needs and opportunities d) Utilize the decision process to determine projects and methods 3) Track nonconsumptive projects and methods a) Conduct nonconsumptive surveys and analysis b) Create web portal c) Use existing database d) Use the Basin Needs Decision Support System (BNDSS) 4) Develop incentives, including funding for projects and methods in the nonconsumptive focus areas a) Assess funding needs b) Target existing funding sources and programs to provide enhanced levels of support for implementation of nonconsumptive needs. c) Explore additional incentives, including funding options 5) Develop environmental metrics that can be used to evaluate future projects (to be considered in the new supply discussions) 6) Manage and improve storage, infrastructure, and reservoir operations to benefit environmental and recreational values [see section 6.2.a]

6.6.7 Actions

To support a strong environment that includes healthy watersheds, rivers and streams, and wildlife, as well as a robust recreation and tourism industry, several actions are necessary:

10. The CWCB technical team and basin roundtables will work in partnership on conducting additional technical work to better determine the levels of existing protections, and where additional projects and methods should be focused. Based upon this work, the basin roundtables and relevant agencies can work together to establish and achieve measurable

outcomes for federally and state listed endangered and threatened species, imperiled species, and economically important recreational uses.

11. To maintain watershed health, the CWCB will work with watershed groups toward a long-term goal of developing watershed master plans for every large watershed area, and where needed, stream management plans. The CWCB will encourage and support capacity in areas that currently do not have watershed groups or other broad local stakeholder groups.
12. The CWCB will continue to support and assist the basin roundtables in moving forward the environmental and recreational projects and methods identified in their draft BIPs and SWSI Phase 2, and will continue to track nonconsumptive projects and methods.
13. The basin roundtables and the CWCB will incorporate the potential effect of climate change on environmental and recreational attributes into the BIPs and the next update of SWSI.
14. To support the development of multi-purpose projects and methods, the CWCB will work with the basin roundtables and other stakeholders on an integrated approach to understanding how environmental and recreational projects and methods can interact with municipal, agricultural, and industrial projects and methods to achieve multiple benefits.
15. The CWCB will strategically support the implementation of BIP identified multi-purpose, projects and methods that help meet environmental, recreational, agricultural and community water needs with state financial and technical resources, taking into consideration locally identified geographic and/or seasonal gaps. This will include establishing priorities in Colorado's grant and loan programs for multi-purpose projects and methods.
16. Working with the basin roundtables and BIPs, the CWCB will coordinate with project sponsors to explore and support opportunities to increase benefits to environmental and recreational values associated with existing and planned storage and infrastructure.
17. The CWCB, other state agencies, basin roundtables, and other interested stakeholders will continue to support and implement state programs that benefit environmental and recreational attributes, such as the Colorado Watershed Restoration Program, Instream Flow and Natural Lake Level Program, Wild and Scenic Rivers Act Alternatives Fund, and Colorado Parks and Wildlife's Wetlands for Wildlife Program.
18. The CWCB, Colorado Parks and Wildlife, and water users will continue to support and participate in collaborative approaches to Endangered Species Act issues, including recovery programs, cooperative agreements, and other efforts to prevent listings and promote the sustainability of endangered, threatened and imperiled aquatic and riparian-dependent species and plant communities.
19. The CWCB will continue to support local governments on recreational in-channel diversions through technical consultation and funding where appropriate.
20. As discussed in Section 9.1, the CWCB will work with appropriate entities to strengthen funding opportunities for environmental and recreational projects, including funding for long-term monitoring and maintenance of such projects, by:
 - a. Coordinating current funding
 - b. Assessing funding needs
 - c. Exploring additional funding opportunities

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7. Water Resource Management and Protection

This chapter examines those factors beyond supply and demand that affect water availability, such as natural hazards, watershed health, and water quality. Section 7.1 delves further into watershed health, how it can be affected by natural disasters, management strategies to protect and improve watershed health, and the critical role it plays in ensuring Colorado's water future. This section, in particular, emphasizes the ways which stakeholders can work together, with a focus on collaboration and information sharing. Section 7.2 provides an overview of natural hazards, which can result in serious consequences for our watersheds, drive up demands for water, and impact water quality. Natural hazards and watershed health both influence water quality, which is of utmost importance to water providers, and the wildlife which depends on healthy streams. Section 7.3 provides a detailed exploration of water quality and the organizations and regulations that are charged with its protection. This section also works to bring together the statewide perception of water quality and quantity. Together, these three elements help to ensure that Colorado is adequately prepared to not just manage, but also protect the water resources we all rely upon.

7.1 Watershed Health and Management

Colorado's Water Plan promotes watershed health and supports the development of watershed coalitions and watershed master plans that address needs from a diverse set of local stakeholders.

Introduction

Colorado's mountain watersheds have a strong influence on the quality and quantity of water. Watershed geography includes physical science, such as climate and geology, as well as the relationship that humans have with the land. Healthy watersheds provide ecosystem services that benefit ecological processes, local and state economies, and social stability. Ecosystem services include flow regulation, flood attenuation, water purification, erosion control, and habitat protection.

This section begins by defining the physical processes that influence watershed health and concludes with recommended strategies for successful stewardship of watersheds and water supply, and a summary of the watershed health strategies developed in the Basin Implementation Plans (BIPs).

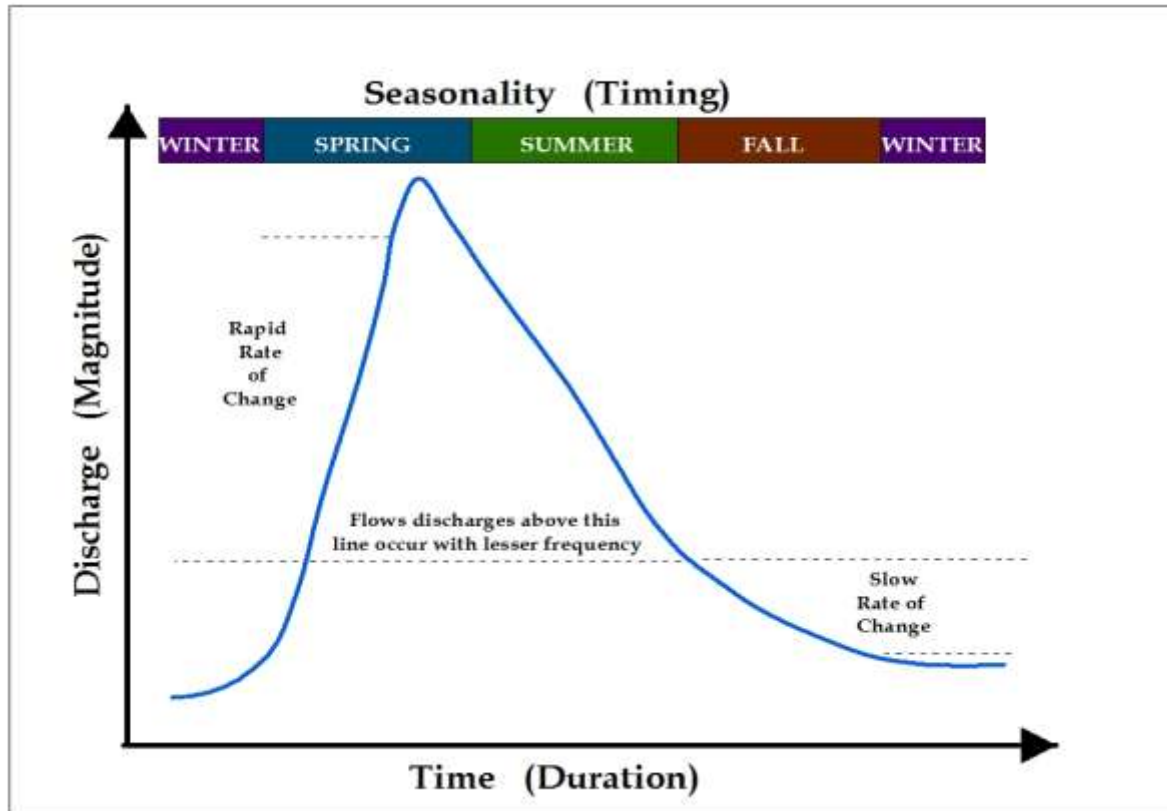
7.1.1 Watershed Health Science

A watershed is an area of land in which all water drains to a common point. Watersheds exist at all spatial scales, from the tiniest of tributaries to the largest rivers on earth. John Wesley Powell defined a watershed as "that area of land, a bounded hydrologic system, within which all living

things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community." Forested watersheds are the natural forebays of Colorado's water supply. As snowmelt and rain travels down gradient to reach these rivers it must go through varying terrain, interacting with the biology and the physical environment of the watershed. This is the watershed's ecosystem. Water quality and quantity are intimately linked to a watershed's health.

Watershed health can be broadly defined as a measure of ecosystem structure and function. Species richness (characterized by abundance and diversity), inorganic and organic resources, and physical attributes of an area comprise structure. Function refers to productivity and hydrology.¹ A critical element of hydrologic function is flow regime. Flow regime defines the magnitude, duration, frequency, rate of change, and timing of flows in stream systems. Magnitude refers to a river's discharge. Duration describes a period of time a river experiences a given discharge. The frequency at which a river experiences a given discharge and the rate at which discharges increase and decrease, (i.e. change), also characterizes flow regime. Finally, the timing of discharges, or seasonality, is influenced by a watershed's hydrologic function. Figure 7.1-1 below represents an annual median flow hydrograph for a snowmelt driven stream. It describes the different elements of flow regimes. Society has adapted its water supply infrastructure to the flow regime of its watersheds. Changes in ecosystem structure and function have direct and indirect effects on a stream's flow regime.

Figure 7.1-1 Stream Hydrograph



Watersheds support dynamic ecosystems that are subject to natural perturbations, such as fire, flood, and drought.² Resilient ecosystems function in a state of dynamic equilibrium. These watersheds experience natural disturbances with no substantial impact on function. Often, the impacts from fire, flood, and drought are exacerbated by anthropogenic perturbations. For example, watersheds that have historically been managed to exclude fires have changed ecosystem structure and productivity. When ecosystem function thresholds are crossed, a watershed no longer exists in equilibrium. The resultant changes to hydrologic function and water quality have direct effects on water supply.

Watersheds work to connect terrestrial, freshwater, and coastal ecosystems, and provide ecosystem services, such as carbon sequestration, water supply, filtration, and purification.³ Colorado watersheds support multi-objective uses for both consumptive and nonconsumptive water supply. Approximately 80 percent of Colorado's population relies on forested watersheds to deliver municipal water supplies.⁴ Watershed health management strategies developed to protect this domestic supply will also protect other uses in the watershed. Sediment is the most concerning non-point source pollutant contributed from our forested lands.⁵ An unbalanced delivery of sediment in rivers has negative effects on both consumptive and nonconsumptive water uses. Sediment is contributed to river systems through natural processes that connect land and water. Increased volumes of sediment are contributed as a result of erosion caused by high to moderate burn severity fires, forest road infrastructure with failing stormwater management infrastructure, and other processes in which the landscape is altered by human or natural causes.

Forests provide ecosystem services for watersheds that help to protect, restore, and sustain water quality and quantity. Healthy forested watersheds absorb rainfall and snow melt and allow it to runoff slowly, recharge aquifers, sustain stream flows, and filter pollutants. Watersheds are largely protected when forest ecosystems are healthy because soil is protected, thereby preventing erosion, promoting soil moisture storage enhancement, and allowing groundwater recharge.⁶ These services can offset natural hazards by reducing floods, maintaining plant communities, and reducing contaminants. Present day forest health concerns are largely attributed to climate change and forest stand density, i.e. ecosystem productivity.⁷ Climate change has the potential to affect watershed health with increasing temperatures, altered precipitation patterns, and earlier snowmelt resulting in potential increases in stream temperatures, increased pollutant concentrations, reduced quality of aquatic habitats, and loss of wetlands. Conversely, healthy watersheds may increase climate change resiliency and provide natural carbon sequestration.⁸

While forests are vital to overall watershed health, the physical extension of these lands are comprised of the lower elevation rangelands. Rangelands have a significant role in water storage, transport, sediment control, water quality, wildlife habitat, and streamflows. Lower elevation watershed health can be favorably influenced by optimal agricultural practices.

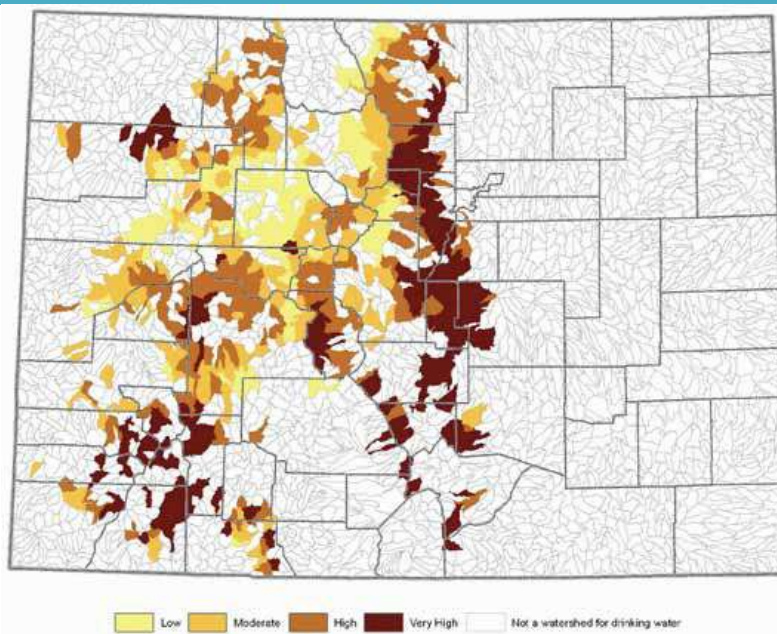
7.1.2 Managing Partnerships for Healthy Watersheds

Managing watersheds for healthy ecosystem structure and function is a unique opportunity for water supply stakeholders. Successful watershed management necessitates a pragmatic approach that includes coalition-building, data collection, planning, prioritization, implementation, and monitoring. This is a cyclical process, and each phase requires continued efforts. Watersheds exist across political boundaries, and watershed health management involves collaboration among many interested entities. Natural resource management may be the driver that catalyzes a need for collaboration, but there are social, political, and economic interests that must be represented as well.

A watershed approach is a flexible framework for managing water resource quality and quantity within specified drainage areas, or watersheds. This approach includes stakeholder involvement and management actions supported by sound science and appropriate technology. Coalition building typically starts when interested parties come together to discuss a watershed health concern. For example, many watersheds in Colorado are identified as having a high post-fire erosion risk as well as being a critical watershed for water supply.⁹ (Figure 7.1-2) This is an example where concerned stakeholders are engaging in collaborative dialogues to address very real watershed health concerns. Coalitions may form to address a variety of concerns including pre- and post-fire mitigation, forest mortality, water quality impairments, flood mitigation and recovery, and land use change. Other groups may come together to discuss watershed protection in a well-functioning ecosystem. Collaboration before a threshold crossing disturbance takes place sets the stage for faster and more resilient recovery measures.

An organizational structure is recommended whether or not the coalition chooses to incorporate. The coalition should be open to diverse interests within the watershed, as well as those interests directly affected by the outputs of the watershed. Diverse stakeholder input at the beginning stages of coalition building increases the likelihood actions to improve watershed health will be successful. Engaged community members will be more likely to participate in building political will, developing management options, and supporting

Figure 7.1-2 CSFS Risk of Post-Fire Erosion in Watersheds that are Important Sources of Drinking Water



project implementation. Stakeholders that may be represented include all levels of government, special districts, private landowners, businesses, citizens, non-profits, educators, recreational interests, agricultural interests, grantors, and conservationists. A coordinator that works for the coalition improves the chances for continued coalition success because the coordinator serves all coalition stakeholders equally, and represents the interests of all coalition members. They are the unifying body, the moderator, the facilitator, and the manager. It is helpful for this person to have a background in both non-profit and governmental work.¹⁰

Watershed planning can happen at different levels depending on the coalition's mission, objectives, and goals. A watershed plan is a strategy that provides assessment and management information for a geographically defined watershed, including the analyses, actions, participants, and resources related to developing and implementing the plan. The development of a watershed plan will require a certain level of technical expertise and the participation of a variety of people with diverse skills and knowledge. Different members of the coalition have varying skill sets that aid in the assemblage and assimilation of watershed information (e.g., GIS data, maps, monitoring reports, risk analysis, and existing assessments).

A holistic watershed planning approach will provide the most technically sound and economically efficient means of addressing watershed health concerns. The process is strengthened through the involvement of stakeholders. This approach will address all the beneficial uses of the water supplied by the watershed, the criteria needed to protect the uses, and the strategies required to restore or protect ecosystem productivity and function. This approach expedites cooperative and integrated water supply planning, which leads to successful implementation of watershed health management strategies.

7.1.3 Forest Health Partnerships

Fires are a part of Colorado's forest ecosystems. Forest management to prevent fires has proven to exacerbate burn intensity.¹¹ Many stakeholders have come together to address forest health through fire mitigation strategies. The U.S. Forest Service has partnered with Colorado's municipal water providers, state agencies, and private interests through the Rocky Mountain Protection Partnership. This partnership functions to preserve water quality by mitigating the effects of forest landscape change caused by severe fires and pine beetles.¹² It is also a venue to strategize post-fire restoration in critical watersheds on public and private lands. Key municipal water providers include Denver Water, Aurora Water, Colorado Springs Utilities, Northern Water Conservancy District, and the Pueblo Board of Water Works. The National Forest Foundation and the Coalition for the Upper South Platte are non-profit organizations with a critical role in the partnership. Partner funds are being leveraged with federal and state funds to plant trees, treat hazardous fuels, restore riparian and wetland areas, treat invasive species, restore trails, decommission roads, restore stream channels, and engage volunteers.

Federal, state, local government, and private partners formed the Watershed Wildfire Protection Group in 2007. The group's vision "is to protect Colorado water supplies and critical infrastructure from catastrophic wildfire and other threats by maintaining healthy, resilient watersheds through collaboration, implementation, leveraging, and education." Core members of this group include the

Colorado Water Conservation Board (CWCB), Colorado State Forest Service, United States Forest Service, Denver Water, Aurora Water, the Coalition for the Upper South Platte, and J.W. Associates. The group provides education and outreach activities statewide and connects practitioners with funders.

The CWCB recommends that the entities listed in the paragraphs above be consulted when considering the formation of forest health partnership. These partnerships have explored strategies to implement pre- and post-fire mitigation projects prioritized to improve forest health and protect critical water supplies. Existing forest health partnerships are adept at leveraging funds and resources from federal, state, and local government agencies as well as from private companies, foundations, and non-profits. CWCB funds from various grant programs including the Colorado Healthy Rivers Fund, the Colorado Watershed Restoration Program, the Fish and Wildlife Resources Fund, and the Water Supply Reserve Account have been leveraged to improve forest health.

7.1.4 Basin Implementation Plan Strategies

Watershed health for the individual basins is largely focused on forest health concerns. The Basin Implementation Plan (BIP) guidance, provided by the CWCB, recommended this as a focus area. Forest health concerns are centered on wildfire, flooding, and sedimentation. Basins were asked to identify projects and methods that would protect critical water supplies and the environment in the event of a natural disaster at the watershed scale. The BIP guidance recommended that existing watershed assessments be assembled or developed. It also recommended beginning collaborative discussions on managing forests to benefit water supply. Basins with water supplies originating in another basin were encouraged to work collaboratively.

All of the basin roundtables identify wildfire as a watershed health concern. This includes recovery from existing fires and identifying pre-fire mitigation strategies. The Arkansas Basin illustrates a process with a strong emphasis on pre-disaster preparedness through collaborative dialogues with potentially affected parties. Figure 7.1-3 outlines the Watershed Health and Emergency Event Life Cycle and the role of stakeholders.

Figure 7.1-3 Coalition Stakeholder Figure



The Rio Grande Basin's approach to watershed health is closely aligned with that of the Arkansas Basin, and the Rio Grande Basin contributed to the Arkansas Basin's watershed health planning process. The primary goal of the basin is to "protect, preserve and/or restore the sustainability of the Rio Grande Basin watershed by focusing on the watershed health and ecosystem function." The basin developed a collaborative watershed coalition during the 2013 West Fork Fire, and they realized the benefits of such a group for restoration and protection of forested watersheds. The coalition known as RWEACT (Rio Grande Watershed Emergency Action Coordination Team) has modeled post fire hydrology, improved their ability to forecast storms and identify flood potential, and developed post-wildfire flood risk analysis maps. The basin's watershed health actions emphasize forest management and stakeholder coordination. This includes forest thinning and prescribed burning as methods to improve forest health. In addition, the Rio Grande Basin included soil health for agricultural lands as a key action in its plan.

The South Platte and Metro Basins also participated in the Arkansas Basin's watershed health planning process. They propose a collaborative dialogue that focuses on post-fire mitigation across watershed (basin) boundaries. The deliverables from this process will include forest health manuals developed at a statewide level. The basin watershed health section also discusses insect infestations, but concludes that insects have little direct impact on water quality and quantity.

The Southwest Basin has a history of collaborative watershed groups focusing on watershed health topics. This includes forest health and resiliency planning for the San Juan watershed, water quality monitoring on the Animas River, watershed health assessments for the San Miguel watershed, and development of Source Water Protection Plans for 23 public water suppliers. A Source Water Protection Plan inventories potential sources of drinking water contamination in a defined watershed.

The Yampa, White, and Green Basin state that more than one-third of their jobs are dependent on water quality influenced by watershed health. They acknowledge that communities in the basin are susceptible to water quality issues caused by severe wildfires. The basin references a Critical Community Watershed Wildfire Protection Plan entitled "Upper Yampa Phase I Watershed Assessment: Prioritization of Watershed Base Hazards to Water Supply." Watershed Wildfire planning is frequently recommended for watersheds critical to water supply. They provide composite hazard rankings for wildfire hazards, flooding/debris flow risk, and soil erodibility. This data is combined with Source Water Assessment and Protection data to prioritize critical watersheds.¹³ Presently, the Watershed Wildfire Protection Plans are geared towards prioritizing forest health treatments for watersheds critical to drinking water supply, but they could be applied to any prioritized water use.

The Gunnison Basin is addressing forest health concerns by partnering with the Colorado and U.S. Forest Services to manage forests, insects, and wildfire. They also anticipate education and outreach associated with this effort. They did not participate in the Arkansas Basin's watershed health planning process, but they do plan to reference materials produced in the effort for future watershed health projects.

The North Platte Basin references a study that monitors forest beetle kill, wildfire potential, and impacts to water quality and quantity. The study is nearing completion and looks at management alternatives in the post beetle kill forest environment. The basin intends to review, disseminate, and implement recommendations identified in the study.

The Colorado Basin identifies 14 collaborative watershed groups actively engaged in improving watershed health. Primary watershed health concerns in the basin include wildfire risk and the evolving forest landscape. Both have the potential to impair water supply. The basin supports watershed wildfire assessments.

7.1.5 Actions

To better understand and promote watershed health, and to support development of watershed coalitions and watershed master plans that address needs from a diverse set of local stakeholders, several next steps are necessary. The parties responsible for implementing the actions are the watershed coalitions or forest partnerships. Water supply stakeholders are responsible for the development of effective watershed coalitions (see section 7.1.2). Coordination across watershed divides can be fulfilled by the Watershed Wildfire Protection Group, other watershed groups with a state or region wide geographic scope, and state agencies focusing on watershed health. These agencies include Colorado Parks and Wildlife, Colorado Department of Public Health and Environment, and the CWCB.

1. Identify existing watershed coalitions and existing watershed plans and assessments, including source water protection plans.
2. Encourage and support capacity in many areas that currently do not have watershed groups or other groups that work with a broad set of local stakeholders.
3. Assist stakeholders in existing watershed groups with tools and resources to address gaps and build capacity in existing plans.
4. Identify public and private funding sources that can be used together to support watershed and forest health projects.
5. Identify watersheds critical to water supply.
6. Work toward a long-term goal of developing watershed master plans for watersheds critical to consumptive or nonconsumptive water supply.
7. Prioritize and implement projects identified in master planning.
8. Monitor projects.
9. Adaptive management.
10. Statewide coordination of watershed coalition and partnership plans, projects, monitoring, and adaptive management strategies.

7.2: Natural Disaster Management

Natural disasters are potentially devastating natural events that can have detrimental impacts to the state and its economy. In Colorado we are prone to droughts, floods, earthquakes, tornados, and wildfire. Natural disasters do not just impact people and property, but can have serious negative effects on our water systems and the amount of water available to meet the needs of Coloradans.

7.2.1 Climate Change Effects on Natural Disasters

In nine out of every ten years, a portion of the state experiences some level of drought conditions.¹⁴ As discussed in chapter 4, droughts and floods that make our water availability so variable can also bring devastating economic and natural consequences to the state. Colorado has invested heavily in developing flood mitigation activities, both structural and non-structural; and leads the nation in

innovative drought preparedness planning. While natural disasters cannot be prevented or avoided, these investments can help reduce adverse impacts.

Given that water influences nearly all sectors of Colorado's economy, and that too little or too much can have a significant effect on the environment and economy, it is important to understand how climate change may affect the frequency, duration, and intensity of these natural hazards. The Colorado Water Conservation Board has examined how water resources will be impacted by climate change through a number of studies including: Climate Change in Colorado, The Colorado River Water Availability Study, The Joint Front Range Climate Change Vulnerability Study, the Colorado Drought Mitigation and Response Plan, and the Colorado River Basin Water Supply and Demand Study.^{15 16 17 18 19}

The most likely impact of future climate change on water supplies is a shift in the timing of runoff. Projections indicate that runoff timing will shift 1 to 3 weeks earlier by mid-century, due to increased temperatures.²⁰ This may affect water right holders who are only permitted to withdraw their allocation during specific timeframes, or those with limited storage. It is also likely to result in decreased late summer streamflow. This is because of both increased temperatures and the projection that precipitation will generally increase in the winter months, and decrease in the summer months.²¹ At the same time, increased population and higher crop irrigation requirements will put additional pressure on a changing water supply.²²

While precipitation trends are far less clear than temperature trends, some studies have examined what floods and droughts might look like under an altered climate. Our paleoclimate record shows droughts that are longer lasting and more intense than those experienced in the 20th and early 21st centuries.²³ However, there is much variability across the state. For instance, in the Yampa/White River Basin, the hydrologic paleo record shows that streamflows are variable enough to capture all but the wettest projected flows under various climate change conditions. Conversely, in the Arkansas River Basin, paleo flows accurately represent only one of the climate projections, and none of the driest. These records reinforce the fact that the past may not be a good predictor of the future.

When flood and drought extremes are directly examined under future climate conditions, significant variability exists across the state. On the Colorado River at Cameo, the average intensity for droughts was somewhat greater than the historical intensity (-24 percent versus -19 percent); while the intensity of surplus, or flood, spells was considerably lower than the historical surplus (27 percent versus 46 percent). When climate projections are taken into account, future projected drought intensities for the same length event range from -19 percent to -32 percent; while surplus intensities range from 17 percent to 38 percent. The frequency of such events depends on which climate projections are used.²⁴

The frequency and intensity of wildfire may also change under a warmer climate, and will continue to affect watersheds and ecosystems. While it is understood that variability in Colorado's climate will continue long into the future and will include wildfires, drought, and floods, the influence of climate change on these events is less certain. The use of scenario planning enables the State to

modify and adapt planning processes as new information becomes available, increasing flexibility and resiliency.

7.2.2 Preparedness and Response

As we look back at our recent history, the last few years have demonstrated the extreme variability that Colorado faces. The year 2011 was historically wet, 2012 was historically dry, and 2013 was both historically dry and historically wet. This variability presents immense challenges to water supply management and planning in Colorado.

The stories from the flood of 2013 involving damaged water infrastructure and diversion structures, facilities that were severely disconnected from the stream or river channels, streams and rivers that significantly changed course, homes and businesses that were damaged or washed away, watersheds affected by fire then flood, and thousands of agricultural acres at risk but then able to be irrigated in 2014 because the State and others responded quickly with grant and loan resources, teach us two things:

Coloradans know how to face and recover from disasters. People came together to support their neighbors, and the thousands of unknown heroes who made a huge impact on the lives of their neighbors and communities. Yet, even when people come together to face catastrophe, having a plan and sufficient resources in place makes the immediate response and the long effort of recovery easier.

As described in section 6.1, *Scenario Planning and Adaptive Strategies*, the future is uncertain. While Section 6.1 describes the types of projects and methods needed in general for average conditions, this section focuses on variability from year to year. In any given year, Colorado needs to be prepared to respond adequately to the extremes of flood, drought, and fire. In order to support local communities and prepare for the disasters that affect our water supply, the State has a number of agencies and programs working both to prepare for, and respond to, extreme events, and will continue these efforts into the future.

Communities in Colorado have a responsibility under the State's floodplain management standards (e.g. floodplain rules and regulations that meet or exceed the Federal Emergency Management Agency minimum requirements) to foster community resiliency and develop wisely in light of flood events. The Colorado Water Conservation Board works with the Colorado Office of Emergency Management and the Federal Emergency Management Agency to provide technical and financial support for these activities. In recent years, Colorado's flood regulations have been improved by increasing freeboard requirements for homes and businesses, with additional protection for critical infrastructure such as hospitals, fire stations, and nursing homes. The Flood Hazard Mitigation Plan for Colorado also helps the state and local communities better prepare for these events.²⁵

The Colorado Drought Mitigation and Response Plan outlines the monitoring, mitigation, and response actions necessary to ensure that Colorado is adequately prepared for drought.²⁶ The Water Availability Task Force brings together state, local, and federal agencies to monitor conditions on a monthly basis. Once an event occurs, the Drought Task Force is activated, bringing

together a multitude of state agencies to collaboratively address the issues that arise. Funding and technical assistance for local communities also exist.

Technical and financial support for healthy watersheds, which can help reduce the risk of catastrophic fires, can also be found. This is further described in *Section 7.1, Watershed Health and Management*. State agencies work closely with local and federal agencies on fire mitigation, response, and recovery. Because many watersheds are on federal lands, our intergovernmental collaboration is vital for protecting those resources. Additionally, as a headwaters state, our downstream neighbors have a vested interest in maintaining our healthy watersheds that contribute to their water quantity and quality. Building on these relationships may also contribute to better long-term protection of the resource.

Although much preparation exists for the eventualities of floods, drought, and wildfires, these events rarely unfold exactly as predicted. That is why flexibility is critical in fostering effective and efficient response to natural disasters when they occur. Colorado flood, drought, and wildfire plans are all updated regularly and make up part of the State's Natural Hazard Mitigation Plan, which is approved by both the Governor and the Federal Emergency Management Agency. These updates incorporate lessons learned, new policies, updated program information and, together with the working partnerships, enable Colorado to respond better to future natural disasters. Existing technical tools such as Colorado's Flood Threat Bulletin are useful for helping state agencies and impacted communities prepare for significant precipitation events. Future enhancements to tools like these could provide even further benefits.

7.3 Water Quality

Colorado's Water Plan encourages the integration of water quantity and water quality concerns through the following approach:

- Recognizing the inter-relationship between quality and quantity, strategies designed to meet Colorado's current and future consumptive, recreational and environmental water needs will incorporate, as a key objective, the protection and restoration of water quality.

Coloradans have a strong connection to water. The quality of water in the state needs to be protected, and in some cases restored to support Colorado's heritage, communities, and way of life - now and into the future. Executive Order D 2013-005 recognizes this by stating "Colorado's water quantity and quality questions can no longer be thought of separately. Each impacts the other and our state water policy should address them conjunctively." The Executive Order also lists "a strong environment that includes healthy watersheds, rivers and streams and wildlife" as one of three core Colorado values. In addition, recent public survey results highlight the value Coloradans place on safe, clean water. These surveys indicate Coloradans believe the quality of both surface and groundwater is very important as a source of drinking water. Coloradans also believe the quality of water in streams and lakes is very important to support recreational uses. The surveys shows public health is the most motivating reason to improve water quality, followed by wildlife and fish habitat.²⁷²⁸

As Colorado plans for its water future, better integration of water quality and quantity planning and management activities is critical. Opportunities to address existing water quality impacts and minimize future impacts must be prioritized to ensure Coloradans continue to have access to safe and clean water. Balancing increasing quantity demands with water quality protection and restoration requires on-going dialogue with all Coloradans and collaboration at all levels of government. Colorado's Water Plan offers a framework for moving forward with the quality and quantity conversations.

The following information is a starting point for an ongoing conversation. The discussion describes how quality and quantity are related to create a foundation for understanding this complex subject. It also identifies an integration goal to improve relationships in support of protecting and restoring water quality. Current water quality management is described as context for identifying ways to improve coordination and recommendations are made to move forward with meeting the integration goal. The water quality foundation for this conversation is in legislation and Water Quality Control Commission and Water Quality Control Division goals established to meet the intent of this legislation.

7.3.1 Water Quality and Quantity Relationships

Water quality in Colorado is protected by state and associated federal statutes as well as local, state and federal regulations. The Water Quality Control Commission adopts regulations, guidance and policies required by the federal Clean Water Act, the Colorado Water Quality Control Act and the federal Safe Drinking Water Act. The Colorado Department of Public Health and Environment, Water Quality Control Division, is the primary agency implementing these regulations, guidance and policies. This water quality management structure is different from what is in place for water quantity management. Understanding the existing relationships between these distinct management frameworks and looking for opportunities to improve coordination and integration is important for protecting the state's water resources.

Water Quality and Quantity Connections

Managing water quantity may cause a change in water quality. When water is diverted to farms or cities, stored for future use or flood control, or managed as return flows to address downstream water rights water quality can be affected. For example:

- Recreational fishing is a way of life in Colorado and is important to local and state economies. Deep reservoirs tend to thermally stratify in summer, with cold water settling to the bottom of the reservoir. Many reservoirs release water downstream from the bottom where the stratified water is very cold. There are places where cold water releases from the bottom of reservoirs have impacted downstream native fish and aquatic life. However, most of Colorado's Gold Medal Fisheries, which are managed by Colorado Parks and

Black Lake No. 1 and No. 2 were enlarged so that stream flows could be maintained during snowmaking season.



Wildlife, are located downstream of dams. Other surface water structures such as diversions to canals and off-stream reservoirs can also impact water quality and fisheries. Such modifications can result in low stream flows that can cause low oxygen concentrations, high water temperatures and higher concentration of pollutants. In Colorado, solutions are explored during project planning to address these types of water quality impacts that can be caused by surface water modifications.

- One option for addressing future municipal water supply needs is through alternative agricultural transfers such as rotational fallowing and interruptible supply options. However, high concentration of salts and other pollutants from this source water may require advanced water treatment technologies such as reverse osmosis to make the water useable for communities. The waste product from reverse osmosis has very high salt levels and cannot be discharged into the stream. Other disposal options for the waste product are limited. If a municipal provider has higher quality source water to blend with lower quality sources then this issue can be avoided. For example, Aurora Water recently completed the Prairie Waters Project where both natural and constructed treatment allows potable water reuse to proceed without requiring new Clean Water Act permits.
- Implementing and maintaining drinking water and wastewater treatment in a semi-arid environment is challenging today and will continue to be in the future. Treatment infrastructure is critical to protecting public health and the environment. The ability of the stream to accept pollutants in wastewater without a negative impact to quality depends on the amount of water flowing in the stream. Water diversions upstream can result in fluctuating stream levels and therefore affect water quality. Changes in treatment process necessary to meet new, more stringent discharge limits or needed upgrades to aging infrastructure can increase operational costs for wastewater treatment facilities. However, protecting water quality through wastewater treatment and other measures can result in cost savings for downstream drinking water treatment facilities because it results in higher quality source water that could require less treatment.
- The Colorado Water Conservation Board (CWCB) is responsible for the appropriation, acquisition, protection and monitoring of instream flow and natural lake level water rights to preserve and improve the natural environment to a reasonable degree. These water rights are established exclusively by the CWCB for nonconsumptive, in-channel or in-lake water uses to support minimum flows between specific points on a stream or levels in natural lakes. The rights are administered within the state's water right priority system. While Colorado law explicitly prohibits the Water Quality Control Commission and Water Quality Control Division from taking any action that requires minimum instream flows, the program has provided tangible water quality benefits across the state specifically for aquatic life classified uses.

Expansion of Gross Reservoir is part of the proposed Moffat Collection Expansion Project. This project will require 401 certification.



Water quality and quantity cause-and-effect connections are integral to making sound water management decisions. These connections are considered during decision-making processes that are dependent on water quality and quantity statutory, regulatory and management relationships.

Statutory and Regulatory Relationships

At the state level, water quality and quantity are managed separately based on different constitutional, statutory and regulatory provisions. However, state and federal statutes that protect in-stream water quality recognize the importance of protecting water rights while still providing the authority to impose water pollution controls. The federal statute protecting drinking water quality also recognizes integration with water quantity by including protections for source water that reduces treatment costs.

Many state and federal water quality-specific regulations intersect with quantity management. The quantity of water available is essential for establishing water quality standards and ensuring standards are attained as required in state and associated federal water quality regulations. Water quality is also recognized in state regulations by addressing the quality of substitute water supplies used in exchanges and substitute water supply plans. Regulations governing reuse also support integration between water quality and quantity management.

One of the primary examples of the regulatory quality and quantity relationship is the Water Quality Control Division's water quality certification of federal permits and licenses under Section 401 of the federal Clean Water Act as implemented through Water Quality Control Commission Regulation No. 82 (known as 401 certification). Section 401 of the Clean Water Act directs states to certify that activities needing federal permits and licenses, such as many water development projects, comply with the applicable provisions of the state's water quality use classifications, standards and designation program during both construction and operation over time. Water Quality Control Commission Regulation No. 82 gives the Water Quality Control Division three certification options for federal permits or licenses including the ability to certify, conditionally certify through identified mitigation measures or deny certification. Certification by the Water Quality Control Division means that when the federal permit or license is implemented, the proposed project will comply with applicable surface and groundwater standards regulations, classifications and all other applicable water quality requirements for the affected waters. For example, if a project requires a Clean Water Act Section 404 individual permit from the Army Corps of Engineers, a 401 water quality certification is required from the Water Quality Control Division. Section 9.4 discusses the 401 water quality certification in more detail.

The Water Quality Control Commission's adoption of site-specific standards and designations is another example of a quantity and quality regulatory relationship. Site-specific standards and designations may reflect a lower level of water quality than would have existed before a hydrologic modification such as a dam, diversion or return flows associated with exercising water rights.

The Water Quality Control Commission is solely responsible for the adoption of water quality standards and classifications; however, local government regulations can also have a water quality and quantity connection. For example, local governments are given permit authority over certain matters under the Areas and Activities of State Interest Act. Under the act, local governments can

adopt regulations that address the impact of municipal and industrial water projects. These regulations, referred to as 1041 regulations, often require mitigation of water quality impacts from water projects. Associations of local governments also prepare Regional Water Quality Management Plans that establish water quality goals and recommendations for regional water quality management. Typically, local 1041 regulations require new water projects to comply with these plans.

Water Management Relationships

The roles and responsibilities defined in statutes and regulations are shared by a number of entities, which creates a complex system for overseeing the state's water resources. At the state level alone, there are many entities involved with protecting water quality which requires coordination and integration to make sure water resources are appropriately managed.

The Water Quality Control Commission and Water Quality Control Division have defined water quality roles and responsibilities.

The Colorado Water Quality Control Act also identifies several additional water quality implementing agencies:

- The Division of Reclamation, Mining and Safety.
- The State Engineer.
- The Oil and Gas Conservation Commission.
- The Colorado Department of Public Health and Environment - Hazardous Materials and Waste Management Division.
- The Division of Oil and Public Safety at the Department of Labor and Employment.

Figure 7.3.1-1: Colorado state agencies and quasi-governmental organizations with quantity and quality responsibilities.



These agencies have initial responsibility for implementing groundwater quality classifications and standards adopted by the Water Quality Control Commission. These implementing relationships are defined through Memoranda of Agreement. The Water Quality Control Commission can intervene in the event it determines an implementing agency is not assuring compliance with water quality classifications and standards.

The Department of Natural Resources plays a critical role in managing water quantity in the state. The Division of Water Resources within the Department of Natural Resources is responsible for water administration, while the CWCB, another division within the Department of Natural Resources, sets water policy, completes water planning and reviews state wildlife mitigation plans. The Department of Natural Resources' Colorado Parks and Wildlife develops state wildlife mitigation plans, which address fish and wildlife resources affected by the construction, operation or maintenance of water diversion, delivery or storage facilities.

The Water Quality Control Commission and the Water Quality Control Division are required by the Colorado Water Quality Control Act to consult with the CWCB before making any decision or adopting any rule or policy that has the potential to cause material injury to water rights. The CWCB receives copies of all Water Quality Control Commission rulemaking hearing notices and all notices include a provision requesting information from the public regarding potential impacts on water rights.

7.3.2 Water Quality and Quantity Integration Goal

Executive Order D 2013-005 states “Colorado's water quantity and quality questions can no longer be thought of separately. Each impacts the other and our state water policy should address them conjunctively.” As section 7.3.1 described, the quality of Colorado's waters is important for consumptive, recreational, and environmental water needs. To this end, it is important to establish a goal related to quantity and quality integration between now and 2050. To develop this goal, a number of documents were reviewed including the federal Clean Water Act, federal Safe Drinking Water Act, the U.S. Environmental Protection Agency's strategic plan, Colorado's Water Quality Control Act, the Water Quality Control Division's strategic goals, the Water Quality Control Commission's strategic water quality goal and the Basin Roundtable Implementation Plans. These laws, goals and plans focus on broader actions than quality and quantity integration yet provide important insight for developing a quality and quantity integration goal as part of Colorado's Water Plan.

It is important to establish a goal related to quantity and quality integration between now and 2050.

The federal Clean Water Act sets a national goal “to restore and maintain the chemical, physical and biological integrity of the Nation's waters”, with interim goals that all waters be fishable and swimmable where possible. The federal Safe Drinking Water Act authorizes the U.S. Environmental Protection Agency to set national health-based standards for drinking water to protect against both naturally occurring and man-made contaminants that may be found in drinking water. The U.S. Environmental Protection Agency states, and water systems work together to make sure that these standards are met. The U.S. Environmental Protection Agency's current strategic plan has a goal regarding protecting America's waters to “protect and restore waters to ensure that drinking water is safe and sustainably managed, and that aquatic ecosystems sustain fish, plants, wildlife, and other biota, as well as economic, recreational and subsistence activities.”

Better integration of water quality and quantity is required to address the Water Quality Commission's overall goal for water quality. Based on review of the laws, goals and plans summarized above, a quality and quantity integration goal was developed. The recommendations in section 7.3.5 address the following quality and quantity integration goal:

Recognizing the inter-relationship between quality and quantity, strategies designed to meet Colorado's current and future consumptive, recreational and environmental water needs will incorporate, as a key objective, the protection and restoration of water quality.

The following steps further refine and advance this goal:

- The Basin Roundtables are encouraged to actively incorporate water quality into decision making processes for consumptive, recreational and environmental projects. To help facilitate this effort, the Water Quality Control Division will provide basin-scale water quality information to the Basin Roundtables for their use in updating their future Basin Roundtable Implementation Plans. This information was originally developed as part of the Statewide Water Quality Management Plan.
- Project proponents must understand the nexus between water quality and quantity and work to avoid or mitigate water quality impacts of a project through the implementation of best management practices, whether associated with 401 water quality certifications or otherwise. The Water Quality Control Division will support this effort by developing guidance on the 401 water quality certification process and best management practices identification.
- The Water Quality Control Division, in concert with other stakeholders including watershed groups and those with point and nonpoint discharges, will continue to employ available programs to maintain, and in some cases, improve water quality at a basin-scale. Progress will be documented over time in the Water Quality Control Division's Integrated Report and Water Quality Control Division's Statewide Water Quality Management Plan (discussed in 7.3.3). The Integrated Report is typically updated every two years and will be used to track progress on the quality portion of the integration goal over time. By 2016, the Water Quality Control Division will develop a baseline for tracking water quality improvements.
- The information reported in the Water Quality Control Division's Integrated Report should also be used in the CWCB's scenario planning efforts when evaluating the status of future *signposts* (see Chapter 6.1). By tracking this information through time, water quality and quantity managers will know if efforts to integrate water quantity and quality are successful and can make course corrections as part of the adaptive management plan efforts.

Current Water Quality Conditions

As plans for meeting consumptive, recreational and environmental needs are produced that recognize the many interactions of statute, regulation and management activities, it is important to understand current water quality conditions in the state. Understanding current water quality conditions is also fundamental for ensuring compliance with water quality regulations as they pertain to water supply planning and implementation activities.

Evaluating the status of surface water quality in Colorado requires understanding the classified uses for waterbodies throughout the state. A classified use is a specific type of use for an identified

waterbody and can include domestic water supply, agriculture, recreation, aquatic life and wetlands. The Water Quality Control Commission assigns classified uses to stream segments and adopts water quality standards for many different pollutants to protect these waterbody-specific uses.

The state is also required to have an antidegradation policy as part of its water quality standards. Antidegradation protects the value of high quality surface waters. Colorado's antidegradation policy establishes that, at a minimum for all surface waters, the existing classified uses and the water quality necessary to protect those uses must be maintained; these are *use protected waters*. The antidegradation policy also provides extra levels of protection for two other types of waters that are designated by the commission. *Outstanding waters* receive the highest level of protection requiring that quality must be maintained at current levels (no degradation). *Reviewable waters* are high quality waters which receive an intermediate level of protection. The rules for antidegradation review require a public process before the natural capacity of a waterbody to dilute and absorb pollutants and prevent harmful effects is completely allocated to a project or permit where a new or increased impact is proposed. Use of such capacity is allowed if the review shows it would accommodate important economic or social development for the area in which the waters are located.

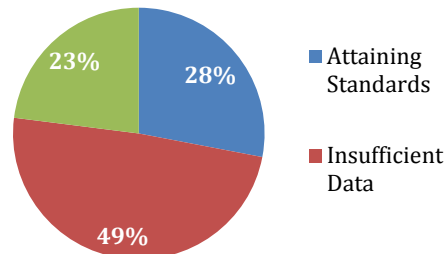
Standards are the basis for evaluating the status of water quality for each waterbody. When available data show water quality standards are not being met, the waterbody is identified in regulation as impaired. These impaired waterbodies, as well as other information about water quality in the state, must be identified in a biennial report to the U.S. Environmental Protection Agency (Integrated Water Quality Monitoring and Assessment Report (Integrated Report)).

For waters that attain water quality standards, the challenge is to maintain the existing good water quality in order to protect classified uses such as drinking water supplies, robust fisheries and recreational opportunities.

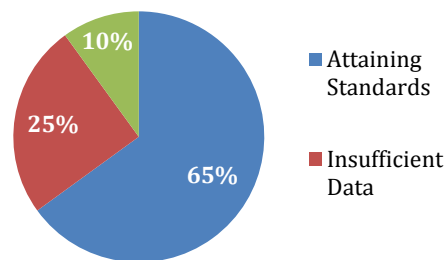
For waters not meeting water quality standards, the most common causes of river and stream impairments are selenium, pathogens such as E. coli and iron. For lakes and reservoirs, the most common causes of impairment are selenium, mercury and dissolved oxygen saturation. When water quality standards are not attained, the ability to use water for domestic water supply, agriculture, aquatic life or recreation can be impacted.

7.3.2-1: Current Water Quality Conditions Water Quality Control Division 2012

Lakes and Reservoirs



Rivers and Streams



Future Water Quality Conditions

Many changes will happen over the next 35 years that have the potential to affect both regional and statewide water quality. Understanding these changes is important as plans are under development for addressing the municipal and industrial supply gap as well as meeting recreational and environmental needs over the next 35 years.

Future water quality conditions will not only be affected by water quantity decisions but will also be influenced by changing water quality regulations. Currently, there are additional proposed regulations designed to further protect and restore water quality. Examples include increased nutrient controls, more stringent arsenic standards and a revised selenium standard. There is also renewed emphasis on implementing actions that will produce measureable, positive changes in water quality. Recognizing the possibilities associated with potential change, both water quantity and quality managers need to seek opportunities to protect and enhance water quality in the future.

Other factors affecting future water quality condition are also important. As the economy and population grow and land uses change, there will be increased water quantity demands and additional stressors on water quality. Future land use decisions are a factor as water quality can be impacted by increased urbanization and associated stormwater runoff, volumes of discharged municipal wastewater and industrial discharges including those from the energy sector. As streams are depleted from additional diversions, existing concentrations of pollutants increase, and water treatment and wastewater treatment processes relying on those streams will become more difficult. New issues may also arise from emerging contaminants or interactions between different constituents that are not now known. These potential impacts could be negative though there can also be opportunities for positive change which reinforces the critical nature of informed and integrated water resource management decisions.

The potential for future positive or negative water quality impacts is compounded by climate change. Predicted effects from a changing climate on water quality include:²⁹

- Potential streamflow volume decreases in the Rockies and interior southwest, and increases in the east and southeast coasts.
- Higher peak streamflow will increase erosion and sediment transport; loads of nitrogen and phosphorus are also likely to increase in many watersheds.
- Many watersheds are likely to experience significant changes in the timing of streamflow and pollutant delivery. In particular, there will be a tendency to shift from snowmelt-dominated spring runoff systems to rain-dominated systems with greater winter runoff.
- Changes in nutrient and sediment loads are generally correlated with changes in hydrology.
- Warming air temperature can directly raise stream and lake temperatures, which can harm aquatic organisms that live in coldwater habitats, such as trout. Additionally, warmer water can increase the range of non-native fish species, permitting them to move into previously coldwater streams. The population of native fish species often decreases as non-native fish prey on and out-compete them for food.

Planning for water quality impacts from these potential fundamental system shifts is challenging and highlights the need to make measurable progress on the water quality and quantity integration goal.

7.3.3 Water Quality Management

Current water quality decisions are made in the context of a management system based on statutes, regulations and implementation processes. This system defines the boundaries to protect and restore water quality, and it also offers opportunities for flexible, integrated approaches for meeting consumptive, recreational and environmental needs. The existing water quality management system is a starting point for finding opportunities and maximizing them to facilitate improved integrated water resource management decisions.

The statutory and regulatory framework for water quality discussed in Subsections 2.4 and 7.3.1 establishes the requirements for protecting and restoring water quality in the state. This framework is implemented through processes at the state and local level. Subsection 7.3.2 discusses classified uses and the water quality standards established to protect these uses. Both are critical to protecting and restoring water quality in the state and are established through Water Quality Control Commission processes with public input.

Water quality management processes also include monitoring, data assessment and reporting. Monitoring and data assessment are essential to identifying and characterizing water quality problems, revising water quality standards, and developing and evaluating the results of control programs. Monitoring is completed in conjunction with many statewide partners. The Water Quality Control Division utilizes its own data as well as partners' data in assessments that support evaluating the status of statewide and basin-scale water quality with respect to meeting water quality standards. Information about attainment of water quality standards is provided in the Integrated Report discussed in 7.3.2 and is also identified in regulation (Water Quality Control Commission Regulation No. 93, Colorado's Section 303(d) List of Impaired Waters and Monitoring and Evaluation List); both are adopted by the Water Quality Control Commission through public processes.

When streams and lakes are identified that do not meeting water quality standards, a restoration plan is produced that defines how much of the pollutant causing the impairment can be in the stream or lake to still ensure that water quality standards are attained. The allowable amount of the pollutant is then divided between all the different sources of the pollutant, both point and nonpoint. A point source is a sewage treatment plant or industrial facility discharge and nonpoint sources are diffuse sources of pollution such as runoff from agricultural field or abandoned mines. This restoration plan is called a Total Maximum Daily Load. There is a public notice process associated with Total Maximum Daily Load development that provides the opportunity for input as the restoration plan is produced. Once the Total Maximum Daily Load is approved by the U.S. Environmental Protection Agency, the Total Maximum Daily Load is the basis for implementing necessary actions to bring the stream or lake back into attainment. As an alternative to implementing controls to meet existing water quality standards, Total Maximum Daily Loads can also result in a re-evaluation of standards and sometimes classifications. Implementation actions can be defined in a Total Maximum Daily Load implementation plan, in a locally driven watershed plan or in a locally driven regional water quality management plan (208 plan). Watershed plans and 208 plans identify stressors to water quality and address other water quality improvement and

protection activities necessary to meet local and regional goals. The Water Quality Control Division works with local partners and local plans to implement priority projects to restore and maintain water quality at a watershed or regional scale.

The Water Quality Control Division also uses information from local plans to support its own planning efforts. For example, the Water Quality Control Division produces a Statewide Water Quality Management Plan for approval by the Water Quality Control Commission. The Statewide Water Quality Management Plan compiles water quality information at a statewide and basin scale in support of implementation activities. This compilation, as well as the Integrated Report, Water Quality Control Commission policies, and other Water Quality Control Division documents, supports the Water Quality Control Division's strategic planning that promotes progress toward national water quality goals and provides specific metrics for measuring that progress.

The purpose of these plans, at different scales by numerous partners, is defining and prioritizing actions for the improvement, restoration and protection of water quality. Implementation tools utilized by the Water Quality Control Division include Section 401 water quality certifications (discussed in section 9.3), permits that allow discharges to streams and lakes as long as certain limits or control measures are met and funding support for partners. The federal Clean Water Act prohibits the discharge of pollutants from a point source to surface water without a permit. Because the state has developed a program that meets the requirements of the federal Clean Water Act, the primary discharge permit program in Colorado is administered by the Water Quality Control Division rather than by the U.S. Environmental Protection Agency. The permits issued to point sources specify the limits or controls that are required to meet Colorado's water quality standards.

Implementation tools often require the development of strategies or best management practices that when completed result in the improvement, restoration and protection of water quality. Strategies are also used to address consumptive and nonconsumptive needs. These are summarized in sections 6.3 through 6.6 of this plan. Examples of strategies that have a quality and quantity nexus include, but are not limited to:

- Water reuse including direct potable reuse, indirect potable reuse, non-potable reuse and graywater use. These strategies are further described in section 6.3.
- Storage including reservoirs and aquifer storage and recovery.
- Source water protection best management practices such as proper storage and disposal of pesticides and proper management of septic systems.
- In Colorado, stormwater has not typically been considered a source of supply but this could be explored in the future. Stormwater best management practices including retention and detention can improve the quality and quantity of this supply and could be incorporated into water management practices.
- Nonpoint source best management practices will be critical to improving water quality for recreational, environmental and consumptive needs in the future. Examples of nonpoint source best management practices include mine tailings removal, riparian buffers, constructed wetlands and habitat restoration.

- The concept of green infrastructure is being discussed at a national level and application of this concept is being explored in Colorado. The focus of green infrastructure is to weave natural processes into the built environment, which can provide stormwater management, flood mitigation, air quality management and riparian zone restoration.
- Water quality trading is based on the fact that sources in a watershed can face very different costs and regulatory requirements in the control of the same pollutant. Trading programs allow facilities facing higher pollution control costs to meet their regulatory obligations by purchasing environmentally equivalent (or superior) pollution reductions from another source at lower cost, thus achieving the same water quality improvement at a lower overall cost.

Funding and financing is discussed in detail in Chapter 9; however, the Water Quality Control Division provides various financial assistance opportunities to assist with efforts to protect public health and the environment. Financial assistance programs administered by the Water Quality Control Division include:

- State revolving funds provide low-interest loans to governmental entities for drinking water and water quality improvement projects.
- The Water Quality Improvement Fund provides grant funds for water quality improvement projects using civil penalties from water quality violations. State House Bill 11-1026 amended the statute to authorize grants for stormwater management training and best practices training to prevent or reduce the pollution of state waters.
- Source water protection grants provide funding for pilot planning projects and development and implementation projects.
- The small system training and technical assistance set-aside provides grant funding to assist with the costs of planning and design for small drinking water systems serving less than 10,000 people.
- State statutes 25-8-703 and 25-1.5-201 authorize funding, when appropriated by the legislature, for small community domestic wastewater and drinking water projects. These programs provide grants to municipalities for costs associated with planning, design and construction of drinking water and wastewater treatment plants.
- Nonpoint source grant funds are distributed through a competitive process to local project sponsors to implement projects which restore impaired waters, prevent future impairments or raise public awareness.

In addition, the Water Supply Reserve Account administered by the CWCB is another financial tool that provides grants to assist Colorado water users in addressing their critical water supply issues and interests. The funds help eligible entities complete water activities, which may include competitive grants for:

- Technical assistance regarding permitting, feasibility studies and environmental compliance.
- Studies or analysis of structural, nonstructural, consumptive and nonconsumptive water needs, projects or activities.
- Implementation of Structural and nonstructural water projects or activities.

7.3.4 Water Quality and Basin Implementation Plans

The various basin roundtables have addressed water quality in the Basin Implementation Plans in two major ways: through quality-related basin goals and measurable outcomes, or through identification of projects and methods with a water quality nexus. In many basins across the state, public water systems, municipal governments, and communities have developed source water protection plans with specific water quality prevention strategies. Many basins also have watershed plans in place that identify priority actions necessary to both protect and restore water quality. These prevention, protection, and restoration strategies and actions should be considered during the project development and prioritization stage. The Colorado Water Quality Control Division can provide information about protection and watershed plans that are in progress or completed.

Every basin roundtable addressed water quality in goals and measurable outcomes. Several basins addressed water quality issues in the context of greater watershed health, while others look to established water quality standards as a potential measureable outcome. The Rio Grande Basin roundtable established the following goal: “Make progress toward meeting applicable water quality standards throughout the Basin.”³⁰ This standards-based goal is accompanied with measurable outcomes, describing actions in pursuit of this goal: mitigating particular water quality impairments, and recommending improvements to monitoring efforts within the basin.³¹ This approach demonstrates how the basin may use the planning process to work closer with CDPHE, to make progress toward meeting established standards.

The Yampa/White/Green Basin roundtable references water quality, as it relates to uses within the basin, in their Goals: “Maintain and consider the existing natural range of water quality that is necessary for current and anticipated water uses.”³² This water quality-centric goal follows the strong BIP theme of protecting existing uses within the basin and providing for future development, recognizing the importance of both quality and quantity. This type of goal seeks to establish how water quality fits within their vision of the basin’s future.

Basin roundtables have also addressed water quality issues through identification of projects and methods which have a water quality nexus. For example, the South Platte/Metro BIP identifies 18 projects with a connection to water quality: these range from assessment of wildfire restoration, to sediment mitigation projects, to mine remediation.³³ These projects address water quality issues at the source, seeking to improve quality through implementation.

The Gunnison Basin identifies currently ongoing projects and methods which address water quality issues. These include several programs related to Colorado River water quality, such as the Gunnison Basin Selenium Management Plan, and projects funded through the Colorado River Basin Salinity Control Forum.³⁴ Additional localized projects for improving municipal infrastructure also have benefits for water quality.

Through these goals, outcomes, and identified projects and methods, the basins seek to address water quality concerns at a more local level. Future efforts of the roundtables will prioritize projects and methods by basin goals, and water quality overall will benefit from this incorporation of quality concerns into the goals and outcomes framework.

7.3.5 Actions

The Water Quality Control Division worked with the Colorado Water Quality Forum and the Water Quality Control Commission to develop recommendations. As Colorado's Water Plan is updated in the future, these recommendations serve as a starting point for implementation efforts focused on:

- Integrated water quality and quantity management.
- Policy considerations.
- Financial considerations.
- Stakeholder and public outreach.

In addition, these recommendations need to be assigned to a responsible party and prioritized for implementation over time.

The Water Quality Control Division's mission is to protect and restore water quality for public health and the environment in Colorado. The Water Quality Control Division's strategic plan states that it will achieve its mission by pursuing the following goals:

- Prevent waterborne disease and reduce chronic public health risks from drinking water through improved implementation of the federal Safe Drinking Water Act and Colorado's drinking water statutes and regulations.
- Protect all designated uses by attaining water quality standards through improved implementation of the federal Clean Water Act and Colorado Water Quality Control Act and association regulations.
- Restore impaired water quality to attainable standards through improved implementation of the federal Clean Water Act and Colorado Water Quality Control Act and associated regulations.

Integrated Water Quality and Quantity Management Actions

Recommendations to promote increased integration of water quality and quantity management include:

- Evaluate water quality impacts associated with proposed solutions and scenarios presented in the Basin Implementation Plans and in Sections 6.3 through 6.6 of Colorado's Water Plan. Identification of impacts will help define the scope of strategies that need to be explored to protect and restore water quality. Information developed about these impacts will be shared between all involved parties.
- Define opportunities in cooperation with Basin Roundtables, CWCB and others for projects or processes that restore and enhance existing water quality conditions to address potential water quality impacts resulting from implementing water quantity solutions. An initial step to implement this recommendation is to assist the Basin Roundtables in developing water quality goals, objectives and measurable outcomes based on current water quality information for each basin to use when updating their Basin Implementation Plans. This collaboration supports the Basin Roundtables in identifying projects and methods that integrate water quality and quantity management to protect and restore water quality.

- Define green infrastructure approaches for the arid west and explore how green infrastructure can be utilized to address Colorado's consumptive and nonconsumptive gaps. For example, green infrastructure in the arid west can go beyond stormwater management activities and low impact development methods to include landscape-scale land use planning that addresses where activities should occur on the landscape in order to meet dynamic goals, including protecting and restoring water quality. Existing information developed by green building and stormwater management groups provides a starting point for developing and maintaining a library of green infrastructure options.
- Evaluate new water supply projects and the potential for multiple benefits, including water quality protection and enhancement. Strive to ensure that all water quality benefits are incorporated into the project plans.
- Examine how new or existing supply projects can be designed and/or operated to advance water quality objectives. Actively pursue incorporation of these design and operation considerations into proposed projects.
- Identify the role of reuse by developing a library of reuse examples such as direct potable reuse, indirect potable reuse, non-potable reuse, graywater use and the associated water quality issues that need to be addressed for each type of reuse. Ensure that these issues are addressed in any initiative that desires to utilize these resources.
- Promote the use of aquifer storage and recovery since water quality impacts associated with this storage strategy are minimal.
- Explore the role of stormwater management from both a quality and quantity perspective to determine if stormwater is a viable additional source of supply to address consumptive needs.
- Address nonpoint sources through on-going management activities that play an important role in protecting and restoring water quality for the benefit of future water uses. These activities should include cataloguing and evaluating local government land use planning tools that minimize nonpoint source pollution associated with development. A comprehensive approach to nonpoint source management including water quality trading should be explored.
- Identify the risks of climate change as they relate to integrated water quality and water quantity management. Develop specific recommendations for addressing these risks.
- Explore how CWA requirements and SDWA requirements can be most efficiently and cost effectively integrated. Develop specific recommendations for implementation.

Policy Considerations

Chapter 10 of Colorado's Water Plan summarizes legislative recommendations. In addition to the legislative recommendations, policy considerations related to quality and quantity integration include:

- Continue to engage in creative, solution oriented actions such as site-specific standards, temporary modifications, discharger specific variances, pollutant trading and conditional 401 water quality certifications. Use all available means to improve water quality and protect the high quality waters that are better than necessary to support classified uses. Maintain ongoing, non-regulatory programs including nonpoint source management and source water protection

planning. These solution orientated actions will also be necessary when addressing impacts from climate change.

- Establish a more complete understanding of the concept of net environmental benefit as wastewater reuse continues to be maximized in Colorado. This concept is focused on the demonstration that the ecological value of using effluent to support riparian and aquatic habitats exceeds the ecological benefits of removing the discharge from the waterbody.
- Review and appropriately modify existing regulations, guidance and policy documents for new types of wastewater reuse so that revisions will protect public health and the environment while also providing sufficient flexibility for water suppliers to develop new water reuse projects across the state.
- Consider and document the water rights implications of water quality strategies and the water quality implications of water development strategies as they both pertain to integrated water quality and quantity management. For example, integrated stormwater management may have impacts on downstream flows and possible water rights impacts would have to be understood and addressed before such a strategy could be implemented.
- Continue to work with neighboring states to address interstate water quality and quantity issues to protect Colorado's compact entitlements.
- Continue statewide monitoring that supports assessment of the quality and quantity integration goal and measures.

Financial Considerations

Future efforts to integrate water quality and quantity will require funding. The recommendations outlined below may be further detailed in Chapters 9 and 10 of Colorado's Water Plan.

- Continue to fund nonpoint source pollution management efforts. Identify new funding opportunities and nonpoint source pollution control strategies.
- Identify costs and funding sources for implementation of green infrastructure and reuse.
- Pursue state funding of regional watershed-based water quality planning to better integrate current and future water quantity efforts.
- Develop and implement state funding mechanisms for future water projects that implement consumptive and nonconsumptive strategies consistent with Colorado's Water Plan. Emphasis should be placed on funding those portions of projects that result in a public benefit.
- Develop and implement state funding mechanisms for implementation of mitigation activities required under a state water court water rights decision or a federal or state water quality protection regulatory action.
- Develop and implement funding mechanisms for the protection, restoration or enhancement of water quality values in river or stream reaches.
- Explore ways to facilitate innovative treatment and engineering solutions through technology transfer and liability management techniques.

Stakeholder and Public Outreach

Stakeholder and public outreach is critical to meeting the water quality and quantity integration goal. The recommendations outlined below may be further detailed in Chapter 7 of Colorado's Water Plan.

- Use a watershed approach for outreach and community engagement around water quality, ways to protect water quality and solutions to address water quality issues. Colorado's many watershed groups already utilize this approach to effectively plan for and implement actions that protect and restore water quality. The approach can be used when developing and implementing strategies that integrate water quality and quantity management.
- Monitor public attitudes and opinions about water quality as it relates to domestic water supply as well as environmental and recreational uses of water to refine future water quality goals and measurable outcomes.
- Develop additional water quality goals and performance measures based on the completed Basin Implementation Plans from the Basin Roundtables.
- Conduct joint CWCB and Water Quality Control Commission meetings at least annually to discuss water quality and quantity integration issues.
- The Water Quality Control Commission should consider holding workshops as part of its annual basin rulemaking process. Workshops should have participation from basin roundtable representatives for the basin that is the subject of the annual rulemaking hearing to gather input and share information related to progress on water quality and quantity integration efforts.

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³ Sandra L. Postel and Barton H. Thompson, Jr., "Watershed Protection: Capturing the Benefits of Nature's Water Supply Services." *Natural Resources Forum* 29 (2005): 98-108.

⁴ Richard M. Edwards and Greg Sundstrom, *Colorado Forestry Best Management Practices, Forest Stewardship Guildlines for Water Quality Protection, 2012 Field Audit Report* (Colorado State Forest Service, 2013), 2.

⁵ Edwards and Sundstrom, *Colorado Forestry Best Management Practices, Forest Stewardship Guildlines for Water Quality Protection*, 2.

⁶ Colorado State Forest Service, *Colorado Statewide Forest Resource Assessment- A Foundation for Strategic Discussion and Implementation of Forest Management in Colorado* (2008), 39. Accessed October 14, 2014, <http://csfs.colostate.edu/pages/statewide-forest-assessment.html>

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- ¹⁰ Carol Ekarius, "Building Successful Watershed Coalitions" (presented at the Colorado Watershed Symposium, Loveland, Colorado, July 18, 2013).
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- ¹³ Front Range Watershed Protection Data Refinement Work Group. *Protecting Critical Watersheds in Colorado From Wildfire: A Technical Approach to Watershed Assessment and Prioritization* (2009), 6-14.
- ¹⁴ Colorado Water Conservation Board, *Colorado Drought Mitigation and Response Plan*, pg#49.
- ¹⁵ Colorado Water Conservation Board, *Colorado River Water Availability Study* (2012).
- ¹⁶ Jeff Lukas, *Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation Second Edition*, (Colorado Water Conservation Board, 2014).
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- ²¹ Jeff Lukas, *Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation Second Edition*, 2014, pg#75.
- ²² Colorado Water Conservation Board, *Colorado Water Availability Study Phase I Report*, pg#.
- ²³ Jeff Lukas, *Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation Second Edition*, 2014, pg#36.
- ²⁴ Colorado Water Conservation Board, *Colorado River Water Availability Study- Phase I Spell Statistics (refinement to CRWAS Phase I Task 6.7) Technical Memo*, Online
<http://cwcbweblink.state.co.us/WebLink/ElectronicFile.aspx?docid=158382&searchid=e42eb888-af4f-4350-a4c8-e63266c40c51&dbid=0>
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- ²⁶ Colorado Water Conservation Board, *Colorado Drought Mitigation and Response Plan*, 2013.
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- ³³ HDR, WestSage Water Consultants, *Draft South Platte Basin Implementation Plan* (Denver: HDR, West Sage Water Consultants, 2014) Appendix.
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8. Interbasin Projects and Agreements

Colorado's Water Plan promotes statewide cooperation for water supply planning through the following long-term goals:

- A. Protect Colorado's ability to fully develop compact entitlements, and continue to support intrastate agreements that strengthen Colorado's position in interstate negotiations.
- B. Encourage multi-partner, multi-purpose, cooperative projects through financial incentives and technical support.
- C. Use the Draft Conceptual Agreement as an integrated package of concepts to:
 - Encourage environmental resiliency;
 - Set high conservation standards;
 - Develop stakeholder support for interstate cooperative solutions; and
 - Establish conditions for a new multi-purpose and cooperative transmountain diversion project if needed in the future.

Colorado is often referred to as “the Headwaters State” because it is the only state in which every major river system starts within the state and then exits to downstream states. Colorado stakeholders created intrastate agreements to help align key parties’ interests and understanding so that Colorado has a united voice when dealing with interstate and federal negotiations and litigation about water exiting the state. This chapter describes some recent examples of intrastate agreements, including the basin roundtable and the Interbasin Compact Committee (IBCC) process. This chapter also examines the next steps and path forward for these critical agreements.

8.1 Existing Stakeholder Agreements and Projects

Colorado has a number of intrastate agreements among diverse and disparate stakeholders. These agreements benefit the individual stakeholders, but also equip the state to effectively protect state interests in interstate matters. The following are recent examples of intrastate agreements that model a collaborative process for future agreements.

Arkansas River Voluntary Flow Agreement

A Voluntary Flow Management Program is a unique arrangement between state and federal agencies, nonprofits, water management organizations, and commercial rafting organizations. These agreements are voluntary: the parties are under minimal obligation to participate, but remain involved because the agreement is successful year after year. The Upper Arkansas River voluntary program, first established in 1990, is a partnership between Colorado Parks and Wildlife, Southeastern Colorado Water Conservancy District, Pueblo Board of Water Works, Trout Unlimited, the Arkansas River Outfitters Association, and the Bureau of Reclamation.

The Arkansas River voluntary flow agreement helps meet the environmental and recreational needs in the Upper Arkansas basin by providing increased recreational flows on the river and beneficial flows

for wildlife. The Bureau of Reclamation's Fryingpan-Arkansas Project facilities provide a flow of at least 700 cubic feet per second at the Wellsville gage from July 1st to August 15th, greatly benefiting recreation in the Arkansas River. In addition, during the spring and fall months, the facilities provide optimal conditions for a healthy brown trout fishery. These efforts bolster the recreational economy and bring tourists from all over the world.

Colorado River Cooperative Agreement

In the fall of 2013, eighteen parties that are reliant on water from the Colorado River finalized the Colorado River Cooperative Agreement (CRCA). The CRCA represents the culmination of years of negotiation between Denver Water and several Western Slope entities. The goal of the CRCA is to protect Colorado River watersheds, while allowing Denver Water to develop future supplies. Over forty stakeholders including water providers, county commissioners, local municipalities, ski resorts, and environmental groups participated in the process alongside the eighteen signatories.

On a river system as complicated as the Colorado, the CRCA represents a new way of looking at water management by considering the interests of as many parties as possible, while encouraging collaboration and innovation. This type of process helps the counties and municipalities more effectively manage environmental and recreational flows. A few examples of cooperative operations under the CRCA are the following Denver Water and Western Slope facilities: Dillon Reservoir, the Moffat Collection System, and the Shoshone power plant protocol. Many BIPs have concerns about local control and multi-purpose collaboration, and the CRCA shows an effective way to address these types of concerns.

Colorado River System Conservation Program

Facing declining levels in Lakes Mead and Powell, four of the largest water providers that depend on Colorado River Basin supplies have joined with the Bureau of Reclamation (BOR) to explore potential long-term solutions. Denver Water, the Southern Nevada Water Authority, the Central Arizona Water Conservation District, and the Metropolitan Water District of Southern California have all contributed \$2 million to a fund which will be used to finance pilot projects in the basin, with the BOR contributing \$3 million. These pilot projects will be geared towards municipalities, industries, and farmers, paying these entities to reduce their use of Colorado River water, thereby potentially increasing levels in the basin's two largest reservoirs.

The program is intended to test and demonstrate the concept of "demand management" in both the upper basin and the lower basin. These cooperative projects could use methods such as temporary fallowing of agricultural endeavors, upgrading to more efficient irrigation practices, reuse of self-supplied industrial water, recycling of municipal supplies to lessen consumptive use, and other possible methods in order to leave more water in the Colorado River.

The project supports the concepts that the upper basin states are exploring under the current contingency planning effort, described in Chapter 2.2. The contingency planning effort in the Upper Division States (Colorado, Wyoming, Utah and New Mexico) names demand management as a key strategy for keeping the Lake Powell reservoir level above critically low levels. While the Conservation Program is not specifically tied to the contingency planning effort, it may provide critically important

information related to demand management concepts that are being explored under contingency planning.

The Program will provide funding for these pilot projects in 2015 and 2016. Considerations for choosing a pilot project include geographic diversity, the schedule for implementation, ease of administration, environmental benefits, and the potential to interface with water users between the project and Lake Powell, for Upper Basin projects. Program projects and management will be handled by the BOR in the Lower Basin, as the BOR serves as river master. In the Upper Basin, projects will be overseen by the Upper Division States, with assistance from the Upper Colorado River Commission. In addition, any project within an Upper Division State may be vetoed by that State's Commissioner for the Upper Colorado River Commission.

Elkhead Reservoir

The 2006 enlargement of Elkhead Reservoir is another example of multiple interests collaborating on a project. The Elkhead Reservoir was originally owned by the city of Craig and was constructed to provide energy to the Craig Station Power Plant and to support recreational sport fishing and boating.

Multiple stakeholders gathered together to plan an extensive \$31 million multi-purpose expansion project that would enhance endangered fish and water flow management. As part of the project, the city of Craig, the Colorado River Water Conservation District (CRWCD), and Colorado Parks and Wildlife formed a joint management of the reservoir. The project was funded through a combination of state funds and stakeholder cost sharing. The Upper Colorado River Recovery Program contributed \$13.6 million to the project. The State of Colorado Species Conservation Trust Fund contributed \$6.5 million. The remainder of the funding came from CWCB construction loan program and the CRWCD. All parties had an interest in the project because it has multiple purposes.

The multi-purpose project allocated 5,000 acre-feet of storage for endangered fish management, which provided the Yampa Basin with water to enhance environmental flows. The stakeholders worked together to address the potential conflicts between sport fish and protecting endangered fish species, installing a fish screen. The CRWCD and CWCB collaborated on an adjudicated water right in a critical habitat on the Yampa for "in-river fish habitat and river flow maintenance and enhancement uses, and uses in furtherance of the Recovery Program." In addition, the project updated existing facilities to meet new uses and needs.

Windy Gap Firming Project

The Windy Gap Firming Project is collaboration between thirteen northeastern Colorado providers to improve the reliability of water supplies from the Windy Gap Project. The original project began delivering water in 1985. It is operated by Northern Water's Municipal Subdistrict. The firming project proposes to build a new reservoir on the eastern slope, called Chimney Hollow. Chimney Hollow will provide dedicated storage that would supply a reliable 30,000 acre-feet of water each year. This water will be supplied via the Colorado-Big Thompson Project, so the BOR must approve a contract allowing use of federal facilities.

The thirteen project participants are committed to addressing environmental impacts caused by the firming project. The subdistrict, on behalf of project participants, spent several years negotiating measures to mitigate environmental impacts. The subdistrict worked with state wildlife biologists to

develop the fish and wildlife mitigation plan, which operates to mitigate higher stream temperatures, increase flushing flows to clean sediment in the stream, and provide nutrient removal to offset water quality impacts in Grand Lake and the Colorado River. Federal reviewers incorporated the plan into the Final Environmental Impact Statement.

The project participants agreed to voluntary enhancement measures to address concerns with the current condition of aquatic life in the Colorado River. The enhancements include a state-authorized plan to provide \$4 million to fund future stream restoration and habitat-related projects on the Colorado River and \$250,000 to study a stream bypass around Windy Gap Reservoir. As part of the 1041 permit approved by Grand County, the subdistrict has entered into several agreements with local governments and environmental nonprofits that provide ecological enhancements. The Windy Gap Bypass Funding Agreement provides \$2 million to construct a bypass around the reservoir, which is matched by \$2 million in funding from the state. An Intergovernmental Agreement between the subdistrict, Grand County, CRWCD, Middle Park Water Conservancy District, and Northwest Colorado Council of Governments provides a reliable water supply to Middle Park to meet their future water needs and provides additional water supplies that Grand County may use for environmental purposes.

The collaboration between eastern and western slope entities and state agencies will improve the conditions for aquatic life in the Colorado River and also help the Windy Gap Firing Project progress to meet water supply needs on the eastern slope.

WISE Partnership

The Water, Infrastructure, and Supply Efficiency (WISE) Partnership serves as an example of how to use infrastructure to meet increasing water demands. The project brings together water providers in the Denver metropolitan area to meet challenges jointly, rather than on an individually. The WISE Partnership explores how existing provider infrastructure can be used to the benefit of all cooperating partners.

In response to the drought of 2002, Aurora Water began construction on the Prairie Waters Project, an innovative supply and filtration system. The Prairie Waters Project stabilized Aurora's water supply and created a large system of treatment and water transport infrastructure. Aurora now partners with Denver Water and the members of the South Metro Water Supply Authority on a project that couples the Prairie Waters infrastructure capacity with Denver and Aurora's unused supply and reusable flows. The partnership steadies water supply in times of drought for these providers and administers the sale of water to South Metro as a new and sustainable supply.

The WISE Partnership creates flexibility in the face of hydrologic uncertainty and establishes triggers to modify yields based on available flows. In addition, South Metro Water Supply Authority members use back up water supplies when WISE water is not available.

State Funding for Collaborative Projects

Funding for opportunities will become more competitive as Colorado moves from the planning phase to the project implementation phase. The BIPs believe that the projects with multi-purpose functions should be prioritized.

When examining appropriate projects to fund, the state looks for multiple stakeholder involvement and multiple project purposes. A few examples of state-funded projects are the Chatfield Reallocation project, the Wild and Scenic Alternatives processes, the Animas-La Plata Project, and a collaborative process to assess the best approaches to secure water for the Upper Colorado River Basin Recovery Implementation Program. In addition to providing funding, the state served as a partner in the planning, permitting, and development of operational procedures for the Chatfield Reallocation and Animas La-Plata projects.

These projects and processes represent the type of collaboration necessary for future water supply planning in Colorado. Local involvement, stakeholder consultation, innovative practices, and multiple uses will be integral to future successful projects and processes. The BIP and Colorado's Water Plan processes have engaged communities, stakeholders, and basin roundtables in an unprecedented way. Continuing this engagement will be important for next steps–project implementation.

8.2 Conceptual Intrastate Agreements and Points of Consensus

The drought in 2002 illustrated that Colorado did not bring together the necessary stakeholders and technical information to adequately plan for Colorado's future. In response, Colorado initiated three important efforts: the Statewide Water Supply Initiative (SWSI), the Colorado Water for the 21st Century Act, and the Water Supply Reserve Account Grant Program.

The Statewide Water Supply Initiative (SWSI) ([SB03-110](#)) established the technical backbone for statewide planning.

The Colorado Water for the 21st Century Act ([HB05-1177](#)) created the basin roundtables and the Interbasin Compact Committee (IBCC). The basin roundtables consist of nine stakeholder groups including the Metro area, Arkansas, Colorado, Gunnison, North Platte, Rio Grande, South Platte, Southwest, and Yampa/White/Green river basins. Members include representatives for the environment, recreation, domestic water suppliers, agriculture, and industry. These members are joined by representatives from each county, municipalities within each county, and conservancy and conservation districts. A basin roundtable may also vote in additional members, who may serve as voting or nonvoting members. The major charge of the basin roundtables is to determine their municipal, industrial, agricultural, environmental, and recreational needs, and identify projects and methods to meet those needs.

The IBCC is made up of two representatives from each basin roundtable, six governor appointees, two legislative appointees, and the Director of Compact Negotiations. The IBCC's main charge is to work with the basin roundtables to develop and ratify cross-basin agreements. A detailed list of the IBCC membership is available [here](#).

The basin roundtable and IBCC processes have evolved over the years, and several work products were developed to reach consensus across the state. These include:

- Statewide Basin Roundtable Summits and the Roadmap documents
- IBCC 2010 Letter to then outgoing Governor Ritter and then Governor-elect Hickenlooper
- IBCC Draft No and Low Regrets Action Plan
- Draft IBCC Conceptual Agreement

Statewide Basin Roundtable Summits

The three Statewide Basin Roundtable Summits held over the last several years have helped focus Colorado and the hundreds of stakeholders involved in water planning throughout the state. The summits provided an opportunity to learn across basins, make sure that statewide planning is heading in the right direction, and to set the course forward.

IBCC 2010 Letter

In December of 2010, the IBCC submitted a letter to the Governor. This letter synthesized the IBCC's ideas and laid the foundation for establishing the No and Low Regrets Action Plan and Conceptual Agreement.

The general consensus was the status quo scenario is not a desirable future for Colorado.

Much of this work is still relevant today and has helped guide the development of Colorado's Water Plan. The IBCC wrote, "The enormous challenge of meeting future water needs facing water users and the State requires the collective input of all stakeholders and a collaborative decision-making process that reaches common ground to plan a sustainable water future that meets our numerous and diverse needs.... Our system of water allocation should be guided and supported by a comprehensive framework that will marshal ever-scarcer government resources in a manner that supports economic growth; protects our environment; provides for municipal, agricultural, and industrial needs; and supports rural, recreation, and ecotourism-based economies."

The IBCC highlighted that the current path was not sustainable for Colorado. The IBCC wrote, "status quo will likely lead to large transfers of water out of agriculture resulting in significant loss of agricultural lands, more dried-up streams threatening ecosystems and recreation-based economies, water-inefficient land use decisions, and continued paralysis on water supply projects. We have discussed status quo as the default position--the results that will likely occur if we, the water community, allow current trends to continue unchanged. Inaction is a decision itself, a decision with significant consequences. The general consensus was the status quo scenario is not a desirable future for Colorado."

The IBCC wrote about the path forward regarding water supply options: "It is clear that no one strategy can meet Colorado's growing water needs without harming values important to all Coloradans. Therefore, a mix of solutions is needed. At the IBCC's August 2010 meeting, it agreed that a future mix of water supply solutions should include all four sources to meet the water supply gap in Colorado: conservation, IPPs, agricultural transfers, and new supply development, while also protecting Colorado's significant water-dependent ecological and recreational resources."

No and Low Regrets Action Plan

Based on the dialogue from the November 2012, March 2013, and June 2013 IBCC meetings, as well as numerous subcommittee meetings, a draft No and Low Regrets Action Plan was developed. The draft document reflects 100 percent consensus by the IBCC members and provides a menu of options that the basin roundtables should consider for the BIPs, and by CWCB as a component of Colorado's Water Plan and Statewide Water Supply Initiative.

Scenario planning is a critical part of the No and Low Regrets Actions Plan. Full implementation will occur within the next 10 to 15 years. Without the full implementation of these foundational actions, the gap between water demand and supply will be much greater than originally projected. This means

that even under a weak economy scenario, new water supplies would be needed. Under the scenarios in which demands for water are greater and supplies are lower, additional new supplies and agricultural transfers will be needed beyond what was envisioned by the basin roundtables.

The IBCC identified the following no and low regrets goals:

- Minimize statewide acres transferred (per basin goals) and implement agricultural sharing projects
- Plan and preserve options for existing and new supply
- Establish low to medium conservation strategies
- Implement nonconsumptive projects
- Have a high success rate for identified projects and processes
- Implement storage and other infrastructure
- Implement reuse strategies

This Action Plan is incorporated throughout Colorado's Water Plan and is available [here](#).

Draft IBCC Conceptual Agreement

A long-standing controversial issue in Colorado is the development of water supply from the Colorado River Basins for use on the eastern slope. It is controversial because of issues such as supply gaps, environmental health, and compact compliance. Table 8-1 shows the opposing viewpoints of the basin roundtables and the BIPs.

Table 8-1: Colorado River Development - Discussion in Basin Implementation Plans

Basin	Compact Discussion	Transmountain Diversions
Arkansas	"As an importing and exporting basin, the future of the State's Colorado River Compact Entitlement directly affects all water uses in the Arkansas Basin;"	"In particular, a future without New Supply, as that term is understood in the lexicon of SWSI 2010, is detrimental to the future of agriculture in the Arkansas Basin." ¹
Colorado	"Continued development from the mainstem of the Colorado River toward full Compact entitlement is not sustainable and will harm all of Colorado."	"In summary, the CBRT does not promote the use of TMDs to meet future water demands without first considering reuse, conservation, and first developing in-basin water supply projects." ²
Gunnison	"The ultimate risk from new development of Colorado River System water is over development of Colorado's entitlement under the Colorado River Compact and Upper Colorado River Basin Compact, resulting in curtailment of water uses in Colorado. However, because Colorado River Storage Project reservoirs have provided drought protection for Upper Basin states, Compact curtailment is not a near term risk. Therefore, in preparing the 2015 Water Plan, risk should be assessed in terms of a shortage of supply resulting in curtailment under Colorado's prior appropriation system."	"1. Future supply of Colorado River water is highly variable and uncertain; therefore any proponent of a new supply project from the Colorado River System must accept the risk of a shortage of supply however the shortage occurs, strictly adhere to the prior appropriation doctrine, and protect existing water uses and communities from adverse impacts resulting from the new supply project. 2. It must be explicitly recognized that a new supply development from any location in the Colorado River System affects the entire West Slope, as well as the Front Range diverters. 3. Any new supply project from the Colorado River System must have specifically identified sponsors and beneficiaries, and meet certain minimum criteria"³
North Platte	<i>Colorado Compact concerns not addressed within BIP.</i>	<i>No position taken on transmountain diversions.</i>
Rio Grande	"The Rio Grande Basin recognizes that it may take the development of Colorado's entitlement under the Colorado River Compact to meet Colorado's water needs."	"The Basin also recognizes that issues across the state are difficult and complex, and is supportive of the seven general areas of agreements under the IBCC, which capture agriculture, environmental and municipal needs. If and when there is a consensus between the Front Range and the West Slope regarding interbasin water transfers the Rio Grande BRT will participate in those discussions and evaluate if additional interbasin transfers are appropriate to meet the significant water needs of the Basin." ⁴
South Platte/ Metro	"The Metro and South Platte Roundtables believe in strong consideration and preservation of the ability to use Colorado's entitlement under the Colorado River Compact as we also pursue other strategies to meet our water demands. Investigating,	"The South Platte and Metro BRTs are supportive of the on-going IBCC discussions and believe that a wide range of water supply solutions should be carefully considered including continued and expanded water conservation and reuse programs statewide. <i>All</i>

	preserving, and developing Colorado's entitlement to Colorado River supplies is beneficial to the state's economic, social, political and environmental future. This may involve large state-level water projects, or small level projects, each with comprehensive West Slope water supply and environmental and recreational components." "Additional amounts of Colorado River water supply may be developed within the State's Colorado River Compact entitlement, especially during wet years and wet cycles. Management techniques such as water banks and methods for temporarily reducing water use during dry conditions are available to manage a warmer and/or drier climate. However, artificially capping development due to a fear of a "compact call" merely shifts future risks to agriculture."	<i>"four legs of the stool plus storage" need to be simultaneously considered as the development of Colorado's Water Plan continues."</i> "Ideally, a Colorado River supply project(s) would be multi-purpose, with associated recreational and environmental benefits. Colorado River supply would be developed in a manner that does not exacerbate compact risks. East slope storage would come from enlarging existing reservoirs, building off-river storage, and using underground storage to minimize riparian impacts. Colorado River supply and east slope storage would form the base of the M&I supply. East slope Agricultural Transfers and conjunctive use of the Denver Basin Aquifer would be used primarily for droughts and drought recovery. Alternative agricultural transfer methods including land and water conservation easements could be used to help maintain agricultural production and the local economic benefits of agriculture."⁵
Southwest	"The Roundtable is concerned about any new transmountain diversion (TMD). A new TMD would increase the risk of a Colorado River Compact call, as well as the risk of contingency measures to address serious conditions such as the inability to generate power from Lake Powell or levels of Lake Mead dropping below Las Vegas' intake. An increase in such risks jeopardizes the Southwest Basin's ability to develop water supplies to meet needs in the Southwest Basin and pits additional pressure on the Basin's agriculture to meet downstream water needs for compact compliance and/or obligations. Therefore, the Roundtable agrees on seven factors to be addressed prior to considering a new TMD."	"The Southwest Basin intends to continue its involvement in two current cross-basin cooperative efforts. One is the IBCC's effort to develop a conceptual agreement between roundtables regarding how to approach a potential future trans-mountain diversion from the West Slope to the East, including the discussion of a possible Future Use Allocation. Another cross-basin cooperative effort is the Southwestern Water Conservation District's participation as a member of the Water Bank Working Group to develop a Compact water bank."⁶
Yampa/ White/ Green	"The Yampa-White-Green Basin Roundtable recognizes that the overdevelopment of limited Colorado River system water is a serious risk that would impact all users of Colorado River Basin water." "With respect to downstream flows, the Yampa-White-Green Basin Roundtable recognizes that the Yampa and White Rivers play a significant role in providing water for compliance with the State of Colorado's downstream obligations, and that this must be recognized in the Colorado Water Plan. The Yampa-White-Green Basin Roundtable also thinks that negotiated equitable apportionment among Colorado River tributary basins must be included in the Interbasin Compact Committee's agreements and in the Colorado	"Thus, before it could be considered by the Yampa-White-Green Basin Roundtable, any proposed trans-mountain diversion out of the Colorado River Basin must undergo a full operational analysis to determine its impact on the entire river system. The analysis must recognize that, within the Colorado River system, the diversion of any "extra" water available during wet years may occur under certain "trigger" conditions of a full (or nearly full) supply in reservoirs designed to carry the Colorado River Basin through a drought. This analysis must be sufficient to determine that the risks of operating project(s) in a junior manner to identified Colorado River Basin needs are understood by all. Such a project should not be funded by the State of Colorado, but by

	Water Plan, as it was in previous interstate agreements, and envisioned by the HB05-1177 process.” “Accordingly, the Colorado Water Plan must address how a Colorado River compact curtailment or any other administrative action causing curtailment would be applied, and must recognize the negotiated equitable apportionment to the Yampa-White-Green Basin for existing and future development as mentioned above.”	interests, public and/or private, willing to accept such operational and financial risk. Prior to undertaking development of a new trans-mountain diversion, the Front Range must first integrate all other water supply solutions including conservation, reuse, and maximize use of its own native water resources and existing trans-mountain supplies.” “The Yampa-White-Green Basin will not consider a new trans-mountain diversion until and unless a satisfactory Intrastate Compact and negotiated equitable apportionment of Colorado River supplies is achieved.”⁷

The two BIPs with the greatest divergence are the Colorado and South Platte/Metro BIPs. The Colorado BIP points out the variability in hydrology, stating that transmountain diversions “should be the last ‘tool’ considered as a water supply solution, once the many and complex questions are addressed over hydrology.”⁸ The South Platte/Metro BIP advocates to “simultaneously advance the consideration and preservation of new Colorado River supply options.”⁹ Both viewpoints recognize the constraints of water availability and Colorado water law, but differ in how they believe such a project fits into water supply planning. The IBCC’s draft conceptual agreement seeks to find a path forward that preserves the option of developing a new transmountain diversion, while addressing many of the concerns expressed by the Colorado Basin roundtable and others.

In 2013, the IBCC focused its discussion on a conceptual framework for future detailed negotiations on a potential new transmountain diversion (TMD). As expressed in the draft agreement, there may be years where additional development is available from the Colorado River system, and some years where this water is not physically available. This discussion stemmed from the No and Low Regrets Action Plan, as the IBCC decided that additional discussion and consideration on this particular issue was necessary. Consensus on the Draft Conceptual Agreement was reached in June of 2014, and was submitted to the CWCB for inclusion in Colorado’s Water Plan.

The Draft Conceptual Agreement focused on the following points of consensus:

1. The eastern slope is not looking for firm yield from a new TMD project and would accept hydrologic risk for that project.
2. A new TMD project would be used conjunctively with eastern slope interruptible supply agreements, Denver Basin Aquifer resources, carry-over storage, terminal storage, drought restriction savings, and other non-western slope water sources.
3. In order to manage when a new TMD will be able to divert, triggers are needed.
4. An insurance policy that protects against involuntary curtailment is needed for existing uses and some reasonable increment of future development in the Colorado River system, but it will not cover a new TMD.
5. Future western slope needs should be accommodated as part of a new TMD project.
6. Colorado will continue its commitment to improve conservation and reuse.
7. Environmental resiliency and recreational needs must be addressed both before, and conjunctively, with a new TMD.

The Draft Conceptual Agreement has been incorporated into elements of the BIPs of the Southwest, South Platte/Metro, and Rio Grande roundtables, as a step forward in identifying the myriad of issues associated with such a project. Moving forward, it is crucial to have the basin roundtables and CWCB members participate in further discussion about the Draft Conceptual Agreement to further inform identified discussion points and project considerations.

The complete Draft Conceptual Agreement is included in full in [Appendix C](#). Once finalized, these points of consensus may serve as the foundation for any new future transmountain diversion projects seeking state support. These considerations will act as a guide to move a project forward with state support.

8.3 Actions

The following are next steps that will support the policies, conceptual agreements, and points of consensus:

- CWCB, the Division of Water Resources, and the Attorney General's Office will protect the ability to fully develop Colorado's compact entitlements and continue to support intrastate agreements that strengthen Colorado's position in interstate negotiations.
- CWCB will help Colorado prepare for a future with scarcer water supplies (i.e. hope for the best, plan for the worst). The State of Colorado will work with other states to evaluate options to achieve sustainable water solutions that balance development of Colorado's compact entitlements and risk of a compact deficit. This concept is further described in the IBCC's conceptual agreement ([Appendix C](#)), under point #4. CWCB will also support continued outreach to stakeholders regarding these interstate cooperative solutions.
- CWCB will work with stakeholders to refine what conservation targets can be achieved, as addressed in Section 6.3.

¹ WestWater Research, CDM Smith, CH2MHILL, Peak Facilitation, *Draft Arkansas Basin Implementation Plan* (Colorado Springs: WestWater Research, 2014) Section 4-8.

² SGM, *Draft Colorado Basin Implementation Plan* (Glenwood Springs: SGM, 2014) 4.

³ Wilson Water Group, *Draft North Platte Basin Implementation Plan* (Denver: Wilson Water Group, 2014) 39-41.

⁴ DiNatale Water Consultants, *Draft Rio Grande Basin Water Plan* (Boulder: DiNatale Water Consultants, 2014) 17.

⁵ HDR, WestSage Water Consultants, *Draft South Platte Basin Implementation Plan* (Denver: HDR, West Sage Water Consultants, 2014) Section 4.8.2.

⁶ Harris Water Engineering, *Draft Southwest Basin Implementation Plan* (Durango: Harris Water Engineering, 2014) Exec Summary, page 102.

⁷ AMEC, *Draft Yampa/White/Green Basin Implementation Plan* (Denver: AMEC, 2014) ii-iii.

⁸ SGM, *Draft Colorado Basin Implementation Plan* (Glenwood Springs: SGM, 2014) 45.

⁹ HDR, WestSage Water Consultants, *Draft South Platte Basin Implementation Plan* (Denver: HDR, West Sage Water Consultants, 2014) 1-21.

9. Alignment of State Resources and Policies

Chapter 9 explores the mechanisms by which the State of Colorado can help implement the Basin Implementation Plans and address Colorado's critical water strategies discussed throughout Colorado's Water Plan. As described in Section 9.1, continuing to support the solid foundation of Colorado's prior appropriation system, interstate agreements and compacts, and retaining local control are all critical to keeping Colorado whole. These systems are flexible enough to move forward with the actions described throughout Colorado's Water Plan. Many of the strategies described in the plan and throughout the BIPs require additional or more coordinated funding. The imminent needs for project funding are described in Section 9.2 along with options for new and existing funding mechanisms necessary for meeting Colorado's water future. The State of Colorado holds numerous water rights, many of which are aimed at protecting the environment or for recreation. In addition, Colorado has purchased water rights in important multi-purpose projects to help with implementation of these water projects. Section 9.3 describes ways to improve coordination between state agencies who own water rights and describes an approach for acquiring new water rights that more strategically addresses the state's Water Values. Many of the projects and methods described in the plan will require permitting, and if the state of Colorado is to be adaptive in its approach to water management, the permitting process needs to be as effective and efficient as possible. Section 9.4 discusses emerging concepts for a more efficient permitting process. Lastly, an educated public is necessary to continue to engage Colorado stakeholders in developing grassroots solutions and moving them forward. However, few resources are available to meet this important need. Section 9.5 discusses the unprecedented educational effort initiated to build the first draft of Colorado's Water Plan and envisions how education and outreach efforts can be implemented in a more sustainable and robust fashion. Together, these state actions will help Colorado implement the water strategies described in Chapters 6 through 8.

9.1 Alignment within the Institutional Setting

Colorado's Water Plan upholds Colorado's water law system, interstate water compacts and equitable apportionment decrees, and local control structures.

Introduction

As described in Chapter 2.1, Colorado has an intricate legal and institutional framework. The institutional setting is the starting point for all other conversations regarding Colorado's water future. Colorado's Water Plan recognizes the prior appropriation doctrine as the foundation of Colorado's water law system and it respects the importance of Colorado's interstate water compacts and other interstate agreements. This plan maintains Colorado's water allocations to prevent erosion through federal reserved water rights or through federal bypass flows. This plan

also recognizes Colorado's history of recognizing local control regarding water development. This plan will continue to recognize and uphold Colorado's commitment to supporting tribal water settlements with the Ute Mountain Ute and Southern Ute Tribes. This section reaffirms Colorado's commitment to these fundamental tenets while advancing strategies for future water management.

Actions

The State of Colorado will continue to uphold the prior appropriation doctrine.

Colorado's prior appropriation doctrine is based on language within the State's Constitution. Over time, the prior appropriation doctrine has proven to be remarkably flexible. This flexibility was demonstrated by the recognition of new beneficial uses, such as environmental and recreational uses, under the law. The prior appropriation doctrine requires that water be put to beneficial use and requires efficient use to assure the greatest utilization of Colorado's water resources.¹ These concepts are ever evolving and will need to adjust appropriately. While the prior appropriation doctrine is affirmed by Colorado's Water Plan, there is room for improving water management within this allocation system. Colorado's water court system has often been criticized as cumbersome and expensive.² Several years ago, a report from the Water Court Committee of the Colorado Supreme Court to the Chief Justice made recommendations to improve the efficiency and cost effectiveness of the water court system. Most of these recommendations have been implemented. Nevertheless, the Water Court Committee should assess whether these changes have had the desired effect of making the water court system more efficient and cost effective. In addition, the standing committee should explore whether there are additional recommendations that could be made in the future.

The State of Colorado will continue to uphold Colorado's water entitlements under Colorado's compacts, equitable apportionment decrees, and other interstate agreements.

For almost a century, Colorado has led the development and protection of interstate water compacts as a method to allocate water on interstate streams and rivers. Colorado vigorously defended its water allocations when downstream states have alleged compact violations.³ Colorado has also been steadfast in defending Colorado's water entitlements that were allocated to Colorado through equitable apportionment decrees.⁴ Colorado's Water Plan reaffirms Colorado's dedication to protecting Colorado's compact and decree entitlements. The State of Colorado has a litigation account that is available to the CWCB and the Office of the Attorney General for Colorado's defense of its water resources.⁵ Importantly, this fund is available to: 1) support water users whose water supply yield is or may be diminished as a result of conditions imposed, or that may be imposed, including but not limited to by-pass flows by any agency of the United States on permits for existing or reconstructed water facilities located on federally owned lands; 2) oppose applications of a federal agency for an instream flow right that is not in compliance with Colorado; 3) protect Colorado's allocations of water from interstate streams; and 4) ensure the maximum beneficial use of water for present and future generations by addressing important questions of federal law.⁶ Colorado should continue to maintain a sufficient balance in this fund to assure that the State of Colorado has adequate resources to defend its water resources. In addition, Colorado should make every effort to comply with its compact and decree obligations. While interstate compacts have

proven to be a solid foundation upon which water allocation can occur, interstate compacts also have been flexible enough to address time of drought and other unforeseen circumstances.

There are other federal laws and regulations that could negatively affect Colorado's ability to fully use its water entitlements. The Wild and Scenic Rivers Act and the Endangered Species Act are two federal statutes that could negatively affect Colorado's ability to fully use its compact and decree entitlements. The Wild and Scenic Rivers Act provides for federal reserved water rights with any such designation. A federal reserve water right could limit Colorado's ability to develop additional water uses. In addition, the Endangered Species Act has been interpreted in other jurisdictions, the most notable example being the delta smelt litigation in California, which required water users to meet endangered species needs first and to meet other water needs second.⁷ Colorado's Instream Flow Program is an effective tool for preventing the potential negative effects of the Wild and Scenic Rivers Act and Endangered Species Act on Colorado's water users.

In these federal and state contexts Colorado will continue to protect the ability to fully develop, and put to beneficial use, its water entitlements.

The State of Colorado will continue to defend against federal intrusion into Colorado's water law and water management system.

The State of Colorado has always vigorously defended Colorado's water allocation and management system from federal intrusion. Recently, many federal agencies have made decisions that encroach on Colorado's primary role regarding water management within the state. Some recent examples include: the U. S. Forest Service (USFS) position on water rights associated with ski areas within Colorado; the USFS proposed groundwater directive; and, the Bureau of Land Management (BLM) Resource Management Plans and USFS Management Plans that advance the possible use of bypass flows as a possible federal agency management tool. The State of Colorado opposes federal encroachment by federal agencies on the State's primacy in water management and will continue to seek changes in federal policy to assure Colorado's primary role relating to water management within the state.

The State of Colorado will continue to work within Colorado's local structure.

Local governments have considerable authority in making water development and management decisions. Colorado's counties and municipalities exercise a broad range of powers to address the needs of their constituents that are explicitly conferred to them by state law. This includes broadly authorizing counties and municipalities to balance environmental protection with the need to provide for the planned and orderly land use. Counties and municipalities have various tools at their disposal, including: creating special districts, requiring Master Plans for development, assessing impact fees to offset new development on existing infrastructure, and 1041 powers which allow local governments to regulate construction or extensions of major new water and sewage treatment systems. The State of Colorado will work collaboratively with local governments within this existing framework and Colorado's Water Plan is a valuable tool for both levels of government in that work.

9.2. Economics and Funding

Colorado's Water Plan coordinates existing funding sources and explores additional funding opportunities.

Introduction

Investing in the long-term sustainable supply and delivery of water is critical to Colorado's future. Even in robust economic times, the difficulties inherent in financing large, long-term and sustainable water projects can create community apprehension and political controversy.

Over the years, the Colorado Water Conservation Board (CWCB) has partnered with various water providers throughout Colorado to conserve, develop, and protect Colorado's water for future generations. CWCB has provided funding through grants and loans for critical multi-purpose and multi-partner projects, such as the Chatfield Reallocation Project, the Animas-La Plata Project, the Rio Grande Cooperative Project, and the Elkhead Reservoir Enlargement Project. For these projects alone, CWCB contributed over \$200,000,000. These projects supplied over 100,000 acre-feet of water to help water providers meet their water supply and storage needs, while also improving stream health, promoting shared uses, sustaining agriculture, and providing long-term recreational benefits.⁸

Financing long-term sustainable water supplies and infrastructure projects requires a collaborative effort involving water users and providers, as well as federal, state, and local entities. Colorado will need to secure funding needed to meet water needs in the long-term through a combination of constructive legislation, partnerships, and state and federal grant and loan programs.

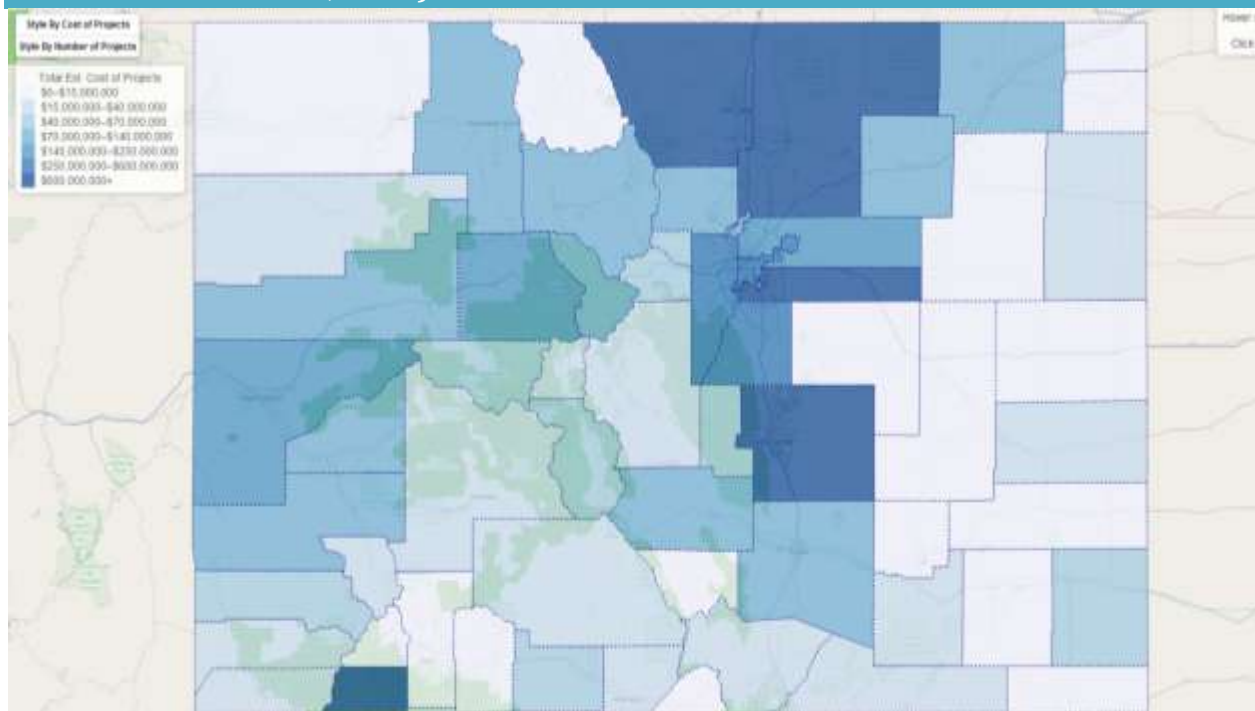
This section provides: 1) a description of existing financial need; 2) an overview of financial assistance programs; and 3) recommendations and suggested approaches to develop an integrated water infrastructure financing model that could assist in addressing Colorado's short and long-term water needs.

9.2.1 Statewide Water Infrastructure Financing Need

The Basin Implementation Plans (BIPs) for the major river basins within the state are a critical component of Colorado's Water Plan. In general, each BIP looked at balancing long-term municipal, industrial, agricultural, environmental, and recreational needs within the respective basins. As part of the BIPs, the basin roundtables identified a list of projects that they believe address the long-term needs of their basin. In addition to these projects, the BIPs include other activities that require financial support including education, outreach, conservation programs, flow agreements, alternative agricultural transfer methods, important legal investigations, and programs that manage various risks and vulnerabilities throughout the state.⁹

It is estimated that between \$17 and \$19 billion will be needed for municipal and industrial water infrastructure improvements by 2050.^{10 a} In addition, approximately \$150,000 is needed per mile of stream for smaller scale river restoration work, but could cost \$240,000 or even \$500,000 per mile for significant structural changes or channel reconfiguration.¹¹ To better determine the amount of river restoration work and other similar types of work may be required, up to 90 watershed level master plans are necessary at an estimated cost of \$18 million statewide.¹² As basins and stakeholders identify recreational and agricultural needs, further projects and methods will need to be developed and funded to meet those needs.

Figure 9.1.1-1: Estimated near-term infrastructure need (Water Information Network of Colorado, 2014)



Future calculated level of financial water infrastructure needs to be identified in the BIP's, as further discussed and refined in 2015. In 2015, CWCB will review the BIPs to develop a list of priority projects. The criteria for a priority project include funding, if it is multiple-purpose, if it has multiple partners, or if it has shared uses. CWCB will identify projects that have the potential to move forward quickly, have cross-basin and statewide benefits, and have a possible funding plan. This is discussed further in Section 9.2.4.

^a This number is based on an estimated \$14-16 billion of identified M&I needs calculated in the Portfolio and Trade-off tool (CWCB, 2011), plus an additional \$3 billion estimated need for maintaining existing M&I infrastructure . However, the numbers are being refined based off the BIPs .

9.2.2 Economics

When Colorado's land, labor, and capital combine with available water, the result is economic prosperity and opportunity. Managing water operations is challenging because of the wide variation in supply and demand. Water providers need to ensure the delivery of quality water to all customers as demand rises and falls at a cost that people can afford and are willing to pay. Water is also extremely mobile and by the nature of its physical properties can move around in streams, seep into soils, move underground, evaporate, be stored in reservoirs or even bottled and transported. The inherent consequence of mobility is that there can be many sequential uses from the same molecule of water since it is rarely consumed fully by a particular user and what is left is available for other uses. To expand even further, another critical feature of water is the overall variability of where it is located, the quality, quantity and for what duration. Colorado is a perfect example of the mobility of water, given that 70% of its population resides east of the continental divide, yet 70% of the state's water supply lies west of the continental divide.¹³

Water can be considered both a private and public good, which makes it difficult to assess its economic value. Water is capital-intensive when compared to other public utilities such as natural gas or electricity, given its weight, viscosity, and volume.¹⁴ The public perceives water as an affordable, accessible, and continually available resource.¹⁵ On average, most families pay less than one percent of their household income for water, so they do not understand the true cost of water when compared to other living expenses, such as fuel, electricity, food, etc.¹⁶ Twelve ounces of bottled water at the store costs \$1.00, but tap water that is treated and delivered across Colorado to a house costs approximately \$3.00 per one thousand gallons.¹⁷ This lack of awareness of the true cost of water could be either an issue with what the public can afford or a learned response to the low cost that consumers have historically paid for treated water delivered to their homes.

With the current and future strain on water supply, it is important to focus on education. Water users need to be aware of the true costs inherent in providing water.

9.2.3. State Funding Resources and Other Funding Opportunities

Current Funding Opportunities

Though the statewide funding needs for both the consumptive and non-consumptive water projects is significant, a planned, phased approach with existing and potential alternate funding sources could address a majority of the state's needs, if not all, depending on how aggressive and successful the approach is. The State recognizes that water providers are in control of their own short- and long-term capital investments, operation and maintenance costs, and customer base. Therefore, user rates and tap fees could be the primary source of funding where the end user is directly connected with the costs and investment. There are opportunities, however, when broader public interests are in play, where combining financial resources and infrastructure can solve complex water supply problems and accelerate the construction of a project. The Water Infrastructure and Supply Efficiency (WISE) Project is a perfect example where over eighteen entities, including CWCB, shared infrastructure, water, and financing to provide critical renewable water to offset well usage in Douglas County.¹⁸

There are a number of existing State funding sources or programs that can assist in meeting the state's long-term water infrastructure needs. These include: the CWCB Water Project Loan Program, CWCB's Water Supply Reserve Fund, the Species Conservation Trust Fund, and the Water Resources and Power Development Authority's (Authority) Water Revenue Bond Program (WRBP). Though these programs cannot solely meet the financial water needs of the state, they can assist in bridging funding gaps when combined with other funding sources.

CWCB Water Project Loan Program

Recognizing the importance of funding raw water projects, the Colorado General Assembly created the Water Project Loan Program, which is comprised of two funds: the Construction Fund and the Severance Tax Trust Fund, in 1971: codified at section 37-60-120 in the Colorado Revised Statutes.¹⁹ Annual revenues to the Construction Fund come from principal and interest (P&I) on existing loans and a portion of Federal Mineral Lease revenues that are paid to the State. Approximately \$18 to \$20 million is available annually for water project loans from this fund.²⁰

In addition to the Construction Fund, in 1995, the Severance Tax Trust Fund was created under section 39-29-109, which directs 25% of the State's severance tax revenues into this fund, which is currently capped at \$50 million annually.²¹ Annual severance tax revenues provided to the CWCB range from \$20 to \$50 million.²²

The Water Project Loan Program has, on average, between \$50 to \$60 million available annually for loans for various water projects throughout the state. The combined fund equity from the Construction Fund and Severance Tax Trust Fund exceeds \$700 million.²³

Water Supply Reserve Fund

This state grant program provides funding at the local basin level to address a variety of short- and long-term water needs. Current funding level is capped at \$10M annually, which is split between the Statewide and Basin Accounts. Funding comes from annual severance tax revenues to the State, and has varied from \$5-\$10 million annually.²⁴ This Program has distributed over \$40 million in grant funds to date for a variety of water related studies and projects.²⁵

Species Conservation Trust Fund

The Native Species Conservation Trust Fund (SCTF) was created in 1998, pursuant to HB98-1006. This fund is used by the CWCB and CPW for programs associated with: recovering species listed as threatened and endangered under state law; recovering and protecting federal candidate species; conducting scientific studies related to the listing or delisting of any species; and evaluating genetic, habitat and declining species baseline data. The SCTF authorizes millions of dollars of work by the CWCB and CPW each year, and this authorization occurs through the annual SCTF legislation.

Water Resources and Power and Development Authority (Authority)

The Authority is a quasi-governmental organization created by section 37-95-101 in the Colorado Revised Statutes to provide low-cost financing for water and wastewater related infrastructure projects to municipalities and special districts. The Authority has four main financing programs: the Drinking Water Revolving Fund (DWRP), the Water Pollution Control Revolving Fund (WPCRF), the Small Hydropower Loan Program (SHLP), and the WRBP.²⁶

The WRBP provides funds up to \$500 million for individual projects, without legislative review, to public entities for water and wastewater projects. The Authority's WRBP rates are consistent with private municipal bond market rates, with the distinction being that they provide bond issuance subsidies, up to a total of \$250,000, for each of up to four projects in any given year. It should be noted that the WRBP can provide funding well above \$500 million with legislative approval.²⁷

The DWRF and WPCRF are both part of the State Revolving Funds, which are operated in every state. These funds are primarily used for water quality projects, and are capitalized by state and federal funds whereby states contribute 20 cents for every federal dollar. These funds are often used to leverage other funds through the issuance of municipal bonds.

The SHLP is a joint program operated in coordination with the CWCB. Loans from this program are limited to up to \$2 million per governmental agency, for eligible projects, five megawatts or less.²⁸ Agencies seeking more than the first \$2 million available through the Authority can apply through the CWCB.

Grant Programs

CWCB also offers a number of grant programs for various water related efforts, such as water efficiency, alternatives to agricultural transfers, emergency drought response, phreatophyte control, and others. Annual combined funding for these various grant programs is in excess of \$4 million.²⁹ A list of these various grant programs can be found [here](#).

A list of federal, state and private funding opportunities for environmental and recreational needs can be found in the Nonconsumptive Toolbox.³⁰ The total amount of funds available from state resources that are dedicated to these efforts on an annual basis is approximately \$11 million.³¹ Some of these funds are extremely competitive, while others are hard to qualify for, and are therefore not fully utilized.

There are currently limited funding sources available for education, outreach, environmental resources, recreation, and other important water related activities that do not involve construction of projects. Though these efforts have strong support from non-governmental organizations, they are typically funded through charitable donations, as opposed to tax revenue. Additionally, much of this type of work has been funded through the Water Supply Reserve Account program, which requires approval by the basin roundtables and the CWCB. Therefore, it may be necessary to identify additional funding sources to fully meet the environmental and recreational water needs in the state.

Potential Future Funding Opportunities

Initial estimates suggest that municipalities will primarily need state, federal, or bond market loans to fund their projects. Over the next 35 years, based on current funding levels, the state expects to have nearly \$2 billion available in CWCB loans for municipal, industrial and agricultural projects.³² Compared to the statewide water infrastructure financing needs discussed above, this amount suggests a potential public financing gap. In order to support innovative water projects, such as multi-use, alternative agricultural transfers, or a new transmountain diversion with a sufficient back-up supply on the eastern slope, combined with significant environmental and recreational enhancements that meet the criteria of the IBCC, consensus and additional state funds may be

necessary. Environmental and recreational projects primarily rely on grants for financial support, since those projects are not typically ratepayer supported. Current capacity to fund environmental and recreational projects and methods over the next 35 years is \$385 million, based on current funding levels.³³ This suggests that it may be difficult to fund projects that promote environmental and recreational interests. Beyond the CWCB loan programs, an additional \$490 million is available from the Water Supply Reserve Account and another grant programs for meeting future needs.³⁴ Federal funding options are also a potential source for meeting financial needs. For scientific and research-based projects, the Bureau of Reclamation's WaterSMART program, managed through Landscape Conservation Cooperatives, has funded several programs throughout the region. For certain agricultural efficiency projects, the Colorado River Basin Salinity Control Forum has brought a significant amount of federal funding to Colorado, aimed at improving the water quality of the Colorado River.

In addition, the Upper Colorado River Basin Fund (Basin Fund) is a federal fund comprised of funds appropriated from the US Treasury for capital projects, as well as proceeds from the sale of hydroelectric power, transmission services and M&I water service sales. The Basin Fund is used to fund important work associated with the Salinity Control Forum, the Upper Colorado River Basin and San Juan River Basin Endangered Fish Recovery Implementation Programs, and the Glen Canyon Dam Adaptive Management Working Group. These programs are described throughout Colorado's Water Plan. In addition, in 2011, the Upper Division Colorado River Basin States (Colorado, Wyoming, Utah, and New Mexico), the United States Bureau of Reclamation, the United States Department of Energy Western Area Power Administration, and the Colorado River Energy Distributors Association signed a Memorandum of Agreement (MOA) that authorizes the use of the Basin Fund to further the purposes of the 1956 Colorado River Storage Project (CRSP) Act (Public Law 485) through fiscal year 2025. This MOA authorized additional uses for operational and maintenance on CRSP facilities, among other specified purposes, and provides more than \$5 million for the CWCB to direct toward CRSP operation and maintenance activities.

Other avenues of funding have been explored to meet Colorado's future water needs. The Interbasin Compact Committee (IBCC) explored several financial options in the No/Low Regrets Action Plan listed below:³⁵

- a federal/state partnership similar to the Central Arizona Project,
- a state water project similar to the California State Water Project,
- a state/local partnership in which the state facilitates the project, but the end-users finance and manage it,
- a public/private partnership similar to those used to build transportation projects (e.g., E 470),
- enactment of a "water" mill levy (the assessed property tax rate used to raise revenue),
- additional bonding authority for the State of Colorado,
- severance tax increases,
- a statewide sales tax,
- federal loan guarantees,
- expanded authority of Great Outdoors Colorado (GOCO) funding,

- specific Farm Bill initiatives that appropriate funds for enhancing agricultural operations while supporting nonconsumptive needs,
- regional taxing,
- statewide user fee,
- statewide tax on internet-based transactions, and
- debt financing (debt backed by existing or newly created revenue source).

In addition, The Nature Conservancy, Colorado Chapter and the Tamarisk Coalition also assessed funding sources for environmental needs.³⁶ When additional funding sources are needed, some potential investment opportunities are:

Constructive Legislation – Water providers, elected officials and community leaders can work to develop productive legislation to create effective and efficient funding processes that will maximize the use of water within the state. Some specific examples that could be considered include:

- Removal of Federal Mineral Lease and Severance Tax Fund cap limits, which could generate an additional \$20 million per year.³⁷
- Increase funding levels to the Water Supply Reserve Account Grant Program (WSRA) account, currently capped at \$10 million. Adding an additional \$10 million could greatly assist in meeting environmental and recreational funding needs.
- Investigate extending instream flow tax credits for water rights donations to the instream flow program beyond 2015.³⁸
- Expand CWCB's authority to improve the management and distribution of existing funds. Enabling CWCB to fund treated facilities could alleviate gaps in funding raw water projects with treated components that are not funded by other sources.
- Investigate the use of Conservation Tax Credits as a potential funding source. Explore broadening the statutory authority of the existing program to allow for the protection of watershed health, instream flow benefits, and alternative transfer methods to mitigate drying up agricultural lands.
 - Return remaining \$133 million in General Fund transfers back to the Construction Fund and Severance Tax Trust Fund. A total of \$163 million was transferred from the Construction Fund and Severance Tax Trust Fund to the General Fund to help balance the State's budget from 2008-2011. To date, \$30 million has been returned.³⁹ These funds could be directed to various water projects, environmental and recreational projects, watershed and stream management, project management, and others.

Public-Private Partnerships – Provide funding to research the pros and cons of private-public partnerships (P3s) and develop a preliminary model of a possible water infrastructure P3. P3s have the potential to reduce both capital investment and risk, while drawing on strengths inherent to both the public and private sectors. However, care must be taken to achieve an appropriate balance between public and private resources, costs, control, and long-term revenue streams. Lessons can be learned from the transportation sector, which utilized public-private funding for a toll road, and factors such as social perception, the interaction of state and private contracting policies, ratepayer concerns, and long-term sustainability of the partnership highlight the challenges and opportunities

faced by P3s. P3's can offer a considerable amount of working capital which, in certain circumstances, can accelerate the delivery of costly, technically complex projects.⁴⁰

State Referendum –Any taxpayer-supported effort and accompanying long-term debt needs to be approached with care and consideration. There should be a clear and concise reason for the need, a comprehensive plan for how and where the funds will be expended, defined oversight and accountability, and a plan that addresses the problem long-term.

In 2003, the Colorado populous voted on Colorado Water Projects Referendum A, a ballot initiative that would have allowed CWCB to borrow up to \$2 billion by issuing bonds to construct water projects throughout the state. This ballot initiative was soundly defeated with 67% against and 33% in favor. Though Referendum A was initiated to resolve a long-term water problem in the state, it was not accompanied by a comprehensive plan outlining how to address that problem, a quantification of the magnitude of financial need, or where and how the money would be spent.

Since 2003, a significant amount of time and resources have gone into developing a comprehensive overview of the state's current and long-term water needs. In 2007, HB 1177 was passed creating the Inner Basin Compact Committee, the basin roundtables, and the Water Supply Reserve Account. In 2010, the State completed the Statewide Water Supply Initiative Study (SWSI) that provided a detailed assessment of the state's current and future water needs. In 2011, the Colorado Water Availability Study (CRWAS) was completed, and this year, initial drafts of the BIPs were completed which identified basin-specific needs and projects.

The development of the BIPs provides an excellent road map of what the State needs to accomplish to address its long-term water supply needs. It is the result of decades of discussion, debate, and collaboration among water users, providers, and the Colorado General Assembly. The BIPs, with prioritization and refinement, could provide the necessary framework to attach to state referendum funding. A State Referendum could generate hundreds of millions of dollars per year, phased over a defined period, generated from sale tax revenues, income tax, etc. The funds could reside in a statewide water investment fund that would be distributed either as a loan, grant or combination of the two, managed and disbursed through the CWCB. A portion of the funds could also be reserved as repayment guarantees for water providers seeking bonds. The basin roundtable or IBCC duties could be expanded to serve as the initial review entity, with projects then referred on to CWCB for final review and approval. The policy developed to manage and disburse money from this fund could include a zero-interest rate to market loans, security or repayment guarantees on bonds, environmental and recreational grants, permitting assistance, legal assistance, expanding funding levels for existing programs, etc. Principal and interest returned to the fund would be invested in water projects or other areas of need within the state.

As a comparison, in 2013, the Texas Legislature authorized a transfer of \$2 billion from the state's "Rainy Day Fund" to create a new loan program, later approved by Texas voters, to fund projects in the State Water Plan. This original investment in the State Water Implementation Fund for Texas (SWIFT) and the State Water Implementation Revenue Fund for Texas (SWIRFT) was designed to fund almost \$27 billion in water supply projects over the next 50 years to ensure that Texas

communities have adequate supplies of water during drought. Additionally, the State of California will be voting in November of 2014 to approve Proposition No. 1, which would allow the state to redirect \$425 million in unsold bonds and sell \$7.1 billion in additional bonds, for a total of \$7.5 billion in general obligation bonds. The funds would be used to manage water supplies, protect and restore wetlands, improve water quality, and flood protection.

Mill Levy – In lieu of a statewide referendum, a more targeted approach could be taken to increase property taxes in those counties with large population bases along the front range, such as Adams, Arapahoe, Boulder, Denver, Douglas, El Paso, Jefferson, Weld, and Larimer Counties. These large population centers could be assessed an additional 4 to 8 mills on their property taxes to provide critical water project funding in their area and to offset impacts to other areas. This could generate approximately an additional \$215 to \$430 million dollars per year and reside in a water investment fund as described above.⁴¹ For comparison, typical Fire District revenues are based on 8 mills.

Container Fee Ballot – In 2010, two citizens filed a Ballot Initiative seeking a fee on beverages sold in Colorado. Unofficially captioned “Container Fee to Fund Water Preservation and Protection” by legislative staff for tracking purposes, the initiative was heard by the Ballot Title Setting Board in April of 2010. The initiative title for the ballot was appealed to the Supreme Court on the basis that by naming the basin roundtables specifically the initiative was not a single subject. The Supreme Court granted the appeal and the initiative was dropped. This initiative has merit and should be reevaluated. It was estimated in 2010 that this initiative could generate in excess of \$100 million per year and could go directly for water projects, environmental and recreational projects, and stream and watershed management efforts throughout the state.⁴² It is an initiative that could help offset the negative environmental impact of plastic containers (i.e., bottled water).

9.2.4. Actions

According to studies by the Environmental Protection Agency (EPA), the Congressional Budget Office, and the Water Infrastructure Network, the cost of addressing our nation’s clean water infrastructure needs over the next 20 years could exceed \$400 billion, which is roughly twice the current level of investment by all levels of government.⁴³ Colorado alone has over \$18 billion in identified water project needs.⁴⁴ There is no easy or inexpensive way to provide Coloradoans with a sustainable long-term water supply. The overarching goal is to provide clean, reliable water, at an affordable price, for many generations.

Several financial “next steps” have been identified as part Colorado’s Water Plan. These include the following:

- Assess funding needs across multiple sectors using the BIPs and other resources as a guide (e.g., municipal, environmental, industrial, recreational, agricultural, conservation, education and outreach, among others).
- Determine the economic benefits and impacts of meeting or not meeting Colorado’s future water needs.

- Align state funding policies and promote coordination among state agencies to strategically support the values identified throughout Colorado's Water Plan, such as the need for multi-purpose and multi-partner projects and methods. Options to consider include:
 - Develop a common grant inquiry process coordinated across funding agencies for environmental and recreational project proponent,.
 - Review and prioritize water projects identified in the BIPs, in coordination with the basin roundtable representatives, to develop a funding plan for those that could move forward. Based on the identified funding level, develop funding strategies that utilize existing and new funding sources to move high-priority projects forward in 1 to 3 years.
 - Investigate the potential to become a project beneficiary through an arranged partnership for projects that are multi-purpose, multi-partner, or those that incorporate public-private partnerships.
 - Identify and develop, in 1 to 2 years, a single multi-benefit, multi-partner, shared infrastructure pilot project that is funded through a joint revenue stream of public and private funding. From this pilot project develop the framework for how future water project P3s could move forward, considering best procurement practices, revenue streams, maintenance and operation, water administration and management, and others.
 - Create a water investment funding committee, made up of representatives from each basin, CWCB, the Authority, Executive Director's Office, large water providers, and the private sector, to evaluate the funding recommendations contained within CWP and others, to develop a well planned, phased approach to provide funding for water projects, environmental projects, recreational projects, and stream and watershed management throughout the state. This committee would meet over the course of 2015 and provide its recommendations to CWCB. Funding recommendations would be based on water project needs identified in the BIPs.
 - Work with State Engineer's Office to develop and fund a modern method to determine probable maximum precipitation for spillway sizing for dams in Colorado with the intent to provide additional storage while minimizing capital investment.
- Explore near-term opportunities to increase funding resources:
 - Develop preliminary support data for various public funding options, such as state referendums, individual county mill levy increases, the plastic container ballot initiative, or other potential funding mechanisms.
 - Develop a draft policy on how a water investment (public tax) fund could be created, managed and disbursed.
 - Investigate the pros and cons of developing a reserve fund that would act as a security or repayment guarantee by the State to water providers seeking bond funds through the Authority.
 - Work with the appropriate people to evaluate the pros and cons of resurrecting the Container Fee Ballot.
 - Reassess the Instream Flow Tax Credit program to determine how to make it more usable.

- Work with various stakeholders, Department of Rural Estate, the Department of Revenue, and appropriate legislative committees to develop strategies to maximize the conservation tax credit program.
- Meet with Colorado Department of Revenue to discuss potential uses of Conservation Tax Credit revenues for stream and watershed restoration.
- Assess whether additional funds are needed to support the Water Efficiency Grant Program, which provides financial incentives for implementing conservation programs and planning for drought. Investigate expanding the authority of the program to provide grant funds to municipalities for documented water conservation/savings to help offset the economic impact of lost revenue due to reduced water usage.
- Assess whether there are additional loan opportunities for municipal conservation practices.
- Assess whether there is an opportunity to establish a water education and outreach grant program.
- Develop amended Water Supply Reserve Fund guidelines on how additional funding could be allocated, approved and disbursed. This could be an area where additional funding could be directed to environmental and recreational projects throughout the state.
- Develop draft amended statutory language to expand CWCB's authority to provide funding for water treatment projects and other areas for potential consideration in CWCB's 2016 Projects Bill.
- Assess the funding opportunity from the Water Infrastructure Finance and Innovation Authority (WIFIA) and the Rural Infrastructure Fund for loans to rebuild aging water infrastructure. Encourage the U.S. Department of Transportation and other agencies to share lessons learned regarding innovative financing programs with the U.S. Army Corps of Engineers (Corps) and EPA as they implement WIFIA.

9.3 State Water Rights & Alignment

Colorado's Water Plan ensures that state agencies coordinate the uses of their current and future water rights and will uphold Colorado's water values, as discussed in Chapter 1.

Several Colorado state agencies hold and exercise water rights for various beneficial uses authorized by Colorado's constitution and statutes, and by permits and water court decrees. The Division of Water Resources (DWR) administers water rights, including state-held water rights, within the state's priority system and does not own any water rights. As part of developing Colorado's Water Plan, the Colorado Water Conservation Board (CWCB) asked each state agency to develop an inventory of its water rights, to the extent it had not already developed one. This section describes state agencies that hold water rights, including each agency's mission and the legal basis for each agency's water rights and their uses. It also summarizes the agencies' water rights inventories and describes how the state is aligning its water rights with the water values

identified in Colorado's Water Plan, provided in Chapter 1. Finally, this section describes how state agencies will work to maximize the use of their water rights to realize to greatest benefits to the state as a whole. Note that the inventory process is ongoing and the CWCB will continue to incorporate the information it receives into as it becomes available.

9.3.1 Inventory of State Agencies Water Rights

CWCB

Mission and Statutory Authorities

Colorado established the CWCB in 1937 whose mission is to *conserve, develop, protect, and manage Colorado's water for present and future generations*.⁴⁵ *Section 37-92-102(3), C.R.S. (2013) authorizes the CWCB to appropriate and to acquire water for instream flow water rights and natural lake level water rights to preserve and improve the natural environment to a reasonable degree. Section 37-60-106(n) authorizes the CWCB to take actions necessary to acquire or perfect water rights for projects it sponsors.*

CWCB Water Rights Inventory

The CWCB currently holds 1,595 decreed instream flow water rights that protect approximately 9,180 stream miles and 480 decreed natural lake level rights.⁴⁶ The CWCB also has entered into 30 transactions by which it has acquired water, water rights or contractual interests in water for instream flow use.⁴⁷ Pursuant to an agreement with the U.S. Army Corps of Engineers (Corps), the CWCB owns two storage rights in Bear Creek Lake in Jefferson County for approximately 2,000 acre-feet, decreed absolute for piscatorial and recreational purposes, and conditional for municipal, domestic, industrial and irrigation.⁴⁸ In 2012, the CWCB exercised its right to acquire its project water allocation of 10,460 acre-feet (supply) and 5,230 acre-feet (depletions) in the Animas-La Plata Project. Currently, the project is decreed for municipal and industrial uses only, but the CWCB may use this water for compact compliance, endangered species and instream flow purposes.⁴⁹ The CWCB intends to sell or lease its water allocation to local water providers in southwest Colorado as demands dictate.

Finally, the CWCB is an active partner in the Chatfield Reservoir Reallocation Project and has multiple roles that include feasibility study sponsor, storage space share holder, and financial lender for low-interest project loans. Further, the Colorado General Assembly appropriated funding within two consecutive legislative cycles so that CWCB could hold, and later disperse for investment recovery, a certain percentage of unused storage space commonly referred to as "orphan shares." In October 2014, following an approval letter and federal Record of Decision⁵⁰, the Colorado Department of Natural Resources (DNR) executed a storage contract with the U.S. Army Corps of Engineers to use up to 20,600 acre-feet of additional storage space in the reservoir. The new space will be used to store water supply for multiple uses.

Uses of CWCB Water Rights

The CWCB uses its Instream Flow and Natural Lake Level water rights to preserve the natural environment to a reasonable degree. In some cases, the CWCB uses water acquired for instream

flow use to improve the natural environment to a reasonable degree. These uses enhance healthy watersheds, rivers and streams, and wildlife. Additionally, through its water acquisitions, the CWCB can work with other entities on multi-purpose projects, aligning water rights to meet consumptive and non-consumptive needs.

One such example of a multi-purpose project is the CWCB's acquisition, in partnership with the Colorado Water Trust and Skyland Metropolitan District, of an interest in the Breem Ditch located in the Gunnison River Basin. This project resulted in multiple uses of the acquired water right, which included preserving and improving the natural environment on Washington Gulch and the Slate River with subsequent municipal use by the District to meet the needs of its constituents. The CWCB also is in the process of negotiating a split-season water acquisition with irrigation in the early season and instream flow use for the remainder of the irrigation season. Creative and flexible approaches such as these enable the CWCB to work with its partners to protect Colorado's streams and the species that rely on them, sustain agriculture, and maximize beneficial uses of Colorado's water. The CWCB will use this water rights inventory process as a starting point for increased coordination with other state agencies to explore opportunities for sharing water.

The legislation that authorized the CWCB to appropriate and acquire water for Instream Flow and Natural Lake Level water rights recognized the need to "correlate the activities of mankind with some reasonable preservation of the natural environment."⁵¹ Consequently, in its implementation of the Instream Flow and Natural Lake Level Program, the CWCB continuously balances the needs of the natural environment with the needs of human water development, as illustrated in part by the multi-purpose projects described above. The General Assembly imposed part of that balance by limiting instream flow appropriations to amounts the CWCB determines are "required for minimum stream flows to preserve the natural environment to a reasonable degree."⁵² The CWCB acknowledges the many competing needs for water in Colorado and will continue to work closely with stakeholders to ensure instream flow protection and other water uses co-exist harmoniously in order to achieve the necessary balance to uphold the CWP water values.

Colorado Parks and Wildlife (CPW)

Mission and Statutory Authorities

CPW was created by the merger of the Division of Parks and Recreation and the Division of Wildlife, the two state agencies responsible for conservation, outdoor recreation and wildlife management for current and future Coloradans.⁵³ CPW's mission statement is: "To perpetuate the wildlife resources of the state, provide a quality state parks system, and provide enjoyable and sustainable outdoor recreation opportunities that educate and inspire current and future generations to serve as active stewards of Colorado's natural resources."⁵⁴ CPW is authorized to acquire land and water, or interests in land and water, for wildlife purposes and parks and outdoor recreation purposes.⁵⁵

Colorado Parks and Wildlife Water Rights Inventory

At present, CPW holds or manages approximately 1,320 decreed water rights, acquired primarily using sportspersons' dollars dedicated to preserving wildlife habitat, providing public access, and producing fish to stock state waters. Using general descriptors of these water rights, roughly 620

are direct flow surface water rights, 270 are groundwater rights, 220 are spring rights, and 210 are storage rights. The water rights are decreed for irrigation, in-reservoir piscatorial uses, direct flow rights for fish, wildlife and recreation, and domestic rights to provide drinking and bathing water at state parks. Some permitted wells, other water interests not associated with court decrees, and various agreements are not included in this number.

Uses of Colorado Parks and Wildlife Water Rights

Governor Hickenlooper, through his executive order, required that Colorado's water values (outlined in Chapter 1) to be reflected in Colorado's Water Plan.

CPW is the state agency charged with protecting wildlife and natural resources and providing recreation now and for future generations. All water rights owned or leased by CPW are dedicated to this purpose.^b This directly supports the Governor's goals and the agency's constitutional and statutory obligation to protect, preserve, enhance, and manage wildlife and recreation for the use, benefit, and enjoyment of the people of this state and its visitors.

There is statewide acknowledgement that supporting environmental and recreational attributes is vital to local economies and Coloradan's quality of life. The statewide environmental and economic benefits provided by Colorado's streams and lakes require that the state protect environmental, wildlife and recreational water needs. For example, endangered or threatened species and species of concern exist throughout the state; consequently, the state must ensure that there is water available to support these species. Similarly, while there are hotspots for recreation (e.g., rafting on the Upper Arkansas River and fishing on the Colorado River), the state benefits by supporting healthy multi-faceted recreational economies on both the Front Range and on the western slope.

CPW provides outdoor recreation, hunting and fishing opportunities for more than 12 million state park visitors, 284,000 licensed hunters and 733,000 licensed anglers. About 45% of Coloradans report that they regularly visit state parks. Recent studies indicate that roughly 18% of Coloradans are anglers and almost 5% of Coloradans hunt. Additionally, over 80% of all Coloradans utilize trails and over 50% participate in water sports. Overall, activities supported by CPW result in over 24 million recreation days per year in Colorado.

CPW's water use supports:

- Fisheries (rivers, reservoirs)
- Fish stocking (hatcheries)
- Recreation (fishing, boating, hunting, wildlife viewing)
- Habitat
 - Instream flows
 - Conservation pools

^b The 'Parks' side of CPW has some domestic water rights that provide water for bathing, drinking etc. at State Parks. These are the only rights not dedicated to protection and preservation of wildlife and natural resources.

- Wetlands, riparian habitat
 - Forage production, terrestrial habitat through irrigation
- Threatened and endangered species protection, recovery and propagation
- Groundwater recharge
- Drinking water for visitors to state parks and wildlife areas

Partnerships are critical to CPW's mission. CPW works extensively with private landowners, local, state and federal agencies, other public entities, such as water districts and municipalities, and nongovernmental organizations (NGOs) in a number of wildlife and recreation related areas. Some of the water-related projects include:

- Partnerships for protecting and restoring species of concern such as the Colorado River cutthroat trout, roundtail chub, bluehead sucker, and flannelmouth sucker.
- General fishery management strategies regarding management classifications for all waters in the state such as the Basin Aquatic Wildlife Management Plans.
- Partnerships with agricultural water users to share and coordinate the use of water resources, such as the Rio Grande cooperative agreement, still in formation.
- Development of data to understand water quality issues and support wise water quality management.
- The Habitat Partnership Program (HPP) is funded by revenue from the sale of big game licenses and develops partnerships among landowners, land managers, sportsmen, the public and CPW to reduce wildlife conflict, particularly conflict associated with forage and fencing. HPP committees are responsible for finding local solutions to local problems. HPP works with public and private landowners to develop distributed water features such as stock ponds, solar wells, and springs statewide that improve livestock or game distribution on the landscape and keep riparian damage to a minimum.
- Protect water-dependent conservation values on easement properties helping to minimize agricultural dry-up and provide long-term benefits to wildlife and landowners. An example of this type of project is conservation pool agreements in the Rio Grande Valley.
- Investments that provide public access and recreational opportunities to and on otherwise private land and water rights.
- Work with CWCB on the protection and enhancement of streams and lakes through the Instream Flow Program. For example, in 2012, CPW loaned water to CWCB from Lake Avery for instream flow use on Big Beaver Creek and the White River.
- Work with CDPHE to ensure protection of water quality for fish, amphibians, wildlife, plants and people.
- Provide water to enhance wetlands on Natural Resource Conservation Service Wetlands Reserve Program easements in the San Luis Valley, benefitting both wildlife and agricultural operations.

CPW is committed to developing positive relationships in every area of the state. There is also the potential to bolster CPW's work with other state agencies to develop and realize additional benefits from water assets. For example, CPW looks forward to working more closely with the State Land Board to develop ways to use water assets that enhance wildlife habitat on state trust lands.

While some examples of projects with multiple benefits are listed above, the ability to use any particular water right for multiple purposes is generally a function of the individual water right decree. CPW's water is first and foremost dedicated to environmental, wildlife and recreational uses, with most of CPW's water rights decreed for these uses. However, CPW actively works within the various water basins to find opportunities to maximize the use of water to benefits Coloradans without diminishing the protect wildlife, habitat and recreational facilities.

Colorado State Board of Land Commissioners (SLB)

Mission and Constitutional/Statutory Authorities

The SLB protects, enhances, and manages Colorado's permanent endowments of assets to generate of revenue for Colorado's public schools and public facilities. The SLB believes that economic productivity in perpetuity is dependent on sound stewardship, which includes the protection and enhancement of the beauty, natural values, open space and wildlife habitat of those lands. Amendment 16 of the Colorado Constitution and Section 36-1-118, C.R.S. govern the SLB's management of its assets.

SLB Water Rights Inventory

The majority of the SLB's water assets consist of agricultural stock wells. The SLB's inventory identified and verified the following water assets:

Type of Water Asset	Quantity	Comments
Ownership Shares in Ditch Companies	9	Used to support agricultural leases located on state trust land.
Decreed Surface Water Structures	17	
Decreed Groundwater Structures	117	
Permitted Structures	55	
Agricultural Stock Wells (estimated)	3,000	These are stock wells located on state trust land, used to support grazing leases and permitted at less than 15gpm.

Uses of SLB Water Rights

All water rights currently owned by the SLB are used to support agricultural production on state trust lands. This directly supports the agency's constitutional and statutory obligation to "protect and enhance the long-term productivity and sound stewardship of state trust land held by the board" by promoting sound land management practices, long-term agricultural productivity, and community stability. This use of the SLB's water rights also supports the CWP goal to maintain viable and productive agricultural lands.

Additional opportunities for the SLB to work with other state agencies to develop and maximize benefits from its water assets include:

- leasing existing water assets to CPW or CWCB to support projects that enhance wildlife habitat on state trust lands;

- selling or leasing land to other agencies for the development of new water projects; and
- purchasing new water assets that can be held by the SLB and leased to other state agencies.

History Colorado

Established in 1879, History Colorado is both a state agency under the Department of Higher Education and a 501(c)(3) charitable organization.⁵⁶ History Colorado is a trustee of the state and holds property on its behalf.⁵⁷

History Colorado Water Rights Inventory

History Colorado's water assets are a mix of surface, ground and leased rights. History Colorado's inventory identified and verified the following water assets:

Table 9.2-2. History Colorado Water Assests		
Type of Water Asset	Quantity	Uses
Leased Water Rights	2	Commercial, Domestic, Storage
Decreed Surface Water Structures	2	Augmentation
Decreed Groundwater Structures	7	Commercial, Domestic, Industrial, Irrigation, Geothermal

Uses of History Colorado's Water Rights

History Colorado uses its water rights in connection with the operation and maintenance of its museums and historic sites.

Actions

Based upon the information compiled in the state agency water rights inventory process, the state agencies discussed in this section are currently using their water rights in ways that accomplish their respective missions, benefit the state, and further the water values underlying Colorado's Water Plan. To further align state water rights with these values and maximize the use of these water rights to realize all possible benefits to the state, the following actions are necessary:

1. The CWCB will continue to work with state agencies to compile and update inventories of their water rights.
2. The CWCB and other state agencies will use the information resulting from the inventory as a basis for coordinating agencies' water right uses and potentially sharing water to provide additional benefits to the state. To accomplish this, the CWCB and other state agencies will:
 - a. Convene work groups comprised of multiple agencies' staff to identify opportunities to align the agencies' water rights to achieve additional benefits and where feasible, use those water rights to meet identified needs. For example, the CWCB and CPW can identify opportunities for releases from CPW reservoirs to be protected under the state's Instream Flow Program; and

- b. Conduct technical and legal feasibility analyses of identified opportunities for aligning or sharing agency water rights and advance feasible projects in a timely manner.
3. The CWCB will identify state-owned water rights within the Colorado River Basin and evaluate opportunities for these rights to assist with Colorado River Compact compliance. For example, the Animas-La Plata project contract between the Bureau of Reclamation (BOR) and the CWCB recognizes that the state's stored water right in the project could be used for compact compliance purposes. There may be other state resources like this one that could assist the state in complying with its obligations under the Colorado River Compact.
4. The CWCB will continue to schedule joint meetings with local governmental water management agencies around the state to facilitate information sharing and coordination on common water rights issues.
5. The CWCB will work with local stakeholder groups to determine where instream flow water rights could provide the greatest benefits, and assist such groups with the instream flow recommendation process.
6. The CWCB will partner in future multi-purpose projects as a water rights holder when such partnership is needed to ensure the success of the project and will further the water values in Chapter 1.
7. CPW will continue to work with the CWCB and interested stakeholders to maximize the use of CPW's water rights to help fill environmental and recreational gaps.

9.4 Creating More Efficient Permitting Processes

Colorado's Water Plan promotes more effective and efficient permitting by encouraging state agencies to work together and complete their work early in the permitting process. This will provide the opportunity for state endorsement without being pre-decisional.

Introduction

Governor Hickenlooper's May 2013 Executive Order reiterated what has been known for years in Colorado – the gap between our water supply and water demand is real and looming. While conservation is a key strategy to narrowing the gap across the state, it cannot solve the problem alone. In fact, scenario planning indicates that at least 80 percent (350,000 acre-feet) of already planned projects will need to be implemented,⁵⁸ and many of these will need to go through the permitting process. Ideally, the permitting process would ensure the implementation of projects that best meet Colorado's water values to support vibrant and sustainable cities, viable and productive agriculture, a robust tourism industry, efficient and effective infrastructure, and a strong environment. To ensure this, the permitting process needs review. To encourage this review, the Executive Order directed the CWCB to "streamline the state role in the approval and regulatory processes regarding water projects."⁵⁹

The purpose of this section is to explore how permitting in Colorado can be made more effective and efficient. The section describes the permitting and licensing processes that project proponents must currently go through, the challenges that arise during the process, and reforms that could help make the process more efficient and effective for all parties involved. The solutions proposed in this chapter mainly focus on how state processes can be more effective, and touches on the benefits that result from the cooperation among federal agencies, local governments, and stakeholders. The approach described in the chapter allows the state to endorse a project without predetermining the outcome of an environmental permit, certification, or mitigation plan.

Summary of the process for each process within water permitting

This section will briefly explain the processes project proponents are required to address to complete their project. A description of entities involved in permitting can be found in Section 2.4.

NEPA Process

The National Environmental Policy Act (NEPA) is a federal law that establishes the country's national environmental policies. To implement these policies, NEPA requires federal agencies to assess the environmental effects of their proposed actions before decision making. Citizen involvement through public disclosure and opportunities for public input is required as the environmental effects are evaluated.⁶⁰ Both of these requirements are fundamental to NEPA because they should lead to implementation of NEPA's policies:

“(a) The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical important of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

(b) In order to carry out the policy set forth in this Act, it is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may –

1. fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
2. assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
3. attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;

4. preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice;
5. achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and
6. enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

(c) The Congress recognizes that each person should enjoy a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment.⁶¹

NEPA's procedural requirements apply to all federal agencies and all federal agency decisions for actions including:

- Financing, assisting, conducting or approving projects or programs.
- Agency rules, regulations, plans, policies or procedures.
- Legislative proposals.

NEPA applies when a federal agency has discretion to choose among one or more alternative means of accomplishing a particular goal. For state water projects, the most common federal actions that lead to NEPA environmental review are a U.S. Bureau of Reclamation contract for storage of water in a facility managed by that agency, a U.S. Army Corps of Engineers ("Corps") Clean Water Act Section 404 permit, or a Federal Energy Regulatory Commission license.⁶²

The NEPA process begins when the federal agency determines there is the need to take an action. This determination may be made by the federal agency itself or may be brought to it by someone outside the agency, for example, through a permit application. The federal agency that will need to take the action is the lead agency and is the agency's responsible for compliance with NEPA. Depending on the circumstances, a joint lead agency and/or cooperating agencies can be identified to share in the responsibilities of completing NEPA environmental review. For many state water projects, an Environmental Impact Statement (EIS) process is required because significant environmental effects may occur if the projects are implemented.⁶³

Clean Water Act Section 404

Section 404 of the Clean Water Act (CWA) establishes a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. Activities in waters of the United States regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports) and mining projects. Section 404 requires a permit before dredged or fill material may be discharged into waters of the United States, unless the activity is exempt from Section 404 regulation (e.g. certain farming and forestry activities).

Under Section 404, no discharge of dredged or fill material may be permitted if:

- A practicable alternative exists that is less damaging to the aquatic environment, or
- The nation's water would be substantially degraded

Various federal agencies have different Section 404 roles and responsibilities. The Corps administers the day-to-day program, including individual and general permit decisions. The Corps also conducts or verifies jurisdictional determinations, develops policy and guidance, and enforces Section 404 provisions. The U.S. Environmental Protection Agency (EPA) develops and interprets policy, guidance and environmental criteria used in evaluating permit applications. EPA also determines the scope of geographic jurisdiction and the applicability of any exemptions, approves and oversees state and tribal assumptions, and reviews and comments on individual permit applications. EPA has the authority to prohibit, deny or restrict the use of any defined area as a disposal site, may elevate specific cases for further evaluation under Section 404(q), and enforces Section 404 provisions. The U.S. Fish and Wildlife Service evaluates impacts on fish and wildlife of all new federal projects and federally permitted projects, including projects subject to the requirements of Section 404. FWS also elevates specific cases or policy issues pursuant to Section 404(q).

An individual permit is required for activities that have potentially significant impacts. Individual permits are issued by the Corps, which evaluates applications under a public interest review, as well as the environmental criteria defined in CWA Section 404(b)(1) Guidelines, and NEPA policies and procedures. For most discharges that have only minimal adverse effects, a general permit is issued. General permits are issued on a nationwide, regional, or state basis for particular categories of activities. Large scale water projects require an individual Section 404 permit.⁶⁴

401 Water Quality Certification

Under Section 401 of the CWA, if an activity that requires a federal license or permit may cause any discharge into navigable waters, the applicant for the federal license or permit must obtain a 401 certification. The Water Quality Control Division is required by Colorado statute (C.R.S., §25-8-302(1)(f)) to review federal licenses and permits under Section 401 of the Clean Water Act. Colorado Water Quality Control Commission Regulation No. 82 (5 CCR 1002-82) authorizes the division to certify, conditionally certify or deny certification of federal licenses and it sets forth best management practices (BMPs) applicable to all certifications, with one exception, noted below.⁶⁵ Regulation No. 82 applies to division certification of CWA 404 permits issued by the U.S. Army Corps of Engineers (Corps), licenses for hydropower projects issued by the Federal Energy Regulatory Commission, and other federal permits involving a discharge including Clean Water Act Section 402 discharge permits issued by EPA.⁶⁶ The exception is for 402 discharge permits issued by EPA for facilities on tribal lands and for federally owned facilities on federal lands: for these facilities, EPA issues the 401 certification.⁶⁷ Individual certification review is not required for Section 404 general or nationwide permits issued by the Corps. These general or nationwide permits are certified under statute (C.R.S., §25-8-302(1)(f)) without additional conditions.

The division issues a section 401 water quality certification when it determines that there is reasonable assurance that both the construction and the operation of the project will comply with state surface and groundwater water quality standards and requirements. If the division concludes that the project will comply with the water quality standards and requirements, only if one or more conditions are placed on the license or permit, the division will issue the certification with the necessary conditions included.

Section 122.2

Colorado State Statute 37-60-122.2 (C.R.S.), known as the Fish and Wildlife Resources Fund and Authorization, declares that fish and wildlife resources are a matter of statewide concern and that impacts on such resources should be reasonably mitigated by applicants proposing water diversion, delivery, or storage projects. Applicants must submit a proposed mitigation plan to the Colorado Parks and Wildlife Commission for review and approval. If mutual agreement on the plan is reached by the applicant and the commission, the plan is forwarded to the CWCB for board adoption as the official state position on the plan. If the commission rejects an applicant's plan, it is still forwarded to the CWCB. If CWCB does not agree with the Commission, then the Governor decides whether or not to approve the plan. Once there is mutual agreement on the plan by the applicant and the Commission, the plan is forwarded to the CWCB for board adoption as the official state position on the plan. A plan is generally required when an applicant seeks a permit or license from the federal government for the specified types of water projects, with some exceptions as noted in the statute.⁶⁸ CWCB grants may be made available to applicants to help implement the mitigation plans. Criteria have been established for such grants for distribution when funds are available.⁶⁹ Examples of Section 122.2 plans that are completed or in process include Southern Delivery System (SDS), Windy Gap Firing Project, Moffat Firing Project, and Chatfield Reservoir Reallocation project.

Reclaimed Water Regulation

Colorado Water Quality Control Commission Regulation No. 84 (5 CCR 1002-84) and the Water Quality Control Division's reclaimed water program is designed to promote the use of reclaimed water in Colorado. It includes requirements for reclaimed water to meet minimal standards, and for treaters and users of reclaimed water to employ best management practices and oversee its use. This regulation applies to the use of reclaimed water for landscape irrigation, agricultural irrigation, fire protection, industrial, and commercial uses as detailed in the table below. The type of reclaimed water use triggers the treatment and best management practices required before and during use.

Table 9.4-1: Reclaimed Water Uses Authorized in Regulation 84	
Approved Uses	
Industrial	Evaporative Industrial Processes
	Washwater Applications
	Non-Discharging Construction and Road Maintenance
	Non-Evaporative Industrial Processes
Landscape Irrigation	Restricted Access
	Unrestricted Access
	Resident-Controlled
Commercial	Zoo Operation
	Commercial Laundries
	Automated Vehicle Washing
	Manual Non-Public Vehicle Washing
Fire Protection	Nonresidential Fire Protection

	Residential Fire Protection
Agricultural Irrigation	Non-Food Crop Irrigation and Silviculture

Regulation 84 requires treaters and users of reclaimed water to obtain and comply with a notice of authorization issued by the Water Quality Control Division. The notice of authorization contains the terms, limits, and conditions, deemed necessary to ensure compliance with Regulation 84.

1041 Local Permits

In 1974, the Colorado General Assembly enacted measures to further define the authority of state and local governments in making planning decisions for matters of statewide interest. These powers are commonly referred to as "1041 powers", based on the number of the bill of the proposed legislation (House Bill 74-1041). These 1041 powers allow local governments to identify, designate, and regulate areas and activities of state interest through a local permitting process. The general intention of these powers is to allow for local governments to maintain their control over particular development projects even where the development project has statewide impacts. The statute concerning areas and activities of state interest can be found in 24-65.1-101 (C.R.S.)

Generally, development may only proceed if consistent with the environmental and developmental goals of the local communities as outlined in their 1041 regulations.

Of particular interest to many local governments are impacts from the construction and operation of large-scale water projects. The Act authorizes local governments to designate as "activities of statewide interest" the site selection and construction of major new domestic water and sewage treatment systems, major extension of existing domestic water and sewage treatment systems, site selection and development of new communities, and efficient utilization of municipal and industrial water projects. Local governments may not pass regulations that are completely prohibitive of the building of municipal water facilities and expansion of existing projects. The Act allows the locality to require a permit with designated conditions before construction.

Past and Existing Colorado Efforts to Make the Permitting Process More Effective and Efficient

Over the years, there have been several attempts to coordinate the permitting process. The Colorado Joint Review Process (CJRP) was created by the general assembly in 1983 to improve the environmental permitting process primarily for energy development. The CJRP was never fully completed for any project.⁷⁰ It is not clear if this is because the energy industry collapsed, or if the process was not considered helpful. Many projects failed to proceed for economic reasons. The CJRP also coordinated the State's combined responses to major projects such as the review of the proposed Denver International Airport, the Two Forks veto, and Colorado's bid for the Super Conducting Super Collider. In 1996, the General Assembly allowed the CJRP legislation to expire.

Another attempt to have a coordinated review process was initiated in 2003 when Colorado's General Assembly established the Colorado Coordination Council through HB03-1323. The council was to be administered by the Executive Director of the Department of Natural Resources. It was a voluntary coordination process that sponsors could choose to use. The permitting areas allowed within the process included "extraction, use, conservation, transportation, or management of natural resources" that require permits, approvals or compliance from federal, state, or local

governments.⁷¹ This process was never used, and the statutes supporting the council were allowed to expire in 2013. According to the Colorado Department of Regulatory Affairs (DORA), which reviews statutes set to expire, “Very few outside, or even inside, the Colorado Department of Natural Resources (DNR) were aware of the Council’s existence. Indeed, most stakeholders contacted as part of this sunset review had never heard of the council... Those within DNR acknowledged that DNR conducted no outreach to inform the community of the Council’s existence and, to the best of anyone’s recollection, no one at DNR had ever suggested that a project sponsor utilize the Council.”⁷²

Recently, progress has been made through the use of Memorandums of Understanding (MOUs) among the State and various Federal agencies. While no formal legislation was passed to initiate the development of these MOUs it is important to recognize that these documents assist in creating a structure for the State and these respective agencies to work together with the intention of making a more coordinated permitting process.^c Additionally, although not formalized and signed progress has been made on a Collaborative Approach to Water Supply Permit Evaluation (CAWS) MOU, which would treat conservation as a demand reducer rather than as an alternative to the project. The process was initiated by the Colorado Department of Natural Resources to educate federal permitting partners about state planning and permitting issues.^d

There is the potential for recent legislation to further this progress. For instance the Hydroelectric Generation Incentives Bill (House Bill 14-1030) became law, and could help streamline the State’s role in the permitting process for small hydroelectric projects.^{e,73}

Despite the lack of an official coordinating statute for state and federal permitting entities to operate under, there is a great deal of coordination. Recently, Colorado Parks and Wildlife and the Water Quality Control Division have become cooperating agencies for several projects undergoing

^c Examples include the FERC MOU concerning collaboration with other federal permitting entities and the State and Forest Service MOU concerning coordination with the Colorado Department of Natural Resources and Forest Service.

^d Collaborative Approach to Water Supply Permit Evaluation (CAWS) MOU: Beginning in 2010, the Colorado Department of Natural Resources, U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers met to educate federal permitting partners about state planning and permitting issues. Out of that process, an MOU was developed concerning the utilization of conservation. Rather than conservation being considered as an alternative, it was agreed to that it would be factored into reducing demands as part of the purpose and need of the project. While this MOU has not yet been finalized, an important collaborative process was begun to help each agency understand opportunities and constraints that may inform the MOU and streamline processes in the future. Additional efforts will take place to revise and/or finalize the MOU as appropriate.

^e The Hydroelectric Generation Incentives Bill ([House Bill 14-1030](#)) passed through the Colorado State Legislature with large margins. At the time of writing this section, the bill has not yet been signed into law by the Governor. The purpose of the bill is to build off of the federal “Hydropower Regulatory Efficiency Act of 2013” and streamline the State’s role in the permitting process of small hydroelectric projects. It is not yet clear how effective this process will be, but one difference between this and past efforts is the narrow focus of the bill and the coordinating power given to one agency.

the Environmental Impact Statement (EIS) process of the National Environment Protection Act (NEPA). Project proponents indicated during the interview process for this section that this has been a helpful collaborative effort.⁷⁴ Furthermore, there has been increased coordination within the Colorado Department of Natural Resources.

Additionally, in 2012 the President issued Executive Order 13604 on “Improving Performance of Federal Permitting and Review of Infrastructure Projects.”⁷⁵ The involved federal agencies reportedly applied an expedited review process to fifty pilot projects, each project having an accelerated schedule with clear project review milestones and a designated lead coordinating agency, with project progress being tracked on a “Federal Infrastructure Permitting Dashboard.” The Dashboard contains an IT platform pursuant to which involved agencies may develop a cooperative schedule, share project documents and quickly communicate with one another as concerns arise.⁷⁶

Basin Roundtable and Interbasin Compact Committee Concepts Concerning Permitting

The IBCC’s no and low regrets action plan as well as the Basin Implementation Plans (BIPs) developed by the basin roundtables discussed permitting in depth. Of the eight BIPs, six discussed challenges or solutions. Table 9.4-2 at the end of this section quotes these important stakeholder sources.

While the individual statements in the table do not reflect the position of the State of Colorado, careful consideration of the challenges and solutions should be incorporated into future discussions.

Additional Stakeholder Outreach

To further understand the needs, issues and potential solutions for the permitting process, CWCB staff met with and interviewed a variety of water providers, environmental groups, state and federal partners. The following is a list of organizations CWCB met with or received comments from concerning permitting. In addition, several individuals provided comment, but are not listed.

Table 9.4-3: Stakeholder Input		
	Met with CWCB	Provided Written Comments
Colorado Department of Public Health & Environment (CDPHE)	X	
Colorado Parks & Wildlife (CPW)	X	
Colorado Attorney General’s Office (AGs Office)	X	
Colorado Division of Water Resources (DWR)	X	
Northern Colorado Water Conservancy District (NCWCD)	X	X
Trout Unlimited (TU)	X	
South Metro Water Supply Authority (SMWSA)	X	X
U.S. Army Corps of Engineers (USACE)	X	
U.S. Environmental Protection Agency (EPA)	X	

U.S. Bureau of Reclamation (BOR)	X	X
Federal Energy Regulatory Commission (FERC)	X	
Denver Water	X	X
Upper Yampa Water Conservancy District	X	
Northwest Colorado Council of Governments	X	
Western Resource Advocates (WRA)	X	X
Colorado Springs Utilities	X	X
Water Reuse Association	X	X
Aurora Water		X
City of Thornton		X
Front Range Water Council		X
Conservation Colorado		X
Colorado Wastewater Utility Council		X
Colorado Oil and Gas Association		X
Pikes Peak Regional Water Authority		X
Fountain Valley Authority		X

CWCB staff will continue to meet with state and federal permitting and licensing partners throughout the development of Colorado's Water Plan. Staff has gotten in touch with or is in the process of scheduling interviews with the following organizations:

- Ute Water Conservancy District
- Centennial Water & Sanitation District
- U.S. Fish & Wildlife Service
- Bureau of Land Management
- U.S. Forest Service
- National Resource Conservation Service (NRCS)
- Colorado Department of Agriculture
- Colorado Counties Incorporated
- Colorado Municipal League

Stakeholders across sectors desire improved coordination and increased early involvement, regardless of whether they represent environmental or utility interests. In many cases, stakeholders believed that these two aspects would shorten the time it took for permitting while not reducing the protections permitting affords to the environment. Other themes expressed by multiple stakeholders included the need to reduce duplication, increase resources, lower costs, unify methods, increase clarity, examine reuse permitting, improve quality of draft EISs, and encourage multi-purpose projects.⁷⁷

One common concept was to bring back something akin to the Colorado Joint Review Program described above.

The Northwest Colorado Council of Governments envisioned the process in the greatest detail, which is summarized below:

Because it is expensive, time consuming, and sometimes "work for the sake of work" for the applicant, regulators, local governments, and other stakeholders to participate in a NEPA process, the state should facilitate a joint review process before and during the NEPA process. This sort of "front loading" minimizes the costs to the applicant and other stakeholders because as early as possible, the applicant and regulators understand what concerns, impacts, and potential for mitigation are relevant in the areas affected by the project; and what will be necessary to satisfy federal, state and local laws and regulations.

This approach also improves the likelihood that alternatives, reports, and studies that are generated during NEPA will be more focused and responsive to actual, real world concerns, rather than reports and studies that are off the mark. Agreement can be reached on the scope of alternatives, reports and studies before the applicant/regulators spend money on consultants to prepare pounds of paper that ultimately are not necessary to satisfy NEPA, the regulators, or affected stakeholders.

Another important result of the process is that for each project, the joint review process would define the regulatory framework and where the overlaps between state local and federal processes are, so that they could be coordinated rather than duplicative or contradictory. This saves money for the applicant, the regulators, and the public concerned about the project as well as ensuring that permits can be issued more quickly.

Finally, it provides a forum to formulate agreements, like the Windy Gap Firing Project IGA, that result in projects that benefit the project proponent, the environment, and affected interests.

In order to be part of the joint review process, participants would have to agree to certain principals regarding rules of engagement. Those rules would require that the parties work in good faith, explain interests not take positions, among others.

The local governments from the areas that would be affected by the project should be responsible for identifying the appropriate local stakeholders and coordinating local input.

Critical input points during the process are during:

- 1) Scoping
- 2) Developing alternatives
- 3) Determination of methodologies and data gaps
- 4) Mitigation and enhancement plans

The Front Range Water Council suggests that Colorado use or modify the expedited federal permitting procedures and dashboard developed as a result of presidential executive order 13604 described above.

[Permitting Issues and Potential Process Improvements](#)

After reviewing the work of the IBCC, basin roundtables, and comments made from water providers, the conservation community, and various state and federal agencies, several common

potential process improvements emerged. Based on these discussions the following process improvements should be further explored:

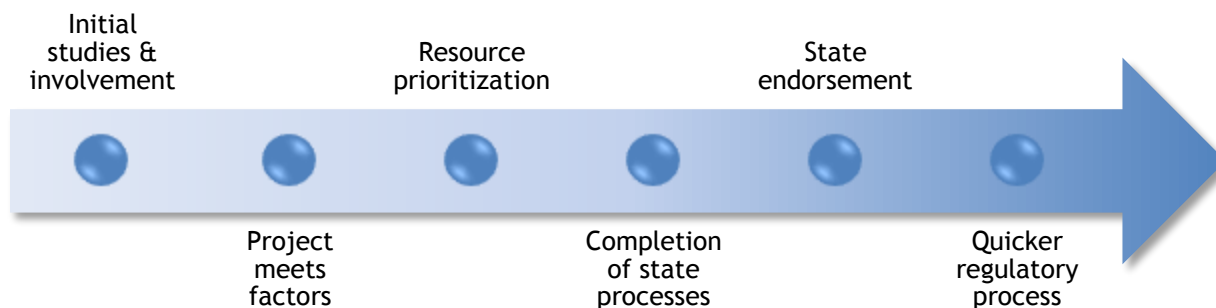
1. **Improve coordination**– eliminate redundant review efforts by different State agencies. Coordinate EIS document review across State agencies with the goal of increasing efficiency.
2. **Increase early involvement** – examine opportunities for state agencies, local governments, stakeholders, and federal agencies to get involved earlier in the NEPA process.
3. **Coordinate technical methods** - reduce duplication of technical methods across state agencies, respecting the various authorities and obligations within existing law.
4. **Increase state and other resources** – the length of time to complete the required environmental reviews should be shortened while maintaining a robust decision-making process. At the beginning of permitting process the State should evaluate potential future staff demands and associated resources to complete the reviews in a timely manner.
5. **Increase clarity** - increase understanding of information required for environmental reviews. Identify required technical elements, assessment methodology and results of reporting of environmental parameters, including hydrology, conservation, scenario planning, water quality status and designated uses, modeling applicability, and risk tolerance. Understand the role of conservation in purpose and need documentation. Develop a State certification and mitigation handbook for project proponents and stakeholders.
6. **Improve the quality of Draft EIS documents** – this would allow for State certification and mitigation plan process to be completed more efficiently. Emphasize issue identification earlier in the EIS process.
7. **Encourage multi-purpose projects** – incentivize projects with multiple objectives such as municipal, industrial, hydropower, environmental, recreation and agricultural purposes. The State should work with project proponents and other beneficiaries to explore opportunities to streamline permitting processes and to equitably allocate mitigation responsibilities.

Potential Conceptual Framework for State of Colorado Support of a Project

The State of Colorado could develop a pathway for a water project to receive a State endorsement and facilitate a quicker regulatory process (Figure 9.4-2). This could be achieved by identifying milestones and decision points at the beginning of the process. Such a process must be designed to reduce rather than increase regulatory burdens on project proponents.

For the first draft of Colorado's Water Plan, a conceptual framework is explored below for the purposes of more discussion among state agencies and stakeholders during the year of the draft.

Figure 9.4-1 Conceptual framework for a project to receive State endorsement



Initial Studies and Stakeholder Involvement

If technical or financial support is being sought for initial planning, feasibility studies, or initial stakeholder involvement priority should be given to projects that:

- Meet the goals and measurable outcomes identified in the BIPs,
- Have a project proponent,
- Meet an identified need, and
- May be built within the next fifteen years

Preference should also be given to projects that seek to be multi-purpose, have multiple partners, and collaborate with a broad set of local stakeholders.

Project meets factors

Project proponents who participate in the cooperative approach should commit to factors that align the project with Colorado's Water Values (see Section 1):

- ✓ Addresses an identified gap through one of the following:
 - Is identified in a Basin Implementation Plan,
 - Meets a defined need in a Basin Needs Assessment,
 - Meets a defined need in the Statewide Water Supply Initiative, or
 - Is identified as being needed as part of no and low regrets
- ✓ Demonstrates sustainability

- Provides a conservation plan or plans aimed at reducing demands
- Includes environmental mitigation and enhancements in the planning phase,
- Mitigates or avoids impacts to or enhance water quality, and
- Mitigates or avoids impacts on agricultural and rural community^f
- ✓ Involves local government consultation
- ✓ Includes a stakeholder and public input process
- ✓ Establishes fiscal and technical feasibility

State Resource Prioritization

If more state resources become available, these factors could allow for the state to commit to a resource-intensive approach at the beginning of the permitting process. This would include coordination with local governments and stakeholders as well as be cooperating agencies through the federal permitting process. Cooperation would need to occur at critical decision points, including scoping, methodological review, alternatives analysis, and development of mitigation and enhancement opportunities. In addition, this process could use a coordinated dashboard approach, defining goals, timelines, and necessary permits. Existing regulations suggest that a coordinated approach is allowable under state existing law. For instance, regulation number 82.5(C)(2) states, “Where possible, the 401 certification process should be coordinated or consolidated with the scoping and review processes of other agencies which have a role in a proposed project in an effort to minimize costs and delays for such projects.”⁷⁸

Preliminary Technical Review for State Processes

The state has an obligation to be a neutral party so as not to be pre-decisional in 401 certification and wildlife mitigation plan processes. If state processes are coordinated during the draft EIS, then the EIS would more fully encompass and address state concerns, resulting in a high quality product. In this case, much of the state’s review work could be done prior, during, and immediately after the Draft EIS process. Review of comments from stakeholders and local government on the DEIS would give the state a good idea on support of the project and /or any outstanding issues related to the project. The goal would be to complete preliminary or contingent 401 certifications and wildlife mitigation plans before the final EIS. Because the specific project that is ultimately approved through the NEPA process must be certified through the 401 certification process, final certification cannot be issued before the completion of the final EIS. However, if state processes are coordinated during the draft EIS, as noted above, then, unless the details of a project change in such a way that it would impact water quality, the final certification could be completed shortly after the final EIS is issued.

State Endorsement

Once State Processes are complete, state endorsement is possible without being pre-decisional.

^f This could take the form of an agricultural impact statement.

Quicker Regulatory Process

Such state endorsement would allow the state to encourage completion of the final EIS and record of decision.

Actions

One of the main purposes of the Colorado's Water Plan is to find ways to support the implementation of the Basin Implementation Plans. Increased efficiency in the permitting process, while not predetermining the outcome and supporting the statutory and regulatory requirements of each permitting agency, is a significant way to assist project proponents. While the decision could be "yes" or "no," having a decision, no matter the outcome, would be beneficial to the state planning process and help remove uncertainty. The actions below help to find efficiencies where possible and increase coordination. In addition, these actions will provide an incentive that encourages multi-purpose projects with many partners, especially for project proponents that meet Colorado's water values, such as enhanced conservation and efficiencies. In addition to the chapter of the water plan, a handbook will be developed, which details the status quo and a "new" joint review process. The following actions are needed to support these efforts:

- CWCB will coordinate the development of a permitting, certification and mitigation handbook in partnership with local, state, and federal agencies.
- The Department of Natural Resources will work with state and federal partners to finalize the CAWS MOU, which factors conservation in as a demand reducer.
- The Department of Natural Resources will form a task force to study, draft recommendations, and, where appropriate, implement ways to improve State coordination in the permitting process. Members of the task force will include all State agencies that have any involvement in the permitting process associated with water projects, including reuse projects. The goal of the task force will be to examine potential process improvements, and the potential conceptual framework for State of Colorado support of a project described above, taking into account stakeholder input received and permitting program directives. The task force deliverable will be a set of guidelines and recommendations that define ways to help state agencies coordinate with each other, federal permitting agencies, local governments with 1041 powers, and other stakeholders. Frequent consultation with these entities will be needed throughout the process.
- CWCB will continue to gather technical information and stakeholder input to explore how to make the permitting process more effective and efficient based off of the potential process improvements described above.
- The State of Colorado will explore option for adding CDPHE and DNR staff and other resources to support a more efficient and effective permitting process.

Table 9.4-2: Summary of IBCC No and Low Regrets Action Plan and Basin Implementation Plan Comments on Permitting ⁷⁹		
IBCC & BRTs	Challenges	Solutions
Interbasin Compact Committee No and Low Regrets Action Plan	"Needs assessment work conducted as part of the Statewide Water Supply Initiative (SWSI) determined that every basin in Colorado will have a gap in water supply by 2050... Expedited permitting processes for IPPs that are in line with the values of the CWP will ensure that important projects move forward in a timely manner."	As part of the no and low regrets action plan, the IBCC considered several potential actions in relation to permitting: As part of the no and low regrets action plan, the IBCC considered several potential actions in relation to permitting: • "Streamline state permitting processes for IPPs that meet values of the CWP: The Executive Order directs the CWP to help expedite permitting at the state level. The state should develop an approach to permitting IPPs that efficiently moves projects through the process and toward an outcome, whether positive or not, while ensuring sufficient protection of nonconsumptive and other values. Public engagement and community outreach regarding water supply needs may need to increase in affected communities to facilitate an efficient permitting process." • "Continue state coordination with the federal permitting entities: The state should continue to meet with federal agencies and look for opportunities, including entering into MOUs, to make NEPA and permitting processes more efficient, especially for projects that meet the values of the CWP and are needed across multiple scenarios. Efficiency would not dictate whether the outcome of the positive is positive or not." • "Support local permitting authorities to identify, as requested, multi-purpose components up front in a project planning to incorporate county and local concerns." • "Upon request of a project proponent, encourage legislative resolutions in support of IPPs that meet the values of the CWP: CWCB and the IBCC should work with the Legislature to develop and pass resolutions in support of specific IPPs that meet the goals and values of the CWP and have demonstrated broad stakeholder support. However, legislative resolutions supporting specific IPPs should not occur until the project 1) aligns with the goals of the CWP, 2) has broad stakeholder support, and 3) has substantively completed the state permitting process. These resolutions can be simple statements of support or more complex efforts to help specific projects through the permitting process, but they should not seek to override or supplant local decision-making or the protection of nonconsumptive or other values." • "Publicly advocate for IPPs that meet the values of the CWP and have stakeholder support: CWCB, members of the IBCC and the Basin Roundtables, and the Governor should actively and publicly advocate for IPPs that meet the values of the CWP and have demonstrated broad stakeholder support. However, public advocacy for specific IPPs should not occur until the project 1) aligns with the goals of the CWP, 2) has broad stakeholder support, and 3) has substantively completed the state permitting process. This advocacy should seek to convince decision-makers at all levels and the general public that permitting and implementing these IPPs is critical to meeting Colorado's water supply needs while maintaining our agricultural heritage, healthy environment, and recreational economies." • "Water providers that meet a certain threshold of conservation savings or best practices implementation could be offered state support and/or the facilitation of certain permitting approvals."

Arkansas BIP	"Significant challenges exist to achieving the storage goals of the Arkansas Basin, including government permitting, regulation, competing stakeholder interests, and reluctance of storage site owners to take on further responsibility."	No permitting solutions mentioned.
Colorado BIP	"Regulatory restrictions, high costs and variable geologic conditions have prevented proceeding with these conditional storage rights." "Water providers must recognize the change in permitting that has occurred and that has resulted in the lengthy and costly regulatory requirements for reservoirs. Rather than undertake this risk with no assurances of approval, water providers should consider other alternatives."	"This BIP recommends that State, Federal and Local regulatory jurisdictions work collaboratively to improve the permitting process." "Improvements to the permitting process to support new water supply projects are imperative in securing safe drinking water in the future." "Secure 401 certification for specific places prior to a Record of Decision (ROD) by the Army Corp of Engineers, through a coordinated permitting process that includes all permitting agencies, including local government" Measurable Outcome: "Reduced average permitting time for reservoir project to under 10 years" "Improve inefficiencies in reservoir permitting process between federal agencies and promote revisions and best management practices (BMPs) to improve process timeline and cost" "Further research needs to be conducted that will evaluate the reservoir permitting process and provide recommendations on improvements."
Gunnison BIP	Several of the project sheets list permitting as a constraint and challenge. In these cases, the text typically reads: "Issues limiting project implementation may include: Regulations – permitting requirements may limit construction activities and potentially increase cost and timing."	"Due to the numerous benefits to future water resource projects, the Gunnison Basin Roundtable recommends the reinstatement of a process similar to the Colorado Joint Review Process or Colorado Coordination Council." In Strategies to address regulations, the following bullet points are included to streamline permitting or develop collaborative solutions: • Collaborate with CWCB to identify technical support mechanisms for Federal permitting activities • Identify methods to proactively address potential regulatory pitfalls that generate excessive time delays and added costs • Identify methods to streamline regulatory processes between multiple agencies with proactive, time-dependent deadlines • Collaborate with CWCB to identify financial support mechanisms for Federal permitting activities "Better management tools will optimize projects to meet multiple needs, minimize cost, and protect public

		health and safety. An example of this is the Extreme Precipitation Analysis Tool (EPAT). Reservoir storage restrictions currently cost the state some 74,000 acre feet in lost storage opportunities. An updated EPAT would provide cost savings by minimizing necessary dam spillway sizes and would streamline the permitting process."
North Platte BIP	Regulations can be a constraint to securing acceptance of a project. Since a large amount of the land in the North Platte Basin is under federal ownership, permitting issues can impact project feasibility, cost, and schedule.... Regulatory bureaucracy and environmental impact requirements may significantly delay project timelines, increase costs and ultimately limit the ability of a project sponsor to implement a proposed project, regardless of the relative size of project scope. Regulatory streamlining and cooperative strategies may help address regulatory constraints."	In Strategies to address regulations, the following bullet points are included to streamline permitting or develop collaborative solutions: • Collaborate with CWCB to identify technical support mechanisms for Federal permitting activities. • Identify methods to proactively address potential regulatory pitfalls that generate excessive time delays and added costs. • Identify methods to streamline regulatory processes between multiple agencies with proactive, time-dependent deadlines. Collaborate with CWCB to identify financial support mechanisms for Federal permitting activities.
Rio Grande BIP	No permitting challenges mentioned.	No permitting challenges mentioned.
South Platte and Metro BIP	"In order to be developed, water supply, infrastructure, and treatment projects must go through a myriad of federal, state and local permitting processes which are both time and resource intensive. Improving the efficiency of current federal and state permitting	"The State of Colorado could support a more efficient EIS process for water supply projects.... Greater efficiency, cooperation, predictability, and consistency in the permitting process could be achieved by establishing guidelines for what the lead federal agency and all state and federal agencies involved in the process require for approval. Efficiency and predictability of the permitting process could be further enhanced by the State compiling agreed upon ranges, tools, and methodologies for assessing contentious topics such as hydrology modeling, system risk, conservation as a demand reducer, and others." • "To increase the efficiency, consistency, and predictability of the EIS process, the State could work cooperatively with Federal agencies to develop a Programmatic EIS. Colorado's Water Plan could be used as the platform for a Programmatic EIS. Under a Programmatic EIS, no specific projects are

	requirements has the potential to save the public money while providing the same assurance of quality and due diligence. The Executive Order cites this issue and calls for the identification of potential areas of improvement in CWP. The intent is not to reduce existing environmental protections but to obtain permitting decisions in a more timely and cost effective manner with a more predictable process for federal and state engagement."	approved, but it would create an analysis from which future specific approvals can rely." • "Starting in 2010, the Corps, Colorado Department of Natural Resources (DNR including CWCB), and the US Environmental Protection Agency (EPA) embarked upon a process called Collaborative Approach to Water Supply Permit Evaluation (CAWS). The major outcome of CAWS was an informal agreement among the three parties that conservation should be used as a demand reducer in analyzing the purpose and need for a project rather than during the alternatives analysis portion of the NEPA process. Though this informal agreement was not publicly documented, an important policy tool going forward could be the use of conservation as a demand reducer in the purpose and need segment of the EIS process. By doing this, water providers will have greater incentive to implement proactive conservation strategies to demonstrate decreased demand and strain on existing resources." • "Scoping for 404 or NEPA permitting must follow federally required processes. Delays often result when new areas of analysis are identified late in the permitting process after scoping has occurred. By ensuring that regulating agency concerns are addressed in their entirety during the scoping process, applicants can more accurately plan for the costs associated with the analysis and avoid delays." • "The state of Colorado could encourage the Corps and EPA Region 8 to revise their 1990 memorandum of agreement (MOA) on sequencing. Their current MOA says that the Corps must determine the Least Environmentally Damaging Practicable Alternative (LEDPA) first and then look at compensatory mitigation to authorize the LEDPA. A revision would enable public works projects to use compensatory mitigation in the identification of the LEDPA. This revision could be limited to public works projects." • "The State of Colorado's requirement for 401 certification and an approved Wildlife Mitigation Process could be improved to provide project proponents greater certainty in project planning. Earlier starts for these approval processes could effectively utilize information from the Federal Process to save project proponents and the citizens of Colorado time and money while allowing for greater certainty of project implementation."
Southwest BIP	No permitting challenges mentioned.	No permitting solutions mentioned.
Yampa/ White/Green BIP	No permitting challenges mentioned.	"Develop methods to assist with streamlining permitting in a cost-effective manner." "Success in permitting and constructing in-basin storage projects."

9.5 Outreach, Education, and Public Engagement

Colorado's Water Plan provides technical and financial assistance for high quality, balanced, and grassroots water education and outreach efforts that inform Coloradans about the issues so they engage in determining Colorado's water future.

To achieve a sustainable water future, Coloradans must be sophisticated water users. Colorado's Water Plan expands outreach and education efforts that engage the public and promote community discourse around balanced water solutions. The plan addresses a number of topics that would benefit educated water consumers including increased conservation, reuse, preservation and enhancement of the natural environment, multi-purpose water projects, and other efforts to meet our future supply gap. Section 9.5 focuses on the extensive work that has already occurred to help educate and engage local stakeholders and the public in the formation of basin implementation plans (BIPs) and Colorado's Water Plan. Moreover, this chapter charts a path to expand this work in the future.

Coloradans are paying more attention to water issues today and are becoming increasingly aware of the limitations of Colorado's water supply. In a recent survey, more than two-thirds of those polled believe that Colorado does not have enough water for the next 40 years.⁸⁰ Despite concerns, most residents are unaware of the main uses of water in the state and are uncertain of how to best meet Colorado's future water needs.^{81, 82}

Outreach creates public awareness of policies and processes, whereas **education** promotes a deeper understanding of these topics. Both are prerequisites to **public engagement**.

Natural disasters—including more than a decade of systemic drought, the catastrophic wildfires in 2012 and 2013, and the flooding on the Front Range in 2013—have increased the public's sense of urgency and desire to get involved in water issues. Outreach, education, and public engagement helps ensure that Coloradans have access to accurate information and are empowered to participate in stakeholder decision-making processes.

The development of Colorado's Water Plan is a unique opportunity to build on past efforts. In conjunction with statewide outreach and education by the Colorado Water Conservation Board (CWCB), the nine basin roundtables held more than 125 meetings to engage the public as they developed their BIPs. Additionally, many water providers, watershed groups, schools, districts, and authorities offer many ongoing water education activities. The recommendations in this section of Colorado's Water Plan involve strategies designed to continue to advance these outreach, education, and public engagement efforts and enhance the overall water supply planning process.

9.5.1 Overview of Outreach, Education and Public Engagement Related to Water Supply Planning in Colorado

Overview of Water Outreach, Education, and Public Engagement in Colorado

Colorado has a long history of water education. As early as the 1800s, explorers on the Pike and the Long expeditions through Colorado shared their experiences in the region and warned westward settlers of the limited water supply.⁸³ Following John Wesley Powell's historic 1866 journey down the Colorado River, Powell brought his concerns on water supply "west of the hundredth meridian" to Congress.⁸⁴ Now, more than 150 years later, water education is evolving to meet the needs of a population whose direct interactions with water resources and supply are far less than in the past. Currently, there are nonprofits solely dedicated to water education and water providers working with school districts to engage younger generations in smart water use.

Previous and Ongoing Efforts and Research

The Colorado Foundation for Water Education (CFWE) was created by the General Assembly in 2002 to promote a better understanding of Colorado's water resources and issues. CFWE is a nonpartisan, nonprofit organization that provides, "basic water information and educational programming, but also enhances leadership among water professionals, creates networking opportunities, helps advance the water planning dialogue in the state, and reaches out to those who aren't already involved in the world of Colorado water"⁸⁵.

The Public Education, Participation, and Outreach (PEPO) Workgroup was established in 2005 through the *Colorado Water for the 21st Century Act* to support the Interbasin Compact Committee (IBCC) process. The PEPO Workgroup operates by basin and informs, involves, and educates the public about the IBCC's and basin roundtables' activities and negotiations.⁸⁶ In addition, the workgroup is tasked with creating a mechanism for providing public input to IBCC and roundtable members. IBCC representatives, education liaisons from each basin roundtable, and other key stakeholders in the water education community comprise the PEPO Workgroup. Under direction and funding through CWCB, CFWE has facilitated the PEPO workgroup since 2008.

Led and funded by the CWCB, several PEPO Workgroup members and the Colorado Watershed Network joined forces with the Colorado Alliance for Environmental Education and other water outreach specialists in 2008 to form a group called the Water Education Task Force. The task force sought to better understand the status of water education in Colorado and published a report containing recommendations for improvements in water education in Colorado that include:

- supporting a statewide public education initiative;
- developing information and communication tools that can be used statewide;
- establishing long-term funding for intrastate and interstate collaboration opportunities;
- coordinating efforts across state agencies; and
- increasing coordination with the Colorado Department of Education on K-12 water resource content.⁸⁷

CFWE assumed management of the Water Education Task Force after the report was published in 2008. CFWE established a partnership workshop that carried out several recommendations

through the Colorado Water 2012 campaign, a celebration of water—past, present, and future. Colorado Water 2012 leveraged hundreds of passionate volunteers, nonprofits, and other organizations to raise awareness about water, increase support for management and protection of Colorado's water, showcase exemplary models of cooperation and collaboration, connect Coloradans to their water, and motivate them to participate in planning the future of their water resources.⁸⁸ The group commented on Colorado Department of Education's revision of state content standards, developed a teacher training program, and set the stage for the Value of Water project.

There are numerous efforts that address public engagement in Colorado's water supply issues. Below are just a few examples.

State Agencies: Many Colorado state agencies conduct water education. These agencies also offer funding for outreach and education efforts and have developed their own programs.

- The Water Quality Control Division (WQCD), an agency of Colorado's Department of Public Health and Environment (CDPHE), funds outreach efforts on water quality through Section 319 of the "Clean Water Act" of 1972.
- Colorado Parks and Wildlife (CPW) has many education programs that focus on youth engagement in water issues. The agency funds the Colorado River Watch program, in partnership with the Colorado Watershed Assembly, which supports student volunteers who collect data on water quality and watershed health throughout the state.⁸⁹ Parks and Wildlife also supports Project WILD, which engages students in environmental education and conservation.⁹⁰
- The CWCB funds and coordinates stakeholder outreach through the basin roundtable process. The CWCB provides education funding through their Water Efficiency Grant Program and also helps to fund CFWE. In 2013, the CWCB hired an outreach, education, and public engagement specialist to manage these efforts.

Statewide Nongovernmental Organizations (NGOs): Various nonprofit organizations with a statewide reach have water education programs. These groups have specific target audiences and distinct objectives related to water supply planning.

- CFWE is a source of balanced water education for all Coloradans.
- Colorado Water Congress provides leadership on key water resource issues and is the principle voice of Colorado's water community.
- The Colorado Watershed Assembly collaborates with diverse stakeholders to protect and improve the conservation values of land, water, and other natural resources of Colorado's watersheds.
- The Colorado WaterWise Council provides resources to stakeholders in the water efficiency and conservation community.
- The Colorado Foundation for Agriculture provides Colorado educators with current information about state agriculture and natural resources.
- There are many membership-based, environmental and recreational nongovernmental organizations, such as Conservation Colorado, Trout Unlimited, the Audubon Society,

Nature Conservancy, and Western Resource Advocates that provide outreach and education to their members on many environmental issues. This list is not fully inclusive.

Universities: There are also several institutions of higher education actively involved in water supply planning, research, dialogue, and education.

- Colorado Water Institute and Colorado Climate Center at Colorado State University, Western State Colorado University, the One World One Water Center at Metropolitan State University of Denver, and the Water Center at Colorado Mesa University are all engaging students, faculty, and the greater community in water issues.
- The Mesa Water Center assisted the Colorado and Gunnison Basin roundtables in their outreach and educational efforts.

Regional and Local: Many of Colorado's conservancy and conservation districts, water providers, and water utilities operate public outreach and education programs to inform and educate a variety of audiences (including customers, news media, and elected officials) about water supplies, conservation, drought, regulations, rebates, watershed protection, capital improvement projects, water quality testing, and many other important local issues.

- Denver Water has developed a successful water conservation and public education program that encourages reduction in daily water use through behavior-change and permanent fixture and landscape retrofits. Denver Water uses community based social marketing and media in addition to more traditional campaign methods like advertising.
- The City of Grand Junction, Ute Water Conservancy District, and Clifton Water District collaboratively run a similar conservation-based outreach program known as the Drought Response Information Project which helps water providers conduct public outreach and education activities about drought and the Drought Response Plan.
- The Rio Grande Watershed Conservation and Education Initiative provides conservation education to the San Luis Valley community to promote stewardship of natural resources.
- The Roaring Fork Conservancy brings people together to protect rivers through watershed action and education.
- The Water Information Program is sponsored by water districts and agencies in the Dolores/San Juan River Basin and provides general information to the public on water topics. The Water Information Program has assisted the Southwest Basin roundtable in educating the region about local and statewide water issues and found in it is the longest-standing program of its kind.
- The Rio Grande Watershed Conservation and Education Initiative assisted the Rio Grande Basin roundtable in their engagement efforts along with many other education programs.
- Aurora Water's Water Conservation Program offers web-based instructional material and in-person classes in xeriscape landscaping, irrigation systems, landscape maintenance, alternatives to turf grass, and vegetable gardening to its customers.

K-12 Education: Water providers such as statewide administer several K-12 programs. All of these programs use education and outreach to help address specific water supply issues, many of them aimed at educating the public on how to reduce municipal and agricultural water use across the

state. Numerous other efforts through water conservancy districts reach thousands of students each year at children's water festivals and special initiatives with area school districts. Below are a few examples.

- The South Metro Water Supply Authority's Water Ambassador Program trains high school students to teach fifth graders about watershed health.
- Aurora Water reaches more than 6000 students a year with K-12 education programs providing classroom presentations, assemblies, and field trips.
- Boulder and Aurora school districts partners with the U.S. Forest Service to train teachers on water education through the "Forests to Faucets" workshops.
- Project WET (Water Education for Teachers) is a national program that trains teachers in Colorado how to educate their students about water. Several local organizations sponsor Project WET trainings throughout Colorado, and the national program has developed curriculum that is specifically applicable to different regions in Colorado.

9.5.2 Review of Outreach, Education, and Public Engagement Activities during Development of Colorado's Water Plan

Colorado's Water Plan outreach, education, and public engagement efforts are unprecedented and build on a decade of stakeholder involvement. Because Colorado's Water Plan rests upon stakeholder engagement, it is critical to demonstrate education and outreach efforts to date and to further expand them in 2015. This is a grassroots effort and this section demonstrates the high level of local and volunteer efforts to reach out to the public.

Background and Overview of Statewide Outreach, Education, and Public Engagement Activities

Throughout the development phase of Colorado's Water Plan, public engagement, coupled with consistent and clear communications, was crucial. Both statewide and within each basin, information was distributed to the water community, to interested stakeholder groups, and to the general public. These activities built upon the strong foundation of outreach efforts by the basin roundtables and the CWCB through the PEPO Workgroup over the past nine years. The CWCB developed an Outreach and Communications Plan in September 2013 to provide a cohesive strategy and structure for all Colorado's Water Plan communications and outreach activities. The outreach and communications plan was crafted around four clearly defined goals, listed below. Table 9.5-1 provides a review of the methods used to achieve those goals. Following the table is an analysis of the input generated from these activities.

The outreach and communications plan goals are:

- to engage the public and to create general public awareness and dialogue about Colorado's Water Plan and its role in ensuring a secure water future for Colorado;
- to build support within the water community for Colorado's Water Plan and increase the level of understanding of the plan and its components;
- to proactively identify and address issues that may create barriers to success for Colorado's Water Plan and mitigate/manage negativity; and

- to share the responsibility of implementing and executing communications about Colorado's Water Plan across CWCB leadership and key stakeholders to foster a collective voice.

Table 9.5-1: Methods Used by the CWCB to Achieve Goals Outlined in Colorado's Water Plan Outreach and Communications Plan

Basin Roundtable Engagement	In addition to regular CWCB attendance and participation at basin roundtable meetings, CWCB staff worked together with the basin roundtables to develop communications materials and messaging about Colorado's Water Plan. Much of this work happened through the existing PEPO Workgroup. Basin roundtable education liaisons partnered with BIP consultant teams to create opportunities to share information regarding the BIP development process and how it relates to Colorado's Water Plan.
Grassroots Stakeholder Group Outreach	The CWCB established and used a database of key community, civic, and water organizations (e.g., Chambers of Commerce, Colorado Municipal League, Water Congress, and regional advocacy groups, among others) with established communications networks (websites, newsletters, email updates, etc.) and partnered with them to distribute Colorado's Water Plan materials. The CWCB engaged these groups in the development of the plan and assist designated information to their constituents. These groups also provided important speaking opportunities at various meetings and gatherings.
Public Input and Response	In all communication materials related to Colorado's Water Plan, public input was actively solicited. A public comment form was built into the Colorado's Water Plan website and a new email account, cwaterplan@state.co.us, was established specifically to receive input on Colorado's Water Plan. Guides for submitting public input were created for key stakeholder groups and posted online. All comments received via Colorado's Water Plan website or by email were provided to the CWCB Board members. CWCB staff member responses and recommendations regarding all input, based on Board feedback, are available for review online. In addition, members of the public were encouraged to engage directly with their basin roundtables.
Opportunities for Public Comment at CWCB Board Meetings	At each meeting of the CWCB, an opportunity for public input was provided to encourage comment regarding Colorado's Water Plan. Interested parties gave presentations at the March, May, July, September, and November 2014 meetings of the CWCB. Members of

	the CWCB also responded to those making comments during the meetings. These opportunities will continue in 2015.
Media Relations	CWCB worked with the press to clearly articulate Colorado's Water Plan development process and to establish an initial foundation of knowledge and awareness in the media. This included CWCB produced op-eds, news releases and other means, and spokespeople.
DNR/CWCB/IBCC Leadership Presentation Circuit	Meetings with the Department of Natural Resources (DNR), CWCB, and IBCC leadership helped enhance understanding of and build support for Colorado's Water Plan in the water community. CWCB identified over 100 key organizations and individuals, listed in Appendix E, throughout the state for one-on-one meetings or group briefings regarding Colorado's Water Plan.
Speaker's Bureau	In coordination with the IBCC and the basin roundtables, CWCB identified representatives from geographically diverse areas who spoke about Colorado's Water Plan in various forums across the state. This included engaging key partners (e.g., agricultural and municipal water providers). CWCB prepared a master calendar of events to promote existing opportunities to reach key stakeholders. CWCB arranged speaking engagements, and developed materials and training sessions for spokespeople.
Branding	CWCB developed an overarching brand (logo, templates, and consistent look and feel) that reflected Colorado's Water Plan purpose and values.
Digital Engagement	CWCB developed a robust online presence for Colorado's Water Plan that served as a hub for stakeholders and the public to obtain information, subscribe to updates, provide input, and get involved with the process. This strategy included a Colorado's Water Plan website, social media channels, and targeted email campaigns tied to key milestones such as the release of the BIPs.
Social Media	CWCB created Facebook and Twitter accounts and integrated them into the Colorado's Water Plan website. CWCB launched and promoted the accounts through a variety of channels, including the website and email campaigns. These social media tools continue to provide an informal and interactive venue for dialogue and the exchange of ideas. CWCB staff monitor and administer these accounts and regularly post relevant information, answer

	questions, and participate in the conversation.
Print Materials	CWCB developed a suite of printed materials. The materials are available for download on the Colorado's Water Plan website and were distributed as to community at speaking engagements and conferences.
Key Meeting Outreach and Follow-Up	As appropriate, staff conducted targeted pre-event outreach and follow-up to increase stakeholder attendance at important events and created opportunities for additional interaction and dialogue.

Input Generated on Colorado's Water Plan Between September 2013 and September 2014

Since work on the first draft of Colorado's Water Plan began in September 2013 through October 10, 2014 the CWCB received, reviewed and responded to over 13,000 comments for consideration in the 2014 draft of the plan. Those comments included over 780 unique email submissions, 120 webforms submitted through Colorado's Water Plan website, 121 handwritten comments, and 322 typed letters. Over 180 documents were also reviewed. To date, CWCB staff members have met with over 100 organizations, agencies, and other partners statewide regarding their involvement in the development of Colorado's Water Plan. A list of those organizations is included in Appendix E.

Pursuant to SB14-115, the Water Resource Review Committee held public hearings in each basin for comment on Colorado's Water Plan.⁹¹ Input submitted to the CWCB on November 1, 2014 included over 200 public comments.

How is public input being included in the development of Colorado's Water Plan?

Input submitted by email to cowaterplan@state.co.us or through the webform on Colorado's Water Plan website, is read by CWCB staff, who then identify which section of Colorado's Water Plan each comment addresses and draft a tailored response. All input is catalogued and presented at the subsequent CWCB Board meeting and can be found on www.coloradowaterplan.com under the "Get Involved" tab, on the "Record of Input Received to Date" page. Public input is considered as CWCB staff continue to revise the draft components of Colorado's Water Plan, including the framework, the Guides for Public Input, and several draft chapters and sections of Colorado's Water Plan. Updated draft chapters and sections will be re-released in November 2014 for final review before submission of the first draft of Colorado's Water Plan to the Governor on December 10, 2014. Input will continue throughout 2015 before the final version of Colorado's Water Plan is submitted to the Governor on December 10, 2015. The CWCB will also continue to forward input related to specific basin roundtables to the basin outreach teams.

Colorado's Water Plan Website

Colorado's Water Plan website launched on November 1, 2013 to provide outreach and education resources on Colorado's Water Plan. The CWCB promotes the website through social media, CWCB staff presentations, and publications related to Colorado's Water Plan. To date there has been a steady rise in the number of people visiting the website each month. Through November 7, 2014 there were nearly 10,000 unique visitors to the website.

The website will continue to be the primary access point for the public to review draft versions of Colorado's Water Plan. Other documents and information will continue to be made available on the site, including the BIPs, all input on Colorado's Water Plan received directly by the CWCB, and the formal responses provided to commenters by the CWCB.

Background and Overview of Basin Outreach, Education, and Public Engagement Activities

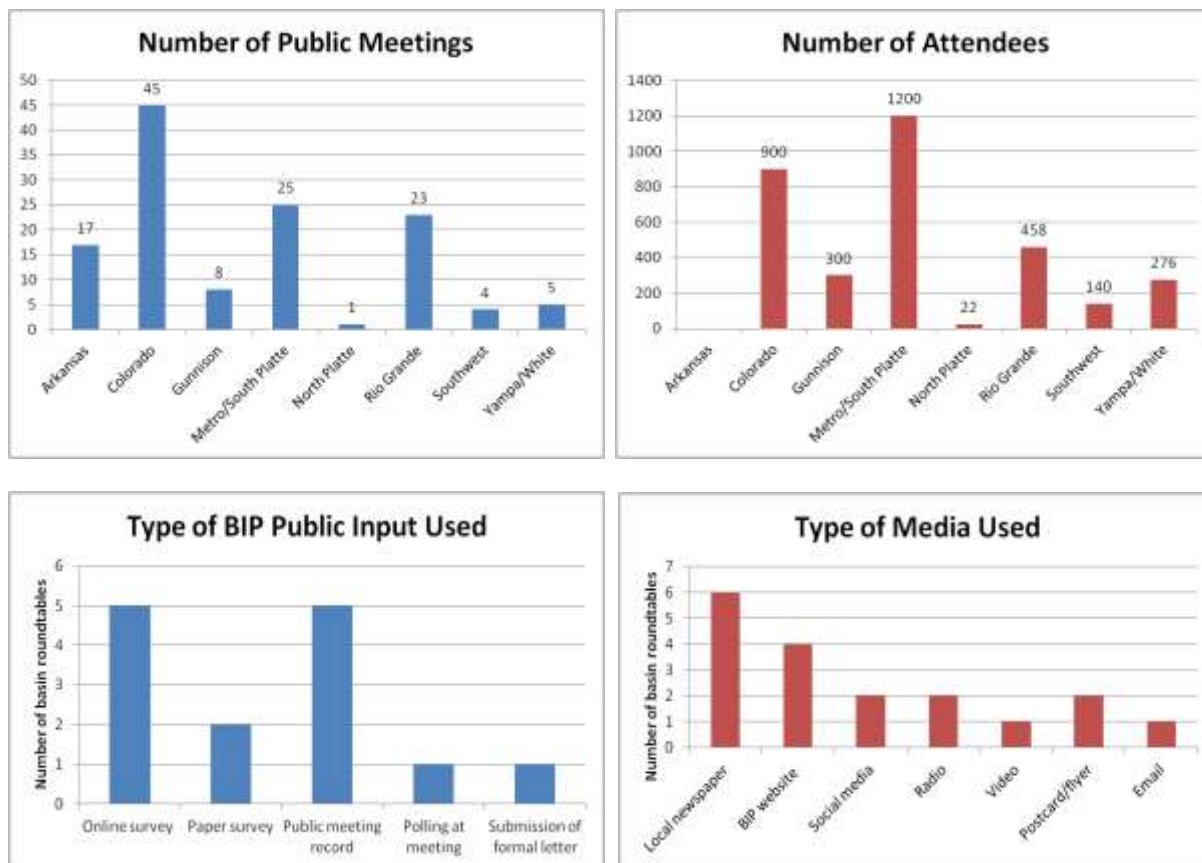
Between February 1 and July 31, 2014, the basin roundtables collectively hosted 126 public meetings, in addition to regular basin roundtable meetings. All in all, 3296 participants were counted among those basin roundtables that collected data on attendance.

This section provides an explanation and summary of basin roundtable and PEPO outreach efforts, including public meetings, over the development phase of the respective BIPs and Colorado's Water Plan. Each basin's education liaison and roundtable leadership have supported information and input opportunities. This includes targeted technical outreach meetings between the BIP consultants and stakeholders to identify specific water needs and projects, as well as meetings with the general public to obtain responses to the BIP goals, needs assessments, and proposed projects. The scope of these efforts far exceeds any other year of roundtable driven activities and the impact of each basin's education and outreach program on public engagement in water supply planning protection has yet to be captured, analyzed, and communicated. However, data from the BIPs has provided significant quantification on:

- the number of public and technical outreach meetings held by each roundtable and cumulatively by all roundtables, and the number of attendees;
- the other outreach activities of each roundtable;
- the groups and stakeholders with whom each roundtable met;
- the type of input the roundtables received;
- how the input was factored into the BIPs; and
- a summary of future planned outreach activities.

Outreach activities conducted by the basin roundtables during the first half of 2014 focused on public meetings in addition to the regular roundtable meetings. A summary of these meetings by basin can be found below. In addition to hosting public meetings, the roundtables all employed innovated approaches to education and outreach. They participated in radio shows, created websites designated to share BIP information, produced printed materials to hand out at local events, gave presentations and hosted speaking engagements, surveyed basin residents on BIP issues, solicited public input and incorporated comments into their BIPs, and targeted and engaged diverse stakeholder groups and individuals basin-wide. Newspapers published almost 70 articles in local newspapers on these efforts during development of the draft BIPs. A total of 757 public

comments from three reporting basins were documented and incorporated in the final BIP documents, although many basins did not have the capacity to report on this level of detail for public input.⁹²



In addition to assistance from the BIP consultant teams during the drafting of the respective BIPs, each basin roundtable used their education action plan to guide their outreach strategies, including the \$2,000 available through the PEPO. Some roundtables are using current funds and staff to implement outreach activities while others have sub-contracted with the BIP consultants or are relying on external partnerships. Some basins have also used Water Supply Reserve Account (WSRA) grants to fund their education and outreach activities. Regardless, all roundtables are collaborating with their outreach teams more than ever before and it will be imperative to consider how to sustain this momentum throughout 2015 and into the future. It will remain the role of the PEPO Workgroup to assist CWCB and the roundtables in continuing strategic planning, implementation, and evaluation of their education and outreach activities.

Below is a summary of the outreach efforts of each basin roundtable.

Arkansas Basin Roundtable Outreach Summary

Number of meetings: 17

Number of attendees: N/A

The basin roundtable's outreach focused on internal organization such as creating basin roundtable letterhead for correspondence and other documents, scripts for public service announcements

distributed to roundtable members for use in attracting participants to meetings, and the development of a website (www.arkansasbasin.com) for archived materials and as a venue for submitting comments online. The Arkansas Basin roundtable hosted a total of 17 public meetings across the basin and has tracked online input and analyzed comments by county, type, and summary of input. Additionally, one full day was dedicated to presentations on Colorado's Water Plan and the Arkansas BIP in conjunction with the Arkansas River Basin Water Forum in April which hosted a "clicker poll" of participants to obtain additional data.

Colorado Basin Roundtable Outreach Summary

Number of meetings: 45

Number of attendees: 900

Outreach focused on presentations at meetings to community groups, local elected officials, water providers, and watershed groups. A series of more than 30 local newspaper articles is archived on the CMU Water Center website and the team is actively using social media and a separate website to disseminate information, meeting notices, and to collect input forms at www.coloradobip.sgm-inc.com. Two distinct paper and online surveys (one on "basin values" and another titled "how community water needs should be met") have been developed and distributed via newspaper articles and email. The surveys collected over 500 responses from adult audiences and student groups, which were compiled in the BIP. Also of note are the extensive partnerships developed with organizations to help spread the word and generate input through formal letters, such as Roaring Fork Conservancy, Eagle River Watershed, Trout Unlimited, and Club 20.

Gunnison Basin Roundtable Outreach Summary

Number of meetings: 6

Number of attendees: 300

The approach to outreach focused on building roundtable capacity to hold public information-and-input meetings in six distinct areas for both the general public and groups of decision-makers as well as numerous BIP technical meetings with target stakeholder groups. The roundtable promoted these meetings through press releases, placing shopper publication advertisements, and personal contact through email, phone calls, or face-to-face encounters. The BIP Committee reviewed comments from the meetings and incorporated them into the BIP, as appropriate. The roundtable also prepared and distributed a booklet titled: *The Gunnison River Basin, A Handbook for Residents*, which includes a compendium of basic information about water use, water law, and water organizations in the Basin.⁹³

Metro/South Platte Basin Roundtable Outreach Summary

Number of meetings: 25

Number of attendees: 1200

The roundtable approached outreach by hosting targeted outreach meetings for BIP stakeholders groups, water boards, legislators, and other community leaders and developed extensive online content on the website (www.southplattebasin.com) where included social media links, several videos of narrated by roundtable leaders, and an online survey for comments. Roundtable members

also participated in two community radio shows. Looking ahead, the roundtable and consultants will do an analysis of public and stakeholder comments for incorporation into the joint BIP.

North Platte Basin Roundtable Outreach Summary

Number of meetings: 1

Number of attendees: 22

Outreach focused on one public outreach meeting, which was announced in the local newspaper along with distribution of a public input survey. The roundtable has also called several special BIP work sessions.

Rio Grande Basin Roundtable Outreach Summary

Number of meetings: 23

Number of attendees: 458

The roundtable engaged in outreach activities through meetings in locations across the basin and targeted three distinct groups: the general community, county commissioners, and stakeholder groups. This has resulted in increased public attendance at regular roundtable meetings. In addition, six separate BIP subcommittees have met a total of 21 times. The team has also produced bi-weekly newspaper articles, monthly radio shows, and created a website (www.riograndewaterplan.com) for archiving materials and public submission of comments. The roundtable also developed a Water 101 booklet specifically for the Rio Grande Basin. In the long-term, they will continue the momentum of existing outreach activities and create a forum to discuss "Multiple Use Project Implementation."

Southwest Basin Roundtable Outreach Summary

Number of meetings: 4

Number of attendees: 140

The approach has focused outreach activities such as distribution of the BIP fact sheets, a "talking points" PowerPoint presentation for roundtable members, seven local newspaper articles, 67 statewide articles specifically referencing Colorado's Water Plan posted on the Water Information Program website, and information about the IBCC/roundtable process presented at the Water 101 Seminar hosted annually by the Water Information Program. Roundtable members have delivered special presentations to water boards and Rotary Clubs plus the BIP consultants have met with and talked to over 100 individuals throughout the basin. Unique to the roundtable is the "social hour" before each Roundtable meeting for the public to attend and network.

Yampa/White/Green Basin Roundtable Outreach Summary

Number of meetings: 5

Number of attendees: 267

The roundtable conducted outreach activities early in the BIP process consisting of meetings hosted by roundtable members and inviting community groups. These meetings have included polling to collect data on participant demographics, water usage, and values. Meetings were advertised through a variety of means including newspapers, radio, postcards, flyers, email, and personal contacts. Stakeholder groups have been encouraged to submit white papers and there is a

Roundtable email account for receiving comments. Three special meetings to consider public input in addition to the regular basin roundtable meetings were scheduled and continue developing the BIP.

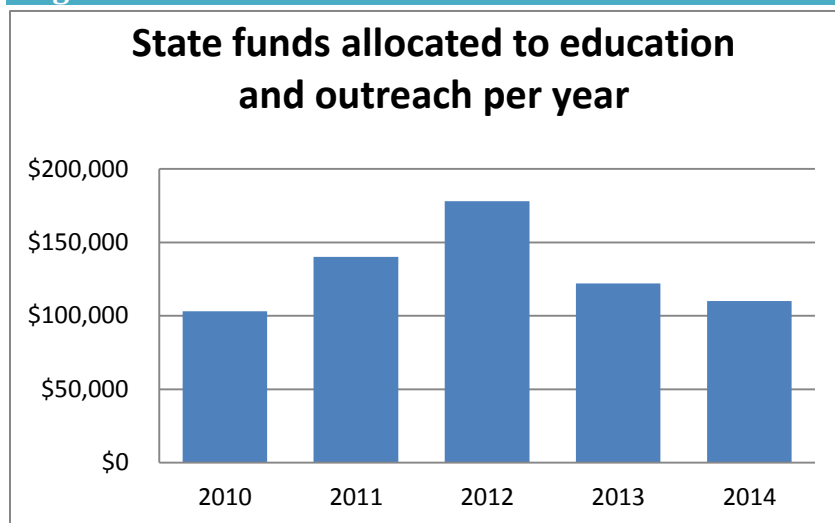
9.5.3 Outreach, Education, and Public Engagement Funding Summary and Recommendations

Despite the immense efforts of various organizations, projects, and partnerships, there is a need for improved coordination of existing programs to maximize their effectiveness. Collaboration creates new opportunities for water education, outreach, and public engagement activities to target new and diverse audience groups statewide. Moreover, there is a need to reassess existing statewide programs that focus on water supply requirements and solutions. The plan will build upon efforts such as the Colorado WaterWise Education Toolkit, the Colorado Watershed Assembly Network, and CFWE's ongoing Water Educator Network. Additionally, the 2008 Water Education Task Force Report recommendations should be updated in the near future, allowing the community to determine what unmet needs exist and identify the most effective strategies to address them.

The Funding Gap

During the development of Colorado's Water Plan and the BIPs, it became clear that the \$2000 of funding available to each roundtable could not fully support and sustain educational programs. To meet each basin's unique outreach and education goals, the roundtables used a creative mix of funding sources including WSRA grants and billed services from their consultants. The basins also relied on partnerships with the CWCB, the PEPO Education Liaisons, the roundtable education committees, and the BIP consultant teams to plan and execute public engagement. The following graph illustrates the state funds allocated to education and outreach through the PEPO Workgroup, the basin education action plans, and related WSRA grants. The peak in FY2012 is directly linked to

Figure 9.5-1



NOTE: The chart does not include outreach and education by consultants for BIPs; this will be included in future draft versions.

increased WSRA grants to support the Colorado Water 2012 initiative.

On average, the costs for outreach activities have been between \$15,000 and \$30,000 per roundtable over the past year; nevertheless, most roundtables have indicated that for their level of current BIP outreach this amount is insufficient. The Rio Grande Basin roundtable, for instance, spent an additional \$40,000 on outreach, beyond what was originally planned, and

projects up to \$10,000 in their 2015 education action plans.⁹⁴ Without securing this additional funding from state and local sources, implementation of the education action plan activities will not occur. Education and outreach cannot rely on a dedicated volunteer base alone, which has been the approach for many basin roundtables over the past five years. All 17 of the Arkansas Basin roundtable's outreach meetings were organized and run by volunteers.⁹⁵

Despite the insufficient funds, each roundtable increased their outreach activities. In the future, the roundtables will not be able to rely on assistance from the BIP consultants. Additionally, WSRA funds were not intended to fund many types of educational projects and several restrictions are placed on the types of educational programs that are eligible. Therefore, despite the prevalence of planned programming related to outreach, education, and public engagement, many potential projects do not have sufficient funding to move forward.

Furthermore, the Water Education Task Force report stated that the annual amount of revenue for water education across the state was \$7.3 million with respondents indicating that \$1.6 million of that amount came from state sources.⁹⁶ Monetary and time limitations were cited as the largest barriers to implementing education programs – more than half of the water education providers surveyed indicated they conduct water education for less than \$5,000 annually. The report stated that limited resources should provide additional incentives and focus for federal and state funding agencies.⁹⁷ Funding must go to the basin roundtable work as well as other important efforts.

It is imperative that the Colorado water community sustain the momentum for outreach and education activities once the development of the BIPs and Colorado's Water Plan end in 2015 and that funding for such activities increase as water supply solutions begin to be implemented.

CWCB's Role in Water Outreach, Education, and Public Engagement

Outreach, education, and public engagement related to the state's water supply planning efforts, including Colorado's Water Plan, the BIPs, and the Statewide Water Supply Initiative (SWSI) are an ongoing and iterative effort. The CWCB needs to continue the leadership it has demonstrated regarding outreach, education, and public engagement activities during the development of Colorado's Water Plan by continuing to aid in research, coordinate efforts, and providing funding and guidance for water education projects statewide.

The CWCB, the PEPO Workgroup, and the basin roundtables will continue education and outreach activities for Colorado's Water Plan and the BIPs for the remainder of 2014 and throughout 2015. In the long-term, the partnerships and communication channels developed by these entities over the past several years will be crucial in the effort to conduct public outreach and education activities on water supply planning and solicit input to implement balanced solutions. Each BIP articulated long-term goals and strategies for cultivating a supportive and engaged citizenry, such as the following selections from basins across the state:

1. Identify milestones and changes in Colorado's Water Plan and the BIP process in which additional media coverage and public participation is needed.
2. Identify the institutional changes necessary to address increasing water demands and the related cultural and economic adaptations in Colorado life.

3. Ensure a diverse and active basin roundtable membership and provide communication tools to inform their constituents and in return deliver meaningful feedback to the roundtables.
4. Maintain a steady traditional, online and social media presence throughout the basin.
5. Engage respected community leaders to champion the solutions set forth in the BIPs.
6. Work closely with organizations that specialize in the facilitation of public education and outreach programs to leverage existing resources within each basin to increase overall impact.
7. Enhance coordination and financial support for watershed groups and other grassroots organizations to effectively engage the public and increase participation.
8. Develop leadership programs for college students to explore water careers through scholarships or training opportunities in water supply planning projects and processes.
9. Establish metrics to evaluate the success and effectiveness of statewide and basin-level communication and education programs and modify strategies as needed.

The lack of financial support and professional resources is a large barrier for implementing these goals. To maintain the momentum of Colorado's Water Plan beyond 2015, outreach and education projects need a dedicated grant fund for information and communication tools that address Colorado's water challenges. The basin roundtables were created to serve as key forums for conversations and planning to address water supply issues. Creating a new fund creates the opportunity for stakeholders interested in water outreach, education, and public engagement to move important projects forward.

Actions

Based on the analysis above, the following recommendations will enhance Colorado's water outreach, education, and public engagement and advance the water supply planning process.

1. Create a new outreach, education, and public engagement grant fund

- A new outreach, education, and public engagement grant fund should be included in the annual bill that appropriates money from the CWCB construction fund for specific projects, also referred to as the Projects Bill, and should be administered by CWCB through the basin roundtables.
- The grant fund should be modeled on the WSRA program. It should consist of statewide and basin funds available for eligible outreach, education, and public engagement projects that meet specific criteria and guidelines developed by CWCB that align with Colorado's Water Plan goals.
- Guidelines should prioritize grants that are dedicated to projects that assist the basin roundtables with communication, outreach, and public education efforts related to issues that were addressed through the BIP, basin roundtable Needs Assessments, Statewide Water Supply Initiative, IBCC, and Colorado's Water Plan processes and products.
- Guidelines should stress the importance of measuring success, targeting specific audiences and approaches, and include other education and outreach best practices that lead to public engagement.

- Guidelines should encourage partnerships that increase the collective impact of local groups and programs.

2. Develop a CWCB-led effort to update and reassess the status of statewide outreach, education, and public engagement programs related to water supply planning

- The CWCB will work collaboratively to:
 - conduct a survey to update the Water Education Task Force Report that assessed what water education programs exist across the state;
 - determine where there are critical gaps in water education both geographically and topically; and
 - evaluate those recommendations set forth by recent studies that have been adequately addressed and those that need to be revisited.
- These steps will help determine what unmet needs exist and identify the most effective strategies to meet those needs.
- Research results will aid in the creation of criteria and guidelines for the new outreach, education, and public engagement grant fund recommended in item 1.

3. Improve the use of existing state resources

- The CWCB will incorporate education and outreach components in the WRSA Grants' criteria and guidelines.
- The CWCB will initiate efforts to improve coordination between state agencies on outreach and education activities. This should include the development of performance metrics and a database to track efforts.
- CWCB intends to foster continued engagement of the Water Education Task Force to use the network of existing water educators in a coordinated fashion to educate the various and diverse audiences in Colorado.

¹ C.R.S. § 37-60-106 2014.

² See Water Court Committee of the Colorado Supreme Court Report to the Chief Justice, August 1, 2009. See also, Melinda Kassen, Symposium: A Critical Analysis of Colorado's Water Right Determination and Administration Act of 1969, 3 U. Denv. Water L. Rev. 58 (1999).

³ See e.g., *Kansas v. Colorado*, 543 U.S. 86 (2004); *Kansas v. Colorado*, 533 U.S. 1 (2001); *Kansas v. Colorado*, 522 U.S. 1073 (1998); *Kansas v. Colorado*, 514 U.S. 673 (1995); *Kansas v. Nebraska and Colorado*, 538 U.S. 720 (2003); *Kansas v. Nebraska and Colorado*, 527 U.S. 1020 (1999); see also, *Kansas v. Nebraska and Colorado*, No. 126 Orig., Report of the Special Master (November 15, 2013).

⁴ See e.g., *Wyoming v. Colorado*, 259 U.S. 419 (1922), *vacated on joint motion by parties*, 353 U.S. 953 (1937); *Kansas v. Colorado*, 206 U.S. 46 (1907); *Kansas v. Colorado*, 185 U.S. 125 (1902).

⁵ C.R.S. § 37-60-121 2014.

⁶ C.R.S. § 37-60-121 2014.

⁷ Bloomberg BNA. "Legal Battles Over California Water Supplies Set to Escalate With Final Bay-Delta Plan." 2013

⁸ Chatfield Reallocation Project (\$62M CWCB Investment - \$80M Loans), Animas- La Plata Project (\$37M Water Purchase) Rio Grande Cooperative Project (\$5M Grant – \$15M Loan/Grant), and Elkhead Enlargement Project (\$??

⁹ Other identified funding efforts within BIP's

¹⁰ CWCB, 2011

¹¹ Colorado Parks and Wildlife, 2014

¹² CWCB, 2014

¹³ B. Harding, *Analysis for CWCB*, 2014.

¹⁴ Chapter 4, The Economic Conception of Water, W.M. Hanemann, University of California Berkley, USA, Section 3.4, Cost of Water.

¹⁵ American Water and Waste Water Crisis, The Role of Private Enterprise, Lewis Solomon - 2011

¹⁶ Colorado average household income, 2008-2012 = \$58,224 (United States Census) . Based on 9,000 gallon monthly household water use (108,000 gallons/yr.) and inside city limit use, Denver - \$35/month, Longmont - \$22.50/mo, and Ute Water Conservancy District - \$42.00 monthly billing rate . Average of three entities = \$33/month water bill.

¹⁷ Based on the average block rates for Denver (\$2.68), Longmont (\$2.44) and Ute Water Conservancy District (\$3.70) for first 9,000 gallons used.

¹⁸ CWCB and Colorado General Assembly approved Project

¹⁹ Colorado Revised Statute, Title 37-60-121

²⁰ CWCB's Annual Financial Compilation Report

²¹ Colorado Revised Statute, Title 39-29-109

²² CWCB's Annual Financial Compilation Report

²³ CWCB's Annual Financial Compilation Report.

²⁴ Tier 2 Severance Tax Operation Fund, Schedule 9, Cash Fund Report

²⁵ CWCB, WSRA Basin and Statewide Account Summary

²⁶ Colorado Water Resources and Power Development Authority. Online. <http://www.cwrpda.com/programs>

²⁷ Colorado Water Resources and Power Development Authority. Online.

<http://www.cwrpda.com/programs/small-hydropower-loan-program>

²⁸ Colorado Water Resources and Power Development Authority Hydro Funding Policy.

²⁹ CWCB, Finance Section, Non-reimbursable Investment Summary .

³⁰ (CWCB, 2011) appendix E

³¹ CWCB, Finance Section, Non-reimbursable Investment Summary.

³² \$55M average annual available CWCB loan funds x 35 years = \$1.925B rounded to \$2B.

³³ \$11M available x 35 years = \$385M.

³⁴ WSRA Funding at \$10M + \$4M in grant funding = \$14M times 35 years = \$490M.

³⁵ (IBCC, 2013)

³⁶ (TNC, 2010; Tamarisk Coalition, 2011)

³⁷ Average annual severance tax fund revenue \$20-\$70M, capped at \$50M.

³⁸ Colorado Revised Statute, Title 39-22-533

³⁹ Senate Bill 13-236

⁴⁰ Committee on Transportation and Infrastructure of the House of Representatives – Panel on Public-Private Partnerships, Final Report 2014

⁴¹ Mill levy calculations based on 4 mills, Adams \$18M, Arapahoe \$30.4M, Boulder \$22M, Denver \$40.4M, Douglas \$17.2M, El Paso \$23.2M, Jefferson \$28.8M, Larimer \$15.2M, and Weld \$18M, approximate total = \$215M. Those figures are doubled for 8 mills or \$430M.

⁴² 2010 Legislative staff review of Ballot potential revenues.

⁴³ Committee on Transportation and Infrastructure of the House of Representatives – Panel on Public-Private Partnerships, Final Report 2014.

⁴⁴ SWSI 2010

⁴⁵ Section 37-60-102, C.R.S. and <http://cwcb.state.co.us/about-us/about-the-cwcb/Pages/main.aspx>.

⁴⁶ The Instream Flow and Natural Lake Level Water Rights Database is located at:

<http://cwcb.state.co.us/technical-resources/instream-flow-water-rights-database/Pages/main.aspx>.

⁴⁷ See <http://cwcb.state.co.us/environment/instream-flow-program/Pages/CompletedTransactions.aspx> .

⁴⁸ Case No. 1-05CW025 (W-232, 79CW306): Application of Colorado Water Conservation Board (Bear Creek Lake).

⁴⁹ Case Nos. 1751B and 80CW237, Division 7 Water Court.

⁵⁰ The approval letter and record of decision can be found here: <http://cwcb.state.co.us/water-management/water-projects-programs/Documents/ChatfieldReallocation/SupportingDocuments/DCG-CEOChatfieldReservoirSRP.pdf>

⁵¹ Senate Bill 73-97, codified at section 37-92-102(3), C.R.S.

⁵² Section 37-92-102(3), C.R.S.

⁵³ Senate Bill 11-208 and Article 9, Title 33, C.R.S. (2014).

⁵⁴ Section 33-9-101 (12) (b), C.R.S. (2014).

⁵⁵ Sections 33-1-105(1)(a)(I) and 33-10-107(1)(a), C.R.S. (2014).

⁵⁶ See <http://www.historycolorado.org/about-us/about-us>

⁵⁷ Section 24-80-202(1), C.R.S. (2014).

⁵⁸ CWCB, “SWSI 2016 Initial Draft Chapter 7: Scenario Planning & Adaptive Management,” CWCB, Denver, 2014

⁵⁹ Governor John Hickenlooper, Executive Order D2013-005 *Directing the Colorado Water Conservation Board to Commence Work on the Colorado Water Plan*. May 14, 2013

⁶⁰ National Environmental Policy Act, 42 U.S.C. §§4321-4370h

⁶¹ National Environmental Policy Act, 42 U.S.C. §§4321-4370h

⁶² Colorado State House of Representatives, *House Report 113-24*. Online, <http://www.gpo.gov/fdsys/pkg/CRPT-113hrpt24/html/CRPT-113hrpt24.htm>

⁶³ Council on Environmental Quality Executive Office of the President, *A Citizen's Guide to the NEPA Having Your Voice Heard*. 2007. http://ceq.hss.doe.gov/nepa/citizens_guide_Dec07.pdf

⁶⁴ U.S. Environmental Protection Agency. Online, http://water.epa.gov/grants_funding/wetlands/upload/2004_4_30_wetlands_reg_authority_pr.pdf 08 May 2014

⁶⁵ Colorado Water Quality Control Division (WQCD), Regulation No. 82 (5 CCR 1002-82), Accessed November 7, 2014 <https://www.colorado.gov/pacific/sites/default/files/Regulation-82.pdf>

⁶⁶ WQCD, Regulation No. 82 (5 CCR 1002-82)

⁶⁷ WQCD, Regulation No. 82 (5 CCR 1002-82)

⁶⁸ Colorado State Statute 37-60-122.2 (C.R.S.)

⁶⁹ Colorado State Statute 37-60-122.2 (C.R.S.)

⁷⁰ Department of Regulatory Agencies (DORA), 2012. *2012 Sunset Review: Colorado Coordination Council*. Accessed November 7, 2014,

<http://cdn.colorado.gov/cs/Satellite?blobcol=urldata&blobheadername1=Content-Disposition&blobheadername2=ContentType&blobheadervalue1=inline%3B+filename%3D%22Coordination+Council%2C+Colorado++2012+Sunset+Review.pdf%22&blobheadervalue2=application%2Fpdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1251828818487&ssbinary=true>

⁷¹ DORA, 2012

⁷² DORA, 2012.

⁷³ Colorado House Bill 14-1030. Accessed November 7, 2014

http://www.leg.state.co.us/clics/clics2014a/csl.nsf/fsbillcont/6463D7584236949F87257C3000062211?Open&file=1030_enr.pdf

⁷⁴ WQCD, Personal Communication.

⁷⁵ Executive Order 13604 of March 22, 2012, 77 FR 18887, March 28, 2012

⁷⁶ Executive Order 13604 of March 22, 2012, 77 FR 18887, March 28, 2012

⁷⁷ NWCCOG, Barbara Green, Personal Communication.

⁷⁸ WQCD, Regulation No. 82 (5 CCR 1002-82)

⁷⁹ Interbasin Compact Committee, Draft No & Low Regrets Action Plan

⁸⁰ BBC Research & Consulting, Public Opinions, Attitudes and Awareness Regarding Water in Colorado (Denver, 2013) Section III Page 9.

⁸¹ BBC Research, Public Opinions, Section IV Page 2.

⁸² James Pritchett, Alan Bright, Andrea Shortsleeve, Jennifer Thorvaldson, Troy Bauder, and Reagan Waskom, Public Perceptions, Preferences, and Values for Water in the West (Fort Collins, 2009) 6-7.

⁸³ Reagan Waskom, "Editorial" in *Colorado Water* 30 (2013) 1.

⁸⁴ Justice Greg Hobbs, "Colorado Water Law: An Historic Overview" in *The Public's Water Resource: Articles on Water Law, History, and Culture*. (Denver: CLE in Colorado, 2007) 69.

⁸⁵ Caitlin Coleman, "Celebrating 10 Years of Statewide Water Education with the CFWE." *Colorado Water* 30 (2013) 20.

⁸⁶ C.R.S. § 35-75-106 (1) 2012.

⁸⁷ Colorado Water Education Task Force, *Colorado Water Education Task Force 2008 Final Report* (Denver, 2008) 3.

⁸⁸ Colorado Foundation for Water Education, *Colorado Water Initiative 2012 Final Report* (Denver, 2013) 3, 9.

⁸⁹ "About Us," River Watch of Colorado, <http://www.coloradoriverwatch.org/sample-page/>.

⁹⁰ "Project Wild" Colorado Parks and Wildlife, <http://cpw.state.co.us/learn/Pages/ProjectWild.aspx>.

⁹¹ C.R.S. § 37-60-106 2014.

⁹² Kate McIntire, memorandum to the Colorado Water Conservation Board, "Agenda Item 9a, Statewide Outreach Status Update – May 2014", 2014.

⁹³ Gunnison Basin Roundtable, *The Gunnison River Basin: A Handbook for Inhabitants* (Grand Junction, 2014).

⁹⁴ Rio Grande Basin Roundtable, *Rio Grande Basin Water Plan* (Alamosa, 2014) 286-290.

⁹⁵ Arkansas Basin Roundtable, *Arkansas Basin Implementation Plan: Draft* (Pueblo, 2014) Section 4.1 Page 4.

⁹⁶ Water Education Task Force, *Final Report*, 6.

⁹⁷ Water Education Task Force, *Final Report*, 6-7.

10. Legislative Recommendations

Colorado's Water Plan does not yet contain legislative recommendations, because those will arise out of discussion of the draft plan and development of the final water plan. Thus any legislation proposed during the 2015 legislative session will not implement any of the recommendations in the draft water plan. However, the state of Colorado will evaluate bills that are offered during the 2015 legislative session and may seek to support bills that are consistent with the objectives and direction of the draft water plan and likewise oppose bills that run counter to the direction of the plan. Following additional public input and evaluation that will occur during 2015, legislative recommendations will be addressed in the final water plan for the 2016 legislative session.

11. Updating Colorado's Water Plan

Colorado's Water Plan is a dynamic document that incorporates Colorado's changing economy, water supplies, water needs, and stakeholder efforts.

Background

Colorado's Water Plan is dynamic by design. As written, Colorado's Water Plan addresses today's challenges with the understanding that our water landscape can change quickly. Colorado's Water Plan must be agile in the face of future uncertainty regarding both water supply and demand, and adopt advancements in water resource management to meet these changing conditions.

Therefore, Colorado's Water Plan will be updated on a four year cycle, during the first year of each gubernatorial term. This timeline will help ensure that water is a focus of Colorado's ongoing policy development.

Before December 2015, Colorado's Water Plan will undergo significant revisions and public outreach. Working with the Colorado Water Congress, the State of Colorado will deliver the State of the State on water issues at the Colorado Water Congress annual conference.

Pursuant to Senate Bill 14-115, the Colorado Water Conservation Board will present the draft plan to the water resource review committee by July 1, 2015 and will consider the feedback from the public hearings planned in 2015 and held by the water resource review committee.

Actions

Update Colorado's Water Plan in 2019, 2023, and every four years thereafter, based upon current data and stakeholder input.