COLORADO'S WATER PLAN

coloradowaterplan.com
cowaterplan@state.co.us
Direct: 303-866-3441

Prepared for:
Governor John W. Hickenlooper

Prepared by:
Colorado Water Conservation Board

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coloradowaterplan.com
cowaterplan@state.co.us
Direct: 303-866-3441

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"We embark on Colorado's first water plan written by Coloradans, for Coloradans."

Governor Hickenlooper's May 2013 executive order to create Colorado's first waterfirstwater plan was a monumental task in a tight timeframe given Colorado's water history. Over two years Seventeen months later with a second draft plan in hand, we would like to express our sincere gratitude to the thousands of individuals and hundreds of organizations that continue to helphelped us build Colorado's Water Plan. Your passion for water in Colorado is at once both humbling and energizing!

The hallmark of Colorado's Water Plan is collaboration. It would not be possible without the participants in the basin roundtables, and the Interbasin Compact Committee (IBCC), the PEPO Workgroup of the IBCC, and the Water Investment Funding Committee.. The hours you volunteervolunteered to spend in community centers, candidly discussing water issues, and the hard work you put into mapping out your basin's water needs and solutions are the heartbeat of Colorado's Water Plan.

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coloradowaterplan.com
cowaterplan@state.co.us
Direct: 303-866-3441

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coloradowaterplan.com
cowaterplan@state.co.us
Direct: 303-866-3441

Acronyms and Abbreviations

Chapter 1

BIP	Basin Implementation Plan
CWCB	Colorado Water Conservation Board
IBCC	Interbasin Compact Committee
SWSI	Statewide Water Supply Imitative

Chapter 2

BLM	U.S. Bureau of Land Management
BOR	U.S. Bureau of Reclamation
CCP	Compact Compliance Pipeline
CDPHE	Colorado Department of Public Health and Environment
CDSS	Colorado's Decision Support System
CEQ	Council on Environmental Quality
Corps	U.S. Army Corps of Engineers
CPW	Colorado Parks and Wildlife
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board
WQCD	Colorado Water Quality Control Division
DLG	Division of Local Governments
DOLA	Department of Local Affairs
DWR	Colorado Division of Water Resources
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
IBCC	Interbasin Compact Committee
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NPS	U.S. National Park Service
RRCA	Republican River Compact Administration
SWSI	Statewide Water Supply Initiative
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Services

Chapter 3

ALP	Animas-La Plata
BIP	Basin Implementation Plan
BLM	U.S. Bureau of Land Management
BOR	U.S. Bureau of Reclamation
CWCB	Colorado Water Conservation Board
ESA	Endangered Species Act
IPP	Identified Projects and Processes
M&I	municipal and industrial
PRRIP	Platte River Recovery Implementation Program
SWSI	Statewide Water Supply Imitative
USFS	U.S. Forest Service

Chapter 4

BOR	Bureau of Reclamation
CWCB	Colorado Water Conservation Board

Chapter 5

BIP	Basin Implementation Plan
CDPHE	Colorado Department of Public Health and Environment
CWCB	Colorado Water Conservation Board
EPACT	Energy Policy Act
GDP	gross domestic product
IPP	Identified Projects and Processes
M&I	municipal and industrial
SWSI	Statewide Water Supply Imitative
WQCC	Water Quality Control Commission

Chapter 6

AMI	Advanced Metering Infrastructure
ARR	aquifer recharge and recovery
ASR	aquifer Storage and Recharge
ATM	Alternative Transfer Method
BIP	Basin Implementation Plan
BLM	Bureau of Land Management
CDA	Colorado Department of Agriculture
CDPHE	Colorado Deparment of Public Health and Evironment
CDSS	Colorado's Decision Support Systems
CIR	crop irrigation requirement
CPW	Colorado Parks and Wildlife
CRCA	Colorado River Cooperative Agreement
CRCT	Colorado River cutthroat trout
CU	consumptive use
CWA	Colorado Water Act
CWCB	Colorado Water Conservation Board
DNR	Department of Natural Resources
DORA	Department of Regulatory Agencies
DPR	direct portable reuse
DRCOG	Denver Regional Council of Governments
DWR	Division of Water Resources
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ET	evapotranspiration
COGCC	Colorado Oil and Gas Conservation Commission
GIS	geographic information system
GPCD	gallons per capita per day
IBCC	Interbasin Compact Committee
IPP	Identified Projects and Processes
IPR	indirect portable reuse
ISA	interruptible service agreements
IWM	irrigation water management
IWSA	interruptible water supply agreement
LULA	Land Use Leadership Alliance Training
M&I	municipal and industrial
MGD	million gallons per day
MW	megawatts
MWh	megawatt per hour
ORV	Outstandingly Remarkable Values
P&M	projects and methods
PBO	Programmatic Biological opinion
PLT	Project Leadership Teams
PSOP	Preferred Storage Option Plan
PUC	Public Utilities Commission
RBF	river bank filtration
RICD	recreational in-channel diversions
RO	reverse osmosis
SECWCD	Southeastern Colorado Water Conservancy District
SMP	stream management plan
SSI	self-supplied industrial
SWSI	Statewide Water Supply Imitative
TMD	transmountain diversion
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WEGP	Water Efficiency Grant Program
WFET	Watershed Flow Evaluation Tool
WISE	Water Infrastructure and Supply Efficiency
WQCC	Water Quality Control Commission
WQCD	Water Quality Control Division
WSRA	Water Supply Reserve Account
ZLD	zero liquid discharge

Chapter 7

BIP	Basin Implementation Plan
CWCB	Colorado Water Conservation Board

Chapter 8

BIP	Basin Implementation Plan
CRCA	Colorado River Cooperative Agreement
CRWCD	Colorado River Water Conservation District
CWCB	Colorado Water Conservation Board
IBCC	Interbasin Compact Committee

SWSI	Statewide Water Supply Imitative
TMD	transmountain diversion
WISE	Water Infrastructure and Supply Efficiency

Chapter 9

AG	Attorney General
ATM	Alternative Transfer Method
Authority	Water Resources and Power Development Authority
BIP	Basin Implementation Plan
BLM	Bureau of Land Management
BMP	best management practices
BOR	Bureau of Reclamation
CAWS	Collaborative Approach to Water Supply Permit Evaluation
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
CFWE	Colorado Foundation for Water Education
CJRP	Colorado Joint Review Process
Corps	U.S. Army Corps of Engineers
CPW	Colorado Parks and Wildlife
CRSP	Colorado River Storage Project
CRWAS	Colorado River Water Availability Study
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board
DNR	department of natural resources
DOC	Department of Corrections
DORA	Department of Regulatory Affairs
DWR	Division of Water Resources
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
EPAT	Extreme Precipitation Analysis Tool
FERC	Federal Energy Regulatory Commission
FWS	U.S. Fish and Wildlife Service
IBCC	Interbasin Compact Committee
IPP	Identified Projects and Processes
IT	Information Technology
LEDPA	Least Environmentally Damaging Practicable Alternative
M&I	Municipal and Industrial
MOA	memorandum of agreement
MOU	Memorandums of Understanding
NCWCD	Northern Colorado Water Conservancy District
NEPA	National Environmental Policy Act
NGO	nongovernmental organizations
NRCS	Natural Resources Conservation Service
P&I	principal and interest
P3	Public-Private Partnerships
PEPO	Public Education, Participation, and Outreach
ROD	Record of Decision
SDS	Southern Delivery System
SLB	Colorado State Land Board of Commissioners
SMWSA	South Metro Water Supply Authority
SWIFT	State Water Implementation Fund for Texas
SWIRFT	State Water Implementation Revenue Fund for Texas
SWSI	Statewide Water Supply Initiative
TU	Trout Unlimited
USFS	U.S. Forest Service
WET	Water Education for Teachers
WIFIA	Water Infrastructure Finance and Innovation Authority
WISE	Water Infrastructure and Supply Efficiency
WPCRF	Water Pollution Control Revolving Fund
WQCD	Colorado Water Quality Control Division
WRA	Western Resource Advocates
WRBP	Water Revenue Bond Program
WRRC	Water Resources Review Committee
WSRA	Water Supply Reserve Account

Chapter 10

AGO	Colorado Attorney General's Office
ATMs	Alternative Transfer Methods
BIPs	Basin Implementation Plans
BRTs	Basin Roundtables
CDA	Colorado Department of Agriculture
CDPHE	Colorado Department of Public Health and Environment
CPW	Colorado Parks and Wildlife
CSU	Colorado State University
CWCB	Colorado Water Conservation Board
DNR	Department of Natural Resources
DOLA	Colorado Deparment of Local Affairs
DWR	Colorado Division of Water Resources
IBCC	Interbasin Compact Committee
NEPA	The National Environmental Policy Act
NRCS	Natural Resources Conservation Service
SWSI	Statewide Water Supply Initiative
WRRC	Water Resources Review Committee
WSRA	Water Supply Reserve Account

Chapter 11

BIP	Basin Implementation Plan
CWCB	Colorado Water Conservation Board
IBCC	Interbasin Compact Committee

COLORADO'S WATER PLAN

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cowaterplan@state.co.us
Direct: 303-866-3441

1. Introduction: Collaborating on Colorado's Water Future

Colorado's Water Plan

People love Colorado. Our population ballooned from 1 million in 1930 to more than ~~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.

This plan articulates ~~In the following pages we chart a course to achieve~~ collaborative, balanced water solutions to Colorado's water challenges. Equally important, it also establishes the method by which we will continue to find solutions into ~~needs, both now and in~~ the future. This method is based in our grassroots basin roundtable structure and the geographic representation that forms the Colorado Water Conservation Board (CWCB).

The Colorado Water Conservation Board

The CWCB is Colorado's water planning and policy agency and is responsible for stream, watershed, and lake protection, water conservation, flood mitigation, stream restoration, drought planning, water supply planning and water project financing. The agency works to protect the state's water apportionments in collaboration with other western states and federal agencies[1]

If we're smart and strategic, (and we are), Colorado has enough water to meet our needs well into the future. As is the case with other Western States, however, we do not have enough water for all of our needs all of the time. Therefore, our principal water challenge lies not in the amount of water we're given but in our management of what we have.

We have used the real and looming "gap" ~~The gap~~ between water supply and demand to catalyze action on water in Colorado. The trade-offs in addressing ~~is real and looming. Drought conditions, such as those experienced in 2013, coupled with our projected population rise, will further widen~~ this gap, if we do nothing or if we continue the status quo, are unacceptable to most of us:

- Continued rapid removal of water from farms and ranches to supply urban growth.
- A blind hope that basin economies, watersheds, and ecosystems can withstand more water diversions.
- Continued mining of groundwater aquifers to supply municipal growth.
- Populations striving to recreate the water-intensive landscapes of the Eastern U.S. instead of adopting a Western water ethic.

- Unchanged regulatory processes for critical water storage projects that require increasingly impracticable amounts of time and money.
- Diminished ability to resist federal government intervention in state water management decisions because we've weakened state management tools.
- Transactional costs that prohibit efficient and effective water sharing.
- Water laws and administration that are out of touch with our changing needs.
- Dogmatic views of water law that position the State of Colorado as the sole obstacle to changes in water use.
- No plan to finance the daunting cost of water infrastructure projects (municipal, industrial, and environmental).

This is the de facto future we are handing down to our children and grandchildren if we do nothing. It is a future without a value-based strategy. Colorado's Water Plan offers an alternate path. Unfortunately, this path will not solve all our problems and it will not be easy. It will require the continued hard work and effort of Coloradans both inside and outside the water profession.

This strategic plan is the first of its kind for Colorado: a plan by Coloradans, for Coloradans. Colorado's Water Plan is designed ~~this plan~~ to be dynamic so~~document~~ that it can evolve~~evolves~~ as Colorado grows and transforms. While the plan reflects the most current water data available, ~~and will be updated by~~ the CWCB will update the plan as data, needs, and projections change. ~~This comprehensive water plan is the first of its kind for Colorado: a plan by Coloradans, for Coloradans.~~

In May 2013, Governor John Hickenlooper issued Executive Order D 2013-~~D2013-~~05 ~~(EO)~~ that directed the CWCB to prepare a water plan for Colorado (see Appendix A). The order directed:

~~A summary of the key directives to the CWCB outlined in this EO 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 support of projects, studies, funding, and other efforts as part of Colorado's 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 (IBCC) and the basin roundtables in drafting Colorado's Water Plan. The CWCB is also directed to review and build upon discussions and points of consensus that have emerged as part of the IBCC 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. Colorado's 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 grassroots work done by the IBCC and basin roundtables.

Colorado's Water Values[2]

- 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 more than~~over~~ a decade of unprecedented efforts engaging diverse stakeholders and developing water planning information, which serves as ~~ultimately~~ the foundation of Colorado's Water Plan. During this past decade, Coloradans from all sectors identified the need for a focused plan for the future.[3]

The roots of the water plan started with extreme drought in 2002 and 2003. When some municipalities were mere weeks away from running out of water, the need for a comprehensive analysis of Colorado's water needs was apparent and sparked the Statewide Water Supply Initiative (SWSI).[4] The CWCB leads the SWSI, an ongoing analysis of Colorado's water resources that provides key technical data and information used to guide decision making. The SWSI also takes different climate variability scenarios into account. As a result of the 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 IBCC and nine basin roundtables.[5] The 27 members of the IBCC represent every basin and nearly every 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 a 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 the IBCC (which engaged hundreds of stakeholders across diverse 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 focused on actively engaging communities through concerted public involvement, and developing balanced, locally-driven, and collaborative water management solutions: the building blocks of this water plan.

Why Do We Need a Water Plan?

Colorado is widely regarded as one of the best locations in which to live, work, and play.[8] As a result, more people and businesses are moving to Colorado and staying. Even with a robust conservation ethic, this growth will increase demand for water. At the same time, we have witnessed sustained and systemic drought on a scale never before recorded by humans. This gap between water supply and our increased demand for water results in the possibility of a significant shortfall within the next few decades, even with aggressive conservation and additional water projects.[9] To complicate matters further, precipitation patterns and amounts have recently shown their ability to swing and vary wildly. ~~Water is obviously vital,[10] 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.~~ For ~~As an~~ example, in 2013 Colorado suffered from systemic drought and deadly flooding simultaneously.[11] ~~The gap between supply and demand (i.e. the[12] Water supply uncertainty is dramatically increased by climate variability and change. Since we are projectingprojectionsprojections 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 additional water projects.[13][14] 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 big water ~~primary~~ challenges facing us~~Colorado faces~~:

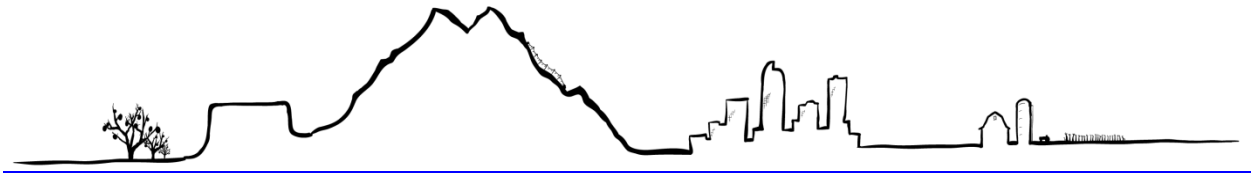
- **Growing water supply gap:** The gap between municipal water supply and demand is growing, and conservation and the completion of proposed water projects are likely insufficient to address projected 2050 shortfalls that could total more than 500,000 acre-feet statewide.[15]
- **Agricultural dry-up:** 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 affect Colorado's economy and food security. In addition, rural communities could dry-up along with agriculture if enough agricultural business goes away.[16]
- **Critical environmental concerns:** A key component of Colorado's brand is its environment. We must address water quality, watershed health, and ecosystem resilience in light of water demands and a changing climate. An increasing number of fish species in Colorado are at risk of becoming endangered because of 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.[17]

- **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 potential big swings in precipitation patterns and amounts in~~the wide variability predicted in~~ the future. This is discussed at length in Chapters 4 and 5.[18]
- **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.[19]
- **Increasing funding needs:** Colorado also 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 strategies. It recognizes that water is important for all sectors and regions in Colorado and greatly affects livelihoods.[20]

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 and have them processed~~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.[21] 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 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 still 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 future generations.

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 all while honoring Colorado's water values and ensuring~~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. Building on successful eastern slope—western slope agreements, Chapter 8 charts a collaborative path forward for any discussion regarding transmountain water from the western slope. 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 updating the plan moving forward.

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[1] "About the CWCB," Colorado Water Conservation Board, accessed October 17, 2014. http://cwcb.state.co.us/about-us/about-the-cwcb/Pages/main.aspx.
[2] Executive Order D2013-05 of May 14, 2013, Directing the Colorado Water Conservation Board to Commence Work on the Colorado Water Plan. 2013.
[3] BBC Research & Consulting, Public Opinions, Attitudes and Awareness Regarding Water in Colorado (Denver, 2013) Section II, 14.
[4] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010* (Denver, 2011).
[5] C.R.S. §§ 37-75-104, 37-75-105.
[6] Colorado Water Conservation Board, *SWSI* (2011) 7-2.
[7] Executive Order D2013-005 (2013).
[8] Colorado Office of Economic Development and International Trade, *Living in Colorado* (Denver: OEDIT, 2014).
[9] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*.

[10] Colorado Office of Economic Development and International Trade. *Living in Colorado* (Denver: OEDIT, 2014).
[11] NOAA Climate.gov, *Despite Fall Floods, Drought Persists in Southeastern Colorado* (2014).
[12] NOAA Climate.gov. *Despite Fall Floods, Drought Persists in Southeastern Colorado. Despite Fall Floods, Drought Persists in Southeastern Colorado* (2014).
[13] CWCB. *SWSI* (2011).
[14] CWCB. *SWSI* (2011).
[15] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*.
[16] Colorado Water Conservation Board, *Alternative Agricultural Water Transfer Methods Grant Program Summary and Status Update* (Denver: CWCB, 2012).
[17] Colorado Water Conservation Board, *Nonconsumptive Needs Assessment Focus Mapping* (Denver: CWCB, 2010).
[18] Jeff Lukas, Joseph Barsugli, Nolan Doesken, Imtiaz Rangwala, and Klaus Wolter, "Executive Summary," *Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation*, Second ed. (Boulder: University of Colorado, 2014).
[19] Larry Eklund quoting John Wooden in *Be Quick—But Don't Hurry: Finding success in the teachings of a lifetime*, 2001.
[20] Nick Penney, 2013.
[21] Denver Metro Chamber of Commerce, *Water* (Denver: 2014).

coloradowaterplan.com
cowaterplan@state.co.us
Direct: 303-866-3441

2. ~~Our~~ Colorado's Legal and Institutional Setting

Chapter 2 provides an overview of the regulatory framework that guides water management in Colorado. The doctrine of prior appropriation establishes~~dominates~~ much of the foundation~~discussion~~ of water law within the state. This chapter presents a brief explanation of this system along with an overview of~~is explained briefly, as well as a look at~~ how this resource is administered by state and federal agencies. As a headwaters state~~the Headwaters State~~, Colorado is subject to interstate agreements and international treaties regarding usage of water and obligations downstream. Section 2.2 of this chapter explains ~~The~~ interstate compacts and equitable apportionment decrees as well as~~are discussed, and~~ their effects on water~~impacts to~~ availability within the state. Colorado also has the distinction of being a local control state, where a variety of planning and implementation authority rests at the local level. Section 2.3 of this chapter reviews key~~Key~~ features of this system ~~are discussed,~~ and describes the importance of these processes to water management within the state ~~is described~~. When moving a water project or method forward in Colorado, interaction with regulatory agencies is necessary at the federal, state, and local levels. Section 2.4 of this chapter briefly enumerates these~~These~~ agencies, their delegated jurisdiction, and the roles each play in the approval or permitting processes~~. are briefly enumerated.~~ Finally, Section 2.5 of this chapter examines the issue of federal and tribal reserved water rights ~~is examined~~, as these types~~type~~ of water designations affect~~impact~~ the management and decision-making of entities within the state. An understanding of this legal and institutional landscape is very important for water managers, moving forward in the planning and implementation processes within Colorado. Moreover, in order to make our laws and policies better, we must understand where we stand and how we got here.

2.1 Colorado Water Law & Administration

To~~In order to~~ plan for the opportunities and challenges apparent in Colorado's water future, we must understand the legal framework on~~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 before~~prior to~~ the creation of the Colorado territory) 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.[1]

Water users in Colorado's semi-arid climate require~~need~~ a flexible system that honors private water rights, provides reliable administration, and responds to changes in supply and demand. As

the Colorado Supreme Court articulated in 2001, "The objective of the water law system is to guarantee security, assure reliability, and cultivate flexibility in the public and private use of this scarce and valuable resource."[2] Through ever-evolving case law, policies established by state and local government, and laws passed by the General Assembly, Coloradans are constantly working together to maintain~~create~~ this flexible and reliable 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. This framework was necessary because of the arid nature of the Western United States, and because the riparian water laws of Europe and the Eastern United States would not have adequately protected older water rights from new uses when there were water shortages.[3] The prior appropriation doctrine was established, in large part, to protect gold mining claims, and it is not a coincidence that the basic tenets of the prior appropriation doctrine are similar to early mining laws.[4] 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, even before ~~prior to~~ Colorado obtained~~obtaining~~ statehood in 1876.[5] 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."[6] The simple distillation of this legal framework is "first in time, first in right."[7]

After constitutional establishment of the prior appropriation system, the Water Right Determination and Administration Act of 1969, ("The 1969 Act"), which applies to surface water and tributary groundwater,[8] further codified the procedure for adjudication and administration of water rights in Colorado. The 1969 Act specified~~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."[9]

The Colorado Doctrine

- All surface and groundwater in~~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.

Colorado allocates and administers water according to two general categories of~~As Colorado Supreme Court Justice Gregory Hobbs described in his 1999 law review article:[10]~~

> ~~Major accomplishments of the 1969 Act include:~~ (1) ~~integration of~~ surface water, which includes ~~and~~ tributary groundwater, ~~into a unitary adjudication~~ and ~~administration system;~~ (2) other groundwater. The first category is subject to Colorado's prior appropriation doctrine,~~specialized water court jurisdiction~~ and is generally governed under Article XVI, Sections 5 and 6, of the Colorado Constitution and the 1969 Act.[11] This category~~engineer administration on a watershed basis; (3)~~

~~resume notice procedure for obtaining jurisdiction for adjudication~~ of water includes all water~~rights; (4) case-by-case decrees and appeals in the context~~ of natural streams and all~~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, which is ~~(~~groundwater that is hydrologically connected to a surface stream. By law, all groundwater in Colorado is presumed to be tributary unless otherwise defined by law or proven by facts. [12]

Major Accomplishments of the 1969 Act[13]

- Integration of surface water and tributary groundwater into a unitary adjudication and administration system;
- Specialized water court jurisdiction and engineer administration on a watershed basis;
- Resume notice procedure for obtaining jurisdiction for adjudication of rights;
- Case–by–case decrees and appeals in the context of an ongoing and comprehensive adjudication;
- Authorization of augmentation plans to enable otherwise out–of–priority water use through the provision of replacement water;
- Effective rulemaking and enforcement authority in the state and division engineer for the protection of state, federal, and interstate rights; and
- Explicit procedures for filing and pursuing applications and objections to applications for water rights, conditional water rights, changes of water rights, and augmentation plans.

The second category is governed by a modified prior appropriation doctrine, and is partially governed by Colorado's Groundwater Management Act ("The Groundwater Act").[14] This category includes groundwater that has been found by law or fact to be not significantly hydrologically connected to a surface stream. This category of water includes many different types such as: (a) designated groundwater (within a designated~~designation~~ groundwater basin);[15] (b) nontributary groundwater outside of designated groundwater basins;[16] (c) not nontributary groundwater; [17] (d) Denver Basin groundwater;[18] (e ~~and (5~~) geothermal groundwater;[19] (f) exempt groundwater,[20] and~~.~~ ~~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 that may require a well permit from the State Engineer's Office,[21] or determinations by the ~~are subject to different allocation and administration systems according to statutes of the~~ Colorado Ground Water Commission.[22] For instance, the doctrine of prior appropriation shall not apply to nontributary, Denver Basin, or designated ground water. Such water is allocated as correlative rights generally

based on overlying land ownership.[23] The Colorado Ground Water Commission (composed of twelve members, nine of whom are appointed by the governor and confirmed by the senate) may determine and alter boundaries of designated groundwater basins and subdivisions thereof by geographic description, subject to statutory limitations.[24]~~General Assembly.~~

The vast majority of Colorado's water rights are subject to~~Under~~ the prior appropriation system that aligns water rights in order of appropriation and adjudication dates. This system can result in a situation where 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 time of water shortage when senior water rights are more highly valued. A "call" on a stream by a downstream senior water rights holder 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 it is~~they are~~ entitled. The State Engineer and Division Engineers are required to regulate such a "call" pursuant to statute.[25]

"Beneficial use," defined as a reasonable level of use beyond which waste may occur,[26] serves as both the measure and limit of the water.[27] There are a number of important water law terms that require definition, and there are three very good existing glossaries found at: http://www.ext.colostate.edu/pubs/crops/04717.html; http://denverwater.org/AboutUs/GlossaryofTerms/; and http://www.coloradoriverdistrict.org/education-resources/water-glossary/. The~~This~~ term "beneficial use" is used ~~to~~ both to determine and ~~to~~ 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.[28] Instream flow water rights held exclusively by the Colorado Water Conservation Board (CWCB) to preserve or improve the environment to a reasonable degree are codified in the statutory definition of beneficial use.[29] The statutory definition of beneficial use has more recently been amended to recognize in-channel uses for recreational purposes.[30]

Water Rights and Adjudication

The prior appropriation system today is a product of our constitutional, legislative, regulatory~~constitution, legislation~~, and ~~the~~ judicial processes~~system~~. Colorado's seven water courts, established in each of the seven major watersheds of the state, issue decrees confirming water-use rights.[31] Water rights may be confirmed for use on a direct-flow basis, by storage, or by exchange.[32] 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 accomplished 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 affected~~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.[33]

Section 6 of Article XVI of the Colorado Constitution sets forth the right to appropriate, "the right to divert the unappropriated waters of any natural stream to beneficial uses shall never be denied."[34] In Colorado, a user appropriates a water right by demonstrating~~is appropriated when a user demonstrates~~ intent and taking~~takes~~ steps to put water to beneficial use. A user makes that right~~, and is made~~ absolute by storing ~~water~~ or applying a specified amount of water directly to beneficial use.[35] A water user may then receive protection under the priority system by adjudicating that right through the water-court process.[36] A user can also obtain a conditional water right by showing an intent to put water to beneficial use and proving that the user "can and will" put the water to beneficial use under Colorado's anti-speculation doctrine.[37] To avoid the requirement of further diligence applications, a conditional ~~become an enforceable perfected water~~ right~~, the owner~~ must be exercised in priority ~~apply to the water court~~ and be established as~~receive~~ an absolute ~~water~~ right by court decree. As the prior appropriation system has evolved, more ~~water rights have been~~ adjudicated water rights exist 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.[38] In over-appropriated basins, new water uses may be~~are~~ created by changing existing water rights to the new uses, or by developing augmentation plans to increase the water supply.[39]~~.~~

Changes of Water Rights

The right to use water in Colorado is usufructory.[41] As such, it is limited to the amount of diversion, location of diversion, place of use, manner of use, and type of use allowed by a water court decree.[42] A water right may be conveyed to another water user or, with appropriate water court or administrative approval, changed to another location of diversion, place of use, manner of use, or type of use, while still retaining its priority. However, changes of water rights are subject to terms and conditions that prevent injury to existing water rights.[43]

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.[40]

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.[44] In addition to establishing historical consumptive use, an analysis must establish the timing, location, and amount of historical return flows (the nonconsumed~~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 at the time of their appropriation.[45] A full analysis considering time, place, and amount of historical use on a stream is generally referred to as a "net stream depletion" analysis. Because the prior appropriation doctrine forbids the change of one water right to the injury of another (even a junior water right[46]), making such changes is a costly proposition with complex legal and engineering analyses required.

The goal of the net stream depletion assessment, including historical beneficial consumptive use, is to make sure that future depletions or consumptive use do not exceed historic depletions or

consumptive use.~~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 before~~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.[47]

Augmentation Plans

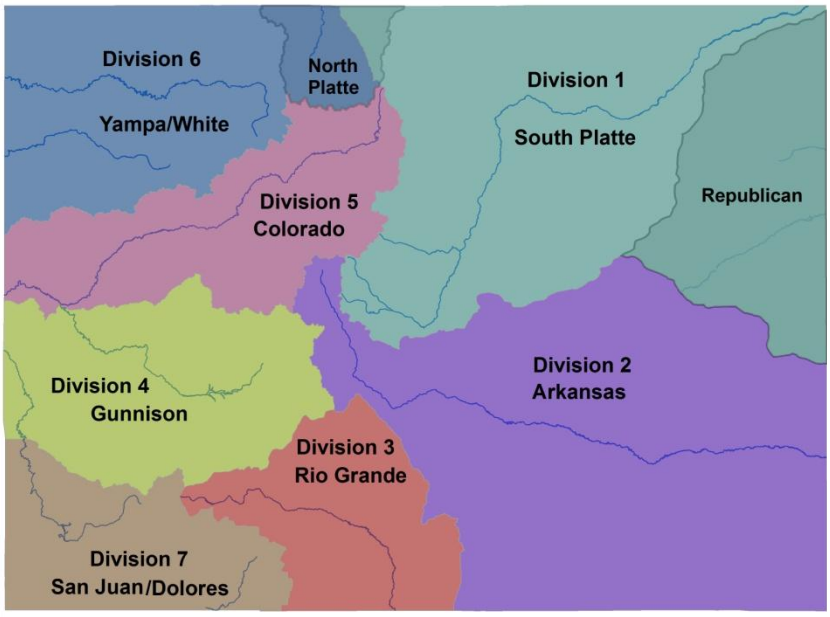
Colorado water law allows users to divert water out-of-priority if they replace any injurious depletions under what is called a "plan for augmentation."[48] A typical plan for augmentation allows a user with a junior water right holder to divert out-of-priority, ("~~(thus~~ cutting in line" so to speak), 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.[49] 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 as well as the same time, location, and amount as the stream depletions caused by out-of-priority pumping or diversions.[50] 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, the 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.[51]

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.[53] Water commissioners, who work under the division engineer, not only monitor diversion structures and streams in the field for immediate administration of water rights, but they also gather important data for use in water-planning studies and

Figure 2-1: Colorado's Water Divisions[52]



decision support systems.[54]

The water commissioners also administer calls on the river system to ensure the holder of a senior water right receives its entitlement.~~a full allocation.~~ Other duties of the water commissioners and other DWR employees~~Division Engineers~~ include regulating headgates and measuring devices as well as~~, and~~ administering and enforcing storage water rights, plans for augmentation, exchanges, and transmountain water diversions.[55] The DWR also oversees the well permitting process for all types of groundwater.[56] Well permits are required for extraction of tributary groundwater, designated groundwater, nontributary ~~non-tributary~~ groundwater, Denver Basin groundwater, produced water from tributary Coal Bed Methane wells, and geothermal groundwater.[57]

In its management of water records statewide, the DWR maintains decrees, permits, maps, historical streamflow and diversion measurements, real-time streamflow and major diversions, and groundwater levels. The DWR also maintains a repository of policy documents, planning materials, rules, and regulations.[58]

Water resources data ~~DWR has~~ collected by the DWR is available online through~~data for many years and placed it into~~ Colorado's Decision Support Systems (CDSS).~~,~~ a joint effort of the CWCB and the DWR.[59] The CDSS consists of data, mapping, and analytical tools and models to assist the state and stakeholders in water-resources planning and -management. The CDSS contains historical data and~~ system designed to analyze and model pertinent~~ information on~~for water users and organizations. Tools within the Decision Support Systems generate maps, tables, and graphs that show information such as~~ streamflow, ~~historical~~ diversions, climate, water rights, call records,~~and detailed~~ well permits, aquifer properties and groundwater levels. The CDSS analytical resources include an online map viewer, data-processing and graphing tools, crop-consumptive-use models, and surface~~information. The Decision Support Systems provide a variety of resources and models for~~ water and groundwater models. The CDSS map viewer is available here.[60]~~management organizations and other interested parties.~~

Moving Forward

The evolution of Colorado water law through the courtroom and the legislative process presents both challenges and opportunities for Colorado's Water Plan. The institution of the prior appropriation system can be~~is~~ difficult to navigate because of the planning and costs associated with the necessary judicial and administrative approvals. Efforts are currently underway to simplify the process and support the evolving water uses in Colorado. Alternatives, such as the~~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, ("CRCA") between Denver Water and more than~~over~~ two dozen western slope entities,[61] and subsequent agreements with various entities including the CWCB, illustrate the ability to work collaboratively and creatively within 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 wherein 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.[62] Initially, downstream states sought to resolve water disputes through litigation before the United States Supreme Court.[63]

Two cases decided by that Court convinced Colorado water leaders that negotiated interstate water agreements were preferable to litigation.[64] Colorado is a party to nine formal interstate water agreements, called compacts. These~~, and these~~ compacts, as well as water administration within Colorado,~~-~~ place limits on Colorado's ability to use all of the water supplies that originate within the state (see Table 2.2-1).

Table 2.2-1: 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 of their fair share of Arkansas River flows, the U.S. Supreme Court announced the doctrine of equitable apportionment.[65] 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.[66] 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."[67] *Kansas v. Colorado* left future disagreements about river use to the uncertain and expensive process of protracted, U.S. 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*.[68] 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.[69] Thus, this decision required junior water users in Colorado to honor senior water rights in Wyoming.[70]

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.[71] Delph Carpenter of Greeley, an experienced irrigation litigator as well as a rancher and former state senator, was appointed interstate streams commissioner in 1913.[72] As an attorney for Colorado, he worked on negotiations with Nebraska regarding the South Platte River.[73] 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.[74]

Table 2.2-2: Colorado's Interstate Decrees

Laramie River Decree, 1957
North Platte Decree, 2001

Carpenter became especially concerned about the Colorado River. California, a prior appropriation state, was growing rapidly.[75] 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.[76] To protect Colorado, Carpenter was the principal force in the negotiation of the Colorado River Compact, and he went on to negotiate additional compacts on behalf of Colorado.[77] Carpenter's model guided other negotiators of interstate water compacts, which provided certainty to water users in all participating states.[a]

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, about the management of interstate waters. However, as more fully described within this Chapter, litigation still occurs regarding compact interpretation, but that litigation tends to be streamlined and more efficient as a result of an existing water compact.~~interstate waters.~~ The nine water compacts, along with two court decrees, are fundamental elements of Colorado's Water Plan 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.

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."[b] 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.[78]

[a] 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).

[b] The "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.

Figure 2-2: The Colorado River Basin



Generally, the compact divides 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).[79] The dividing point between the basins is Lee Ferry, Arizona.[80] The compact recognizes each basin's right to the beneficial consumptive use of 7.5 million acre-feet of water per year in perpetuity.[81] The lower basin states may increase their beneficial consumptive use by 1 million acre-feet per year.[82] 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 10 consecutive years."[83] 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 in excess of the apportionments between the basins.[84] If no surplus exists, the upper and lower basins are to share equally in meeting any such deficiency.[85] 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.[86] 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."[87] Complete text of the compact can be found here.

Upper Colorado River Basin Compact

The Upper Colorado River Basin Compact divides the right to beneficial consumptive use of the Colorado River among the upper division states (Colorado, Wyoming, Utah, and New Mexico) and Arizona.[88] The compact was signed by these five states on October 11, 1948 and ratified by Congress in 1949.[89] 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.[90] In addition to the allocation provisions, the compact outlines parameters for the upper division states to assure compliance with the flow obligation at Lee Ferry under the Colorado River Compact, and establishes a commission to implement and administer the compact.[91] Each of the four upper division states and the federal government may appoint a commissioner to the commission.[92]

The Upper Colorado River Basin Compact also sets forth specific terms for apportioning among the states the use of interstate tributaries to the Colorado River, including the Yampa, San Juan, Little Snake, and Henry's Fork.[93] The compact also recognizes water use as decreed by the La Plata River Compact and accounts for such uses as part of the Upper Colorado River Compact.[94] 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.[95] This compact does not impose any fixed delivery obligation.[96] 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.[97] The compact also addresses the allocation of benefits from use of storage at John Martin Reservoir, which was completed the same year the compact was approved.[98] Specifically, the compact directs

that John Martin Reservoir be operated for the benefit of both states and provides specific terms for operation.[99] 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.[100] The compact also establishes the Arkansas River Compact Administration with designated roles and responsibilities.[101]

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.[102] 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.[103] 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.[104] This compact recognizes New Mexico's right to divert and store water from the Animas and La Plata Rivers for uses under the federal reclamation Animas-La Plata Project with the same priority as those diversions made under the same project for Colorado users.[105] 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.[106] 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.[107] 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.[108] This compact allows both states unrestricted use of the river between December 1 and February 15 of each year.[109] 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.[110] 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.[111] 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.[112] 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.[113] 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.[114] 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.[115] 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.[116] If the water supply of any

sub-basin varies by greater than 10 percent relative to the period of record used as a basis for the compact, the allocations also change by the same percentage.[117]

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.[118] Consequently, in 1959 the states established the Republican River Compact Administration (RRCA).[119] 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.[120] 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 3300 acre-feet from the Beaver Creek. Kansas and Nebraska may each consume 190,300 acre-feet and 234,500 acre-feet of water, respectively.[121]

Despite efforts to avoid litigation and promote interstate amiability 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 consensus 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 River 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.[122] 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.[123] It requires that Colorado deliver a certain amount of water at the New Mexico/ 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.[124] The compact assumes a normal release of 790,000 acre-feet from Elephant Butte to irrigate lands in southern New Mexico and Texas and to provide water to Mexico consistent with the 1906 Treaty.[125] 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.[126] The compact also establishes a commission for compact administration purposes. Colorado's State Engineer serves as Colorado's Commissioner.[127] 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.[128] This compact allocates the waters of the South Platte River between Colorado and Nebraska.[129] It relies on the western 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.[130] 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.[131] Like the La Plata Compact, the South Platte Compact specifies that minor irregularities in water delivery will not constitute a violation of the compact.[132] 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.[133] 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.[134] 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.[135] 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.[136] Deliveries to water users in Colorado are to be made from flows of Costilla Creek downstream of where it leaves the mountains.[137] Moreover, the compact allocates 36.5 percent of the usable capacity of the Costilla Reservoir to Colorado and 63.5 percent to New Mexico.[138] 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.[139] A commission comprising~~comprised of~~ the state engineers for both Colorado and New Mexico oversees the compact.[140] 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 be diverted by Colorado outside the Laramie River Basin.[141] Further, no more than 1800~~1,800~~ 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.[142] 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.[143] 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 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.[144] Complete text of the decree can be found here.

Other Institutional Interstate & 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). These less formally recognized interstate water agreements are more fully described below. 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 been resolved through interstate agreements, and some of these cooperative arrangements are further described below.~~.~~

Pot Creek Agreement

Colorado and Utah used a Memorandum of Understanding (MOU) to define their relationship regarding Pot Creek, rather than an interstate compact.[145] 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 established an equitable and workable division of water between the two states. This MOU stipulates 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 beforeprior to the formulation of an interstate compact. One aspect of the Pot Creek MOU defines the parameters for appointing a water commissioner with the authority to administer water in both Colorado and Utah. The expenses are to be divided 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.[146]

Sand Creek Agreement

Sand Creek originates in the Laramie Mountains of Colorado and flows into Wyoming where it joins the Laramie River.[147] To equitably apportion Sand Creek, Colorado and Wyoming signed an MOU on March 13, 1939. The Sand Creek MOU allocates waters according to the priority water rights in Colorado and Wyoming, recognizing that Wyoming was entitled to 50.68 cubic feet per second beforeprior 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 limits diversions of the Sand Creek Ditch and the Wilson Supply Ditch to amounts of water in excess of the water allocated to Wyoming.[148]

Colorado River Agreements

Within the Colorado River Basin, states~~there~~ have made~~been~~ extraordinary strides toward cooperation in the last several decades. For example, the Upper Colorado River Endangered Fish 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).[149] 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 seeks to minimize the potential threats to the species that could result in a federal listing using coordinated state-driven preventative measures.[150]

In 2007, the states overcame 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 for Lake Powell and Lake Mead through 2026.[151] 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.[152]

Continued cooperative efforts have helped lower basin interests to use water more efficiently. Such efforts include the creation of the 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.[153] 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.[154]

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, to protecting power generation~~,~~ and instream natural resources, including endangered

fish and other natural resources, and to ensuring the continued use and development of existing water supplies.

~~-~~Platte River Agreements

On the South and North Platte Rivers, Colorado, Wyoming, and Nebraska are currently working with the Department of the Interior to collectively manage the rivers with the dual goals of endangered species recovery and water development protection. The Platte River Recovery Implementation Program, established in 1997 and authorized by Congress in 2008, seeks to restore habitat, provide for increased stream flows, and encourage an adaptive management approach to river operations.[155] This program is further described in Chapter 6.

Republican River Agreements

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 any negative effects of compact compliance on~~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 Agreements

On the Rio Grande, the state continues to work on intrastate and interstate issues related to groundwater administration and compliance with the compact 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 develop 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 Rio Grande River 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.[156]

San Juan/Dolores River Agreements

In the San Juan/Dolores Basin, a major project was recently built~~is underway~~ to assist Colorado in meeting its compact obligations to New Mexico. The Long Hollow Reservoir was~~is being~~ constructed to both supplement the irrigation needs for the region and to assist in fulfilling compact requirements. This reservoir allocates~~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 the CWCB 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.[157] 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.[158]

2.3.1 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.[159] 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 substantial~~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.[160]

Counties and municipalities are also required to adopt master plans for the development of their jurisdictions, which may include a water ~~-~~ supply component.[161] State law encourages water efficiency and conservation through public project landscaping guidelines.[162]

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 added burden~~impacts~~ of new development on existing infrastructure and capital improvements and cannot be used for ongoing expenses and maintenance.[163] Nearly half of Colorado's cities have implemented impact fees, and the most commonly used fees are for water and sewer.[164] 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.[165]

In addition to providing a tool for offsetting burdens on~~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.[166]

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 effects~~impacts~~ of new developments.[167]

2.3.2 Special Districts

Colorado law allows voters to create many types of local special districts,[168] 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.[169] There are several~~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.[170]
- 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.[171]
- Water and Sanitation Districts—provide both water and wastewater services.[172]
- Metropolitan Districts—provide two or more of a variety of services including parks and recreation, wastewater, and water.[173]
- Park and Recreation Districts—provide park or recreational facilities or programs.[174]
- Irrigation districts—provide for the irrigation of lands in the district and the drainage work necessary to maintain irrigation.[175]
- 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.[176]
- Urban Drainage and Flood Control—assist local governments with multi-jurisdictional drainage and flood control challenges and provide funding or levy property taxes to fund programs and projects.[177]
- Groundwater Management Districts—adopt rules and regulations to help administer groundwater within the district.[178]

2.3.3 The Department of Local Affairs (DOLA) Overview

The 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 the 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 the 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. The DLG often funds county and municipal comprehensive plans and encourages water supply and conservation elements.

2.4 Local, State, Tribal, and Federal Water Planning, Approval, and Permitting

Those who wish to~~To~~ implement a water project in Colorado must have~~,~~ permits, licenses, contracts, certifications, or other approvals from numerous local, state, and federal governmental entities~~. are required.~~ Partnerships with and among these agencies at all levels of government are critical to ensure that environmental issues can be identified and addressed in a timely and effective manner. This section provides an overview of the entities typically involved in permitting and the State's role in planning.

2.4.1 Governmental Entities with Permitting, Licensing, Contract, and Certification Responsibilities

Typically, the following organizations are involved in the permitting process.

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 effects~~impacts~~ resulting from proposed water projects because of their 1041 powers, which are detailed below under the state planning section.[179]

State Entities:

- *The CWCB* is a division within the Colorado Department of Natural Resources. The CWCB sets water policy and planning in Colorado.[180]
- *The Colorado Water Quality Control Division (WQCD)* 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).
- *The DWR* is housed in the Colorado Department of Natural Resources and is responsible for water administration. The DWR ensures that the water rights for a project can be administered. New water rights and well permits must be filed with the DWR.
- *The 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.[181]

Tribal Entities:

- The Southern Ute Indian Tribe and the Ute Mountain Ute Tribe are federally-recognized tribal governments with responsibilities for the protection and use of water on the Southern Ute Indian Reservation and the Ute Mountain Ute Reservation.
- The Ute Mountain Environmental Programs Department is a Ute Mountain Ute Tribal department and is responsible for implementing tribal water quality standards (including antidegradation provisions under Section 303 of the Clean Water Act) and for federal permitting under Section 401 of the Clean Water Act for projects located on the Ute Mountain Ute Reservation.
- The Southern Ute Water Resources Division is a division of the Southern Ute Indian Tribe overseeing: 1) water resources planning; 2) project implementation, including cooperative projects with the non-Indian communities coordinating tribal actions in Colorado's water courts; and, 2) the Tribe's role in the cooperative and coordinated administration of the Tribe's water rights.

Federal Entities:

Federal entities have several roles that relate to water-management issues in Colorado. As land managers, federal agencies provide land-use authorizations for water projects that occupy federal lands. In addition, the federal agencies have many federal laws that federal agencies must comply with when they issue land authorizations for any water projects. These include, for example, the Federal Land Policy and Management Act, the Endangered Species Act, and the Wild and Scenic Rivers Act, and the National Environmental Policy Act (NEPA). In addition, the following can all act as lead agencies responsible for NEPA compliance and oversight, and many of these agencies are responsible for compliance with land-use authorizations for water projects.

~~*The* **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 the placement of dredged or fill material in waters of the United States, including jurisdictional wetlands under Section 404 of the CWA.
- *The U.S. Army Corps of Engineers (Corps)* is responsible for 404 permitting under the CWA and for the approving uses of their federally owned flood control and water- ~~-~~supply facilities.
- *The U.S. Forest Service (USFS)* manages national forests and grasslands and has substantial land holdings in Colorado (role related to water rights described in Section 2.5).
- *The U.S. Fish and Wildlife Service (USFWS)* manages threatened and endangered species recovery programs and regulates actions affecting~~impacting~~ threatened or endangered species listed under the ESA. This agency is responsible for determining if a project exceeds the bounds of any programmatic biological opinions regarding further water development. In addition, under the Fish and Wildlife Coordination Act, federal agencies responsible for

coordinating federal NEPA~~)~~ compliance must consult with the USFWS regarding the project's potential effects on~~impacts to~~ threatened and endangered fish and wildlife species.

- *The BOR* is the agency that built, and now manages, several water supply and hydropower projects. In Colorado, these include Blue Mesa Reservoir and the Fryingpan-Arkansas Project. The~~Fry-Ark project.~~ BOR is responsible for contracting water out of these federal projects and for the use of these federally owned facilities by third parties.
- *The U.S. Bureau of Land Management (BLM)* is responsible for managing substantial public land holdings within Colorado.
- *The U.S. National Park Service (NPS)* manages substantial land holdings within Colorado for national parks and monuments (see Section 2.5 for the NPS).
- *The Federal Energy Regulatory Commission (FERC)* is responsible for licensing non-federal hydropower projects.

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.[182] The Council on Environmental Quality (CEQ) regulations addressing cooperating governing agencies NEPA specify~~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.[183]

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. 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.

The permitting process is explored in greater detail in Section 9.4, along with potential permitting process improvements.

2.4.2 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.[184] The basin roundtables and the Interbasin Compact Committee (IBCC) were created in 2005 and are participants in the CWCB's statewide water planning efforts.[185]

The IBCC is made up of two representatives from each basin roundtable, six governor appointees, and two appointees from the state legislature.[186] Their charge is to develop agreements among basins and to develop statewide policy issues.[187]

Both the basin roundtables and the IBCC provide critical input to the Statewide Water Supply Initiative (SWSI) and Colorado's Water Plan. The SWSI creates a technical foundation and a common technical platform that stakeholders and Colorado's Water Plan use and build upon. The report, which is periodically updated with the latest technical information, ~~and~~ tracks Colorado's changing water supply and demand. In addition, the basin roundtables and the CWCB have developed a forum where project proponents can find technical and financial support.[188]

Other state agencies have a critical role in planning for other water related aspects. For instance, CPW develops~~develop~~ management plans for fish and other water-~~-~~dependent species.[189] These planning efforts and the technical documentation supporting them often provide a baseline of information that is helpful in the permitting process.

~~These planning efforts and the technical documentation that underpin them often provide a baseline of information that is helpful in the permitting process.~~

2.5 Tribal and Federal Reserved Water Right Issues within Colorado

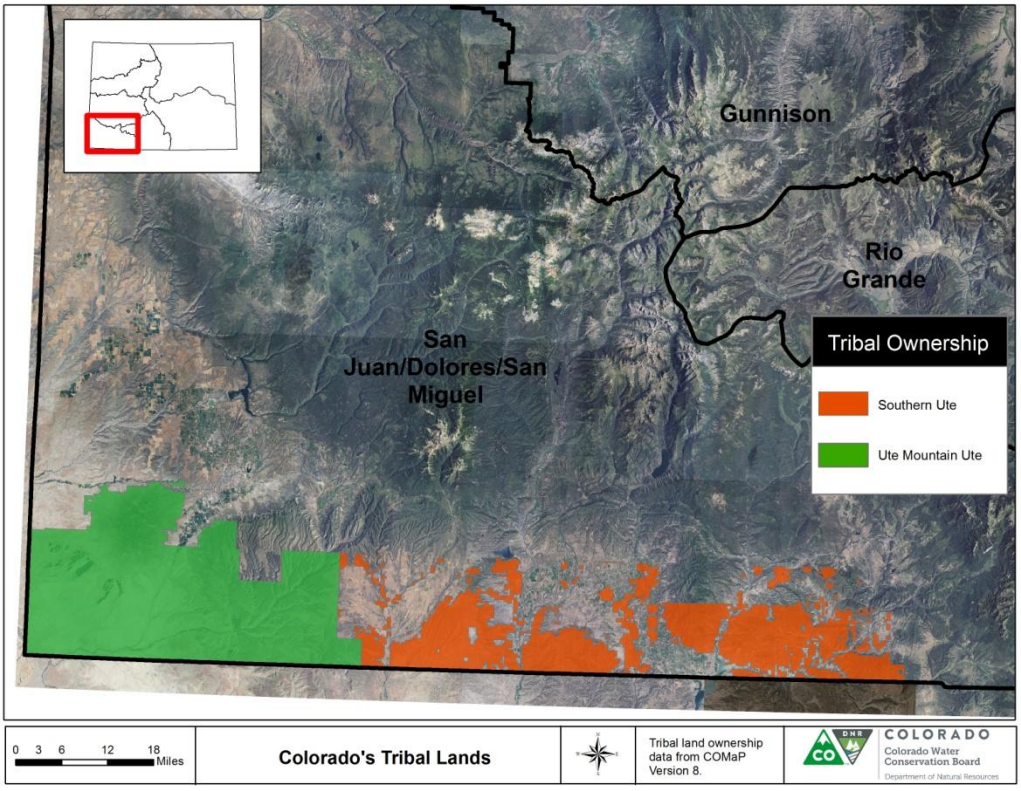
In addition to the patchwork of local, state, and federal agencies involved in water planning (~~,~~ described in Section 2.4)~~,~~ many federal agencies and Native American tribes hold water rights that serve as part of the existing institutional setting for water planning. Colorado is home to a substantial 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 more than~~approximately~~ one-third of this land (24,996~~086~~,075 acres, including tribal lands).[190] ~~F~~ederal agencies with major federal land holdings in Colorado include: the USFS, the BLM, the NPS, and the 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 the Ute Mountain Ute Reservation also includes lands in northwestern New Mexico and in southeastern Utah). The Southern Ute Tribe is governed by its tribal council whose constitution was approved in 1936.[191] The Ute Mountain Ute Tribe is governed by its tribal council whose constitution was approved in 1940.[192] Beyond the two tribes, only the USFS, the NPS, and the BLM~~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."[193] 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 a sufficient~~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.[194] The Winters Doctrine was a landmark~~land mark~~ case because~~for~~ it was the first time the federal government deviated from the established convention that water law was purely a state matter.[195] 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.[196] 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 typically but not always 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 procedure for administering all other water rights within the states. The ability, therefore, of the state systems to function to avoid conflict and create a firm water supply through a comprehensive and cohesive water administration system was complicated by the ~~judicially created~~ federal reserved water rights~~right under the Winters Doctrine~~.

Figure 2-2: Colorado's Tribal Lands



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."[197] 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.[198] 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 and the Tribes administer~~state administers~~ the reserved rights recognized by these proceedings in priority in conjunction with state-based water rights.

2.5.1 Federal Agencies

Water rights held by the USFS, the USFWS, and the NPS have complicated histories.[199] 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 nonconsumptive reserved rights were denied by the water court and withdrawn with prejudice.[200] In Water Division 3, the USFS reached a stipulated decree settlement for both consumptive and nonconsumptive reserved rights in 2000.[201] 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.[202] The USFS's applications for federal water rights are still pending in Water Division 7.[203] The USFWS manages eight National Wildlife Refuges and two National Fish Hatcheries~~has several large wildlife refuges~~ in Colorado. These facilities use water in compliance with water-right decrees based on Colorado's system of prior appropriation. The NPS has obtained federal reserved water rights for Rocky Mountain National Park, ~~the~~ Great Sand Dunes National Park, Colorado ~~and~~ National Monument, the Black Canyon of the Gunnison, and ~~the~~ Mesa Verde National Park.[204] 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.[205]

2.5.2 Tribes

In 1895, the United States established the ~~The~~ Southern Ute Indian Reservation in southwest Colorado and the Ute Mountain Ute Reservation in the southwest corner of Colorado and northern New Mexico (later adding lands in southeastern Utah).[206] In 1976, the United States, on behalf of the Southern Ute Tribe and Ute Mountain Ute Tribe,~~tribes~~ filed ~~water~~ claims to water~~through the United States in 1976 on over twenty-five streams~~ in southwest Colorado to resolve reserved rights~~. Rather than litigate each of these~~ claims for the two reservations. Through an enormous effort of ~~,~~ the Ute Tribes, the State of Colorado, the United States, water districts, and local water users, all of the~~and other~~ parties were able to resolve the Tribal litigation claims in 11 river basins through negotiated settlement (resulting in the 1986 ~~settlements for each river, which were combined and incorporated into the~~ Colorado Ute Indian Water Rights Final Settlement Agreement).[207] In 1988, Congress passed the Colorado Ute Indian Water Settlement Act approving the ~~dated December 6, 1986 (~~1986 Settlement Agreement. The settlement set forth shared responsibilities~~).~~[208]

~~The Final Settlement Agreement quantifies the entitlements of the tribes to reserved water rights in the state of Colorado and provides~~ for administration of some of the tribal~~those reserved~~ rights.[209] 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~~.[210]

In the early 1990s, complications concerning ~~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 issues~~concerns~~ prevented the full implementation of the 1986 Settlement Agreement as it related to ~~, 1988 Settlement Act, and 1991 consent decrees on~~ the Animas and La Plata Rivers; and for the second time, the parties forged a new compromise related to the down-sizing~~. To address these concerns, Congress modified its authorization~~ of the Animas-~~–~~La Plata Project. Congress approved the modifications and ~~, and~~ amended the 1988 Settlement Act in December ~~the Colorado Ute Settlement Act Amendments of~~ 2000.[211] The institutional~~, Pub. L. No. 106-554, 114 Stat. 2763A 258 (2001) (2000 Amendments).[212] According to these amendments, water use from the Animas La Plata Project is limited to municipal and industrial 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 agreed to by the Ute Tribes, the State of Colorado, and the United States in the overall settlement establishes quantities of water rights, priorities~~, construction~~ of tribal rights, permitting requirements, conditions for changing water rights, conditions for leasing, and other terms. Most importantly, it recognized the need for cooperative~~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 coordinated administration~~the reservoir for the Animas-La Plata Project filled in 2011.[213]~~

~~The purposes~~ of the Tribes' ~~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 under state and federal law. ~~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.[214]~~

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[1] Mortimer Stone ed.,~~[1]~~ "A Survey of Colorado Water Law," ~~" (Mortimer Stone ed.) 47~~ *Denv. L. J.* 47~~177, 233~~ (1970~~): 231-247.~~~~).~~

[2] *Empire Lodge Homeowners' Ass'n v. Moyer*, 39 P.3d 1139, 1147 (Colo. 2001).

[3] A. Dan Tarlock, James N. Corbridge, Jr., David H. Getches, and Reed D. Benson, *Water Resource Management: A Casebook in Law and Public Policy, Sixth Edition* (New York: The Foundation Press, 2009): 154-265.
[4] Tarlock et al., *Water Resource Management: A Casebook in Law and Public Policy*, 67-70, 154-158.
[5] Mortimer Stone ed.,~~[5]~~ "A Survey of Colorado Water Law," 230-235." ~~(Mortimer Stone ed.) 47 *Denv. L. J.* 177, 233 (1970).~~
[6] Colo. Const. amend. XVI, § 6.~~[6] *Comstock v. Ramsay*, 55 Colo. 244, 254, 133 P. 1107, 1110 (1913).~~
[7] *Comstock v. Ramsay*, 133 P. 1107, 1110 (Colo. 1913). ~~Const. of 1876, art. XVI, § 6.~~
[8] Water Right Determination and Administration Act of 1969, Colo. Rev. Stat. §§~~,~~ 37-92-101 through -602 (2014).~~et. seq., C.R.S.~~
[9] C.R.S § §37-92-102 (1)(a).~~), C.R.S.~~
~~[10] *Colorado's 1969 Adjudication and Administration Act: Settling in,* University of Denver Water Law Review Volume 3 1999.~~
[11] Colo. Const. amend. XVI, §§ 5, 6; C.R.S § 37-92-101 et seq.
[12] *Safranek v. Limon*, 228 P.2d 975, 977 (Colo. 1951).
[13] Justice Gregory J. Hobbs, Jr., "Colorado's 1969 Adjudication and Administration Act: Settling In," *University of Denver Water Law Review* 3 (1999): 18.
[14] Colorado Groundwater Management Act, C.R.S. §§ 37-90-101 through -143 (2014)
[15] See C.R.S §§ 37-90-103(6), (7) for the definition of the term; see C.R.S § 37-90-101 et seq. for the governance of "designated groundwater."
[16] See C.R.S § 37-90-103(10.5) for the definition of the term.
[17]See C.R.S § 37-90-103(10.7) for the definition of the term.
[18] C.R.S § 37-90-137(4); The Denver Basin Rules, 2 C.C.R § 406.2 (1985).
[19] The Colorado Geothermal Resources Act, C.R.S §§ 37-90.5-101 through -108 (2014).
[20] C.R.S §§ 37-92-602.
[21] "Guide to Colorado Well Permits, Water Rights, and Water Administration," Colorado Division of Water Resources, accessed June 24, 2015, http://water.state.co.us/DWRIPub/Documents/wellpermitguide.pdf.
[22] C.R.S §§ 37-90-104, 106.
[23] C.R.S § 37-90-102(2).
[24] C.R.S §§ 37-90-104, 106.
[25] C.R.S §§ 37-92-501-503.
[26] C.R.S § 37-92-103 (4).
[27] *Williams v. Midway Ranches Property Owners' Association*, 938 P.2d 515, 522 (Colo. 1997).~~[27] § 37-92-103 (4), C.R.S.~~
[28] Colorado Foundation for Water Education, *Citizen's Guide to Colorado Water Law, 3rd Edition*, (Denver: Colorado Foundation for Water Education, 2009): 17-21.
[29] §37-92-102 (3~~103 (4~~), C.R.S.~~: §37-92-103 (4).~~
[30] §37-92-102 (5).~~), C.R.S.~~
[31] "Water Courts," Colorado Judicial Branch, accessed June 24, 2015, https://www.courts.state.co.us/Courts/Water/.
[32] Interview with Dick Wolfe, State Engineer for the Colorado Division of Water Resources, in Denver, CO (June 23, 2014).
[33] Interview with Dick Wolfe, State Engineer for the Colorado Division of Water Resources, in Denver, CO (June 23, 2014).
[34] Colo. Const. amend. XVI, § 6.
[35] *Empire Lodge Homeowners' Ass'n v. Moyer*, 39 P.3d 1139, 1147 (Colo. 2001).
[36] David Getches, *Water Law In a Nutshell, 3rd Edition* (St. Paul: West Publishing, 1997): 152-155.
[37] Carrie L. Ciliberto ed., *Colorado Water Law Benchbook, First Edition, 2013 Supplement* (Denver: Continuing Legal Education in Colorado, 2013): §2.4.3 at 2-9; C*ity of Thornton v. Bijou Irrigation Co.*, 926 P.2d 1.
[38] Interview with Dick Wolfe, State Engineer for the Colorado Division of Water Resources, in Denver, CO (June 23, 2014).
[39] C.R.S § 37-92-103(9).

[40] George E. Radosevich, ~~George E.,~~ *Western Water Laws and Irrigation Return Flow* (Ada: ~~U.S.~~ EPA, ~~:~~ 1978); Bryan A. Garner, ed., ~~:~~ *Black's Law Dictionary, 7th Edition* (St. Paul: West Group, 1999): 1542-1543~~4th ed. revised, 1968~~.
[41] *Santa Fe Trail Ranches Property Owners Association v. Simpson*, 990 P.2d 46, 54.
[42] *Santa Fe Trail v. Simpson*, 990 P.2d 46, 54.
[43] § 37-92-305 (3), (4) C.R.S.
[44] *Trail's End Ranch, L.L.C. v. Colo. Div. of Water Res.*, 91 P.3d 1058, 1063 (Colo. 2004).
[45] *Santa Fe Trail v. Simpson*, 990 P.2d 46, 54;~~45~~ *Colorado Water Conservation Board v. City of Central*, 125 P.3d 424 (Colo. 2005).
[46] *Colorado Water Conservation Board v. Central*, 125 P.3d 424 (Colo. 2005).
[47] *Colorado Water Conservation Board v. Central*, 125 P.3d 424 (Colo. 2005).
[48] C.R.S § 37-92-103 (9).~~48 *Simpson v. Bijou Irrigation Co.*, 69 P.3d 50, 60 (Colo. 2003).~~
[49] *Simpson v. Bijou Irrigation Co.*, 69 P.3d 50, 60 (Colo. 2003).
[50] C.R.S. ~~§§~~ 37-92-305(5)~~,) & (8), C.R.S.~~
[51] "Guide to Colorado Well Permits, Water Rights, and Water Administration," Colorado Division of Water Resources, accessed June 24, 2015, http://water.state.co.us/DWRIPub/Documents/wellpermitguide.pdf.
[52] "Colorado Basins," State of Colorado Department of Natural Resources, Division of Water Resources, accessed June 23, 2015, http://water.state.co.us/DWRIPub/DWR%20Maps/ColoradoRiverBasins.pdf; "Division Offices by Major River Basins," Division of Water Resources, accessed June 23, 2015, http://water.state.co.us/DivisionsOffices/.
[53] "DWR Home," Colorado Division of Water Resources, accessed June 24, 2015, http://water.state.co.us/.
[54] "Division Offices by Major River Basins," Division of Water Resources, accessed June 23, 2015, http://water.state.co.us/DivisionsOffices/.
[55] "DWR Home," Colorado Division of Water Resources, accessed June 24, 2015, http://water.state.co.us/.
[56] "Guide to Colorado Well Permits, Water Rights, and Water Administration," Colorado Division of Water Resources, accessed June 24, 2015, http://water.state.co.us/DWRIPub/Documents/wellpermitguide.pdf.
[57] Colorado Foundation for Water Education, ~~:~~ ~~"~~*Citizen's Guide to Colorado Water Law, 3rd Edition*, (Denver: Colorado Foundation for Water Education, 2009): 17-21.~~"~~ Accessed June 23, 2015,~~September, 2014.~~ http://issuu.com~~www.yourwatercolorado.org~~/cfwe/docs/wl4_r9_web/1; "Guide to Colorado Well Permits, Water Rights, and Water Administration," Colorado Division of Water Resources, accessed June 24, 2015, http://~~education/~~water.state.co.us/DWRIPub/Documents/wellpermitguide.pdf; Produced Nontributary Ground Water Rules, 2 C.C.R § 402.17~~is/water-law~~.
[58] Interview with Dick Wolfe, State Engineer for the Colorado Division of Water Resources, in Denver, CO (June 23, 2014).
[59] "Colorado's Decision Support System," Colorado Division of Water Resources and Colorado Water Conservation Board, accessed June 24, 2015, http://cdss.state.co.us.
[60] "Map Viewer," Colorado Division of Water Resources and Colorado Water Conservation Board, accessed June 24, 2015, http://cdss.state.co.us/onlineTools/Pages/MapViewer.aspx.
[61] "Colorado River Cooperative Agreement: Path to a Secure Water Future," Denver Water, accessed June 24, 2015, http://www.denverwater.org/SupplyPlanning/Planning/ColoradoRiverCooperativeAgreement/.
[62] Thomas V. Cech and J. William McDonald, *Defend and Develop* (Ashland: Wellstone Press), 25.
[63] Cech and McDonald, *Defend and Develop*, 25-26.
[64] Daniel Tyler, *Silver Fox of the Rockies* (Norman: University of Oklahoma Press), 88-122.
[65] *Kansas v. Colorado*, 206 U.S. 117 (1907).
[66] *Kansas v. Colorado*, 206 U.S. 46 (1907).
[67] *Kansas v. Colorado*, 206 U.S. 46 (1907).
[68] *Wyoming v. Colorado*, 259 U.S. 419 (1922).
[69] *Wyoming v. Colorado*, 259 U.S. 419 (1922).
[70] *Wyoming v. Colorado*, 259 U.S. 419 (1922).
[71] Tyler, *Silver Fox of the Rockies*, 104-105.
[72] Tyler, *Silver Fox of the Rockies*, 100.
[73] Tyler, *Silver Fox of the Rockies*, 104-105.
[74] Tyler, *Silver Fox of the Rockies*, 119.

[75] Tyler, *Silver Fox of the Rockies*, 115.
[76] Tyler, *Silver Fox of the Rockies*, 115.
[77] Tyler, *Silver Fox of the Rockies*, 88-122.; 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.

[78] § 37-61-101 et seq., C.R.S. and approved by Congress by the Boulder Canyon Project Act, Chapter 42, § 4, ~~page~~ 45 (1928)(codified at 42 U.S.C.A. § 617c).
[79] § 37-61-101 et seq.~~.,~~ C.R.S.
[80].§ 37-61-101 et seq., C.R.S.
[81] § 37-61-101 et seq., C.R.S.
[82] § 37-61-101 et seq., C.R.S.
[83] § 37-61-101 et seq., C.R.S.
[84] § 37-61-101 et seq., C.R.S.
[85] § 37-61-101 et seq., C.R.S.
[86] § 37-61-101 et seq., C.R.S.
[87] *Arizona v. California*, 283 U.S. 423 (1931).
[88] § 37-61-101 et seq., C.R.S.
[89] § 37-61-101 et seq., C.R.S. 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)).
[90] § 37-62-101 et seq., C.R.S.
[91] § 37-62-101 et seq., C.R.S.
[92] § 37-62-101 et seq., C.R.S.
[93] § 37-62-101 et seq., C.R.S.
[94] § 37-62-101 et seq., C.R.S.
[95] § 37-69-101 et seq., C.R.S. and approved by Congress by Act on May 31, 1949, ch.155 (codified at 63 Stat. 145).
[96] § 37-69-101 et seq., C.R.S.
[97] § 37-69-101 et seq., C.R.S.
[98] § 37-69-101 et seq., C.R.S.
[99] § 37-69-101 et seq., C.R.S.
[100] § 37-69-101 et seq., C.R.S.
[101] § 37-69-101 et seq., C.R.S.
[102] Arkansas River Compact Administration, *Resolution Concerning an Operating~~Operationg~~ Plan for John Martin~~Matrin~~ Reservoir, Resolution No. 2010-01*(1980, revised 1984 & 2010).
[103] *Kansas v. Colorado*, 543 U.S. 86 (2004).
[104] § 37-64-101, C.R.S. and approved by Congress by Act on September 30, 1968, Public Law No. 90-527 (codified at 82 Stat. 885, 898).
[105] § 37-64-101., C.R.S.
[106] § 37-64-101., C.R.S.
[107] § 37-63-101 et seq., C.R.S. and approved by Congress by Act on January 29, 1925, ch. 110 (codified at 43 Stat. 796).
[108] § 37-63-101 et seq., C.R.S.
[109] § 37-63-101 et seq., C.R.S.
[110] § 37-63-101 et seq., C.R.S.
[111] § 37-63-101 et seq., C.R.S.
[112] § 37-63-101 et seq., C.R.S.
[113] § 37-67-101 et seq., C.R.S. and approved by Congress by Act on May 26, 1943, ch. 104 (codified at 57 Stat. 86).
[114] § 37-67-101 et seq., C.R.S.
[115] § 37-67-101 et seq., C.R.S.
[116] § 37-67-101 et seq., C.R.S.
[117] § 37-67-101 et seq., C.R.S.
[118]§ 37-67-101 et seq., C.R.S.

[119] "Republican River Compact Synopsis," Republican River Water Conservation District, accessed October 8, 2014. http://www.republicanriver.com/CompactInfo/tabid/93/Default.aspx.
[120] "Republican River Compact Synopsis."
[121] "Republican River Compact Synopsis."
[122] C.R.S. § 37-66-101 et seq., C.R.S. and approved by Congress by Act on May 31, 1939, ch. 155 (codified at 53 Stat. 785).
[123] § 37-66-101 et seq., C.R.S.
[124] § 37-66-101 et seq., C.R.S.
[125] § 37-66-101 et seq., C.R.S.
[126] § 37-66-101 et seq., C.R.S.
[127] § 37-66-101 et seq., C.R.S.
[128] § 37-65-101 et seq., C.R.S. and approved by Congress by Act on March 8, 1926, ch. 46 (codified at 44 Stat.195).
[129] § 37-65-101 et seq., C.R.S.
[130] § 37-65-101 et seq., C.R.S.
[131] § 37-65-101 et seq., C.R.S.
[132] § 37-65-101 et seq., C.R.S.
[133] § 37-68-101 et seq., C.R.S. and approved by Congress by Act on December 12, 1963, Public Law No. 88-198 (codified at 77 Stat. 350).
[134] § 37-68-101 et seq., C.R.S.
[135] § 37-68-101 et seq., C.R.S.
[136] § 37-68-101 et seq., C.R.S.
[137] § 37-68-101 et seq., C.R.S.
[138] § 37-68-101 et seq., C.R.S.
[139] § 37-68-101 et seq., C.R.S.
[140] § 37-68-101 et seq., C.R.S.
[141] *Wyoming v. Colorado*, 353 U.S. 953 (1957).
[142] *Wyoming v. Colorado*, 353 U.S. 953 (1957).
[143] *Nebraska v. Wyoming,* 534 U.S. 40 (2001).
[144] *Nebraska v. Wyoming,* 534 U.S. 40 (2001).
[145] Dick Wolfe and Joseph Grantham, "Water Administration: State Engineer's Office," in *Colorado Water Law Benchbook*, eds. Carrie Ciliberta and Timothy Flanagan (Denver: Continuing Legal Education in Colorado, Inc., 2014), 14-63.
[146] Wolfe and Grantham, "Water Administration: State Engineer's Office," 14-63.
[147] Wolfe and Grantham, "Water Administration: State Engineer's Office," 14-64.
[148] Wolfe and Grantham, "Water Administration: State Engineer's Office," 14-64.
[149] Utah Department of Natural Resources, Division of Wildlife, *Conservation~~Conservantion~~ and Management Plan for Three Fish Species in Utah* (Salt Lake City: 2006), 5.
[150] Utah Department of Natural Resources, Division of Wildlife, *Conservation~~Conservantion~~ and Management Plan for Three Fish Species in Utah*, 5.
[151] U.S. Bureau of Reclamation, *Record of Decision: Colorado Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead* (2007). http://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf.
[152] U.S. Bureau of Reclamation, *Record of Decision: Colorado Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead*.
[153] International Boundary and Water Commission, United State and Mexico, *Minute No. 319: Interim International Cooperative Measures in the Colorado River Basin through 2017 and Extension of Minute 318 Cooperative Measure to Address the Continued Effects of the April 2010 Earthquake in the Mexicali Valley, Baja California* (2012). http://www.ibwc.state.gov/Treaties_Minutes/Minutes.html.
[154] "Weather Modification~~Modificiation~~ Program," Colorado Water Conservation Board, accessed October 8, 2014, http://cwcb.state.co.us/water-management/water-projects-programs/pages/%C2%ADweathermodificationprogram.aspx.
[155] "Program Information," Plate River Recovery Implementation Project, accessed October 8, 2014. https://www.platteriverprogram.org/AboutPRRIP/Pages/ProgramInformation.aspx; see also Platte River

Recovery Implementation Program and Pathfinder Modification Project Authorization, enacted by Congress on May 8, 2008, Public Law No. 110-229.~~.~~

[156] *Texas vs. New Mexico and Colorado*, Docket No. 22O141, Original (January 2013).
[157] Colorado Constitution, Article XX § 9.
[158] Colorado Constitution, Article XIV § 16.
[159] § 29-20-102, C.R.S.
[160] § 29-20-301 et seq., C.R.S.
[161] § 30-28-106 and 31-23-206, C.R.S.
[162] § 37-96-101 et seq., C.R.S.
[163] § 29-20-104.5, C.R.S.
[164] Colorado Municipal League. 2013. Accessed October 2014. http://www.cml.org/.
[165] Kathlene, Dr. Lyn, Jewlya Lynn, Adam Greenwade, Wendy Sullivan, and Quinn Lung. *Colorado Review: Water Management and Land Use Planning Integration*. 2010.
[166] § 31-15-707, C.R.S.
[167] § 24-65.1-101 et seq., C.R.S.
[168]§ 32-1-103 et seq., C.R.S.
[169] Special District Association of Colorado. *Legislator's Guide to Special Districts*. 2013.
[170] § 32-4-40, C.R.S.
[171] § 32-1-103 (18), C.R.S.
[172] § 32-1-103 (24), C.R.S.
[173] § 32-1-103 (10), C.R.S.
[174]§ 32-1-103 (14), C.R.S.
[175] § 37-41-101 to 37-44-149, C.R.S.
[176] § 37-45-101 and 37-47-101 to 37-50-142, C.R.S.
[177] Urban Drainage and Flood Control District. Accessed October 15, 2014. http://www.udfcd.org/. and § 32-11-101, C.R.S.
[178] § 37-90-101 et seq, C.R.S.
[179] Department of Local Affairs, "1041 Regulations~~Regulatations~~," accessed October 8, 2014. http://www.colorado.gov/cs/Satellite/DOLA-Main/CBON/1251595404521.
[180] § 37-60-122.2, C.R.S.
[181] § 37-60-122.2, C.R.S.
[182] National Environmental Policy Act (NEPA) enacted by Congress on January 1, 1970, Public Law No. 91-190, 83 Stat. 852 (codified as amended at 42 U.S.C. § 4321-4370).
[183]Council on Environmental Quality, *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act, 40 CFR Parts 1500-1508* (2005).
[184] § 37-60-101 et seq, C.R.S.
[185] § 37-75-101 et seq, C.R.S.
[186] § 37-75-101 et seq, C.R.S.
[187] § 37-75-101 et seq, C.R.S.
[188] § 37-75-101 et seq, C.R.S.
[189] § 37-60-122.2, C.R.S.
[190] Ross W. Gorte, Carol Hardy Vincent, Laura A. Hanson, and Marc R. Rosenblum, *Federal Land Ownership: Overview and Data* (Congressional Research Service, 2010), http://fas.org/sgp/crs/misc/R42346.pdf.
[191] Department of the Interior, Office of Indian Affairs, *Constitution and By-Laws of the Southern Ute Tribe of the Southern Ute Reservation* (Washington: United States Government Printing Office, 1936).
[192] Department of the Interior, Office of Indian Affairs , *Constitution and By-Laws of the Ute Mountain Tribe of the Ute Mountain Reservation* (Washington: United States Government Printing Office, 1940).
[193] *Winters v. United States*, 207 U.S. 564 (1908).
[194] *Winters v. United States*, 207 U.S. 564 (1908).
[195] *California v. United States*, 438 U.S. 645, 653(1978).; *United States v. New Mexico*, 438 U.S. 696, 702 (1978).
[196] *Cappaert v. United States*, 426 U.S. 128 (1976); *United States v. New Mexico*, 438 U.S. 696, (1978).
[197] 43 U.S.C § 666 (1952).
[198] 43 U.S.C § 666 (1952).

[199] James M. Corbridge Jr. and Theresa A. Rice, *Vranesh's Colorado Water Law, Revised Ed.* (Niwot: University Press of Colorado, 2000), 441-461.
[200] In the Matter of the Amended Application of the United States of America for Reserved Water Rights in the Platte River in Boulder, Clear Creek, Douglas, El Paso, Gilpin, Jefferson, Larimer, Park and Teller Counties (Dist. Ct., Water Div. No. 1, Colo. 1993) (Nos. W-8439-76, W-8977-77, W-9052-77, and W-9065-77).; U.S. v. Jesse, 744 P.2d 491 (Colo. 1987).; 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).
[201] 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).
[202] 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).; 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).; 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).
[203] 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).; 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).
[204] 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).; 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).; 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).; 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).; 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).
[205] 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).
[206]Charles Kappler, *Indian Affairs: Laws and Treaties*, vol. 2, ed. (1904; repr., Washington, DC: Government Printing Office, 1972).
[207] Colorado Ute Indian Water Rights Settlement Act of 1988, Pub. L. No.100-585 (102. Stat. 2973).
[208] Colorado Ute Indian Water Rights Settlement Act of 1988, Pub. L. No.100-585 (102. Stat. 2973).
[209] Colorado Ute Indian Water Rights Settlement Act of 1988, Pub. L. No.100-585 (102. Stat. 2973).
[210] Colorado Ute Indian Water Rights Settlement Act of 1988, Pub. L. No.100-585 (102. Stat. 2973).
[211] 1988 Settlement Act in the Colorado Ute Settlement Act Amendments of 2000, Pub. L. No. 106-554, 114 Stat. 2763A 258 (2001).
[212] 1988 Settlement Act in the Colorado Ute Settlement Act Amendments of 2000, Pub. L. No. 106-554, 114 Stat. 2763A 258 (2001).
[213] 1988 Settlement Act in the Colorado Ute Settlement Act Amendments of 2000, Pub. L. No. 106-554, 114 Stat. 2763A 258 (2001).
[214] 1988 Settlement Act in the Colorado Ute Settlement Act Amendments of 2000, Pub. L. No. 106-554, 114 Stat. 2763A 258 (2001).

coloradowaterplan.com
cowaterplan@state.co.us
Direct 303-866-3441

3. Overview of Each Basin

Introduction

This chapter~~section~~ examines the river basins in the context of the larger river systems that~~which~~ they comprise. While we are one state, each river basin is unique~~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 the Colorado Water Conservation Board (CWCB) members reviewed and updated these~~were asked to update~~ descriptions, working from the Statewide Water Supply Initiative ~~(SWSI)~~ report released by the CWCB in 2011. Basin descriptions, concerns, and challenges have been updated with this most recent request for feedback.

Basin Descriptions and Challenges

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 more than~~over~~ 10,000 feet to an elevation of 3340 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 1/3~~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. More than~~Over~~ 20 percent of the land is publicly owned. A large amount of the grassland is devoted to agriculture with 1/3~~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 affected~~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 developed well-administration rules to bring Colorado into compliance with the compact, and Colorado compensated Kansas for damage claims (aboutapproximately $34 million). Recently, the Colorado State Engineer developed 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 pertainingwith respect to water management issues and needs over the next 40 years, which are 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 effects onimpacts to rural economies are substantialsignificant in the lower portion of the basin downstream of Pueblo Reservoir.
- Recreational in-channel diversions or water rights for recreation will have an influenceimpact 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).

Basins of the Colorado River System

The Colorado River system (including tributary basins) drains more than 1/3over 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, approximately~~about~~ 75 percent of the water in the entire river basin originates in the state. In the State of Colorado, transbasin diversions account for approximately~~about~~ 5 percent of the total water supply, or approximately~~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 9830~~9,830~~ square miles. Elevations in the basin range from greater than 14,000 feet in the headwaters areas, to about 4300~~4,300~~ feet at the Colorado-Utah state line. The basin's mountainous upper reaches 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.



Colorado River

Snowpack in the elevations above 9000~~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 landscapes in the Upper Colorado River Basin (about 85 percent). Livestock grazing, recreation, timber harvesting, and gas drilling are the leading uses of the federal lands. Active and inactive mines can also be found within the basin.

Basin Challenges: The Colorado River Basin will face several key challenges pertaining~~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 affect~~impact~~ 20 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~~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 effects~~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 more than~~over~~ 8000 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 9500~~9,500~~ feet of elevation change.



Gunnison River

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.

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

- Growth in the headwaters region 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 5100~~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 affecting~~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 among~~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 several~~a 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:



Dolores River

- The Colorado Ute Indian Water Rights Settlement Act of 1988 settled~~—Settles~~ the reserved water right claims of the Southern Ute and Ute Mountain Ute Tribes concerning quantity, priority, and administration 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 7600~~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~~Settlement~~ provided the Tribes with a municipal and industrial (~~an~~ M&I) water source to supply and augment future depletions of the San Juan River system that~~which~~ are constrained by the San Juan Recovery Program for Endangered Native Fish. The Animas-La Plata Project~~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.
- Land in the~~The~~ Southwest Basin is extensively owned~~also characterized~~ by the~~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 that are ~~,~~ 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 it is also seeing growth with an increase of 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~~identified projects~~ and Processes~~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.

South Platte River Basin

Basin Description: The South Platte River Basin is the most populous basin in the state~~State~~. Per Statewide Water Supply Initiative~~SWSI~~ 2010, the South Platte Basin population is expected to double from about~~approximately~~ 3.5 million people to 6 million people by 2050. Approximately 85 percent 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.



South Platte River

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, the Big Thompson River, and the Cache La Poudre River join the South Platte; then crosstraverse 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 mostthe majority of these lands in the forested mountains. The South 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 aboutapproximately 400,000 acre feet of transbasintrans-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, more thanover 30,000 acre feet are pumped from nontributarygroundwaternon-tributary groundwater aquifers to supplement supplies. YetHowever, surface water diversions in the South Platte Basin average aboutapproximately 4 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 leaves 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 programProgram 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 mosta 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. ColoradansColoradoans 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 percent of total water diversions. Conversion of agricultural water to M&I uses (agricultural transfers) will

continue to be an importanta ~~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 effects on~~impacts to~~ rural communities, ~~as well as to~~ open spaces, wetlands and recreation areas that are tied to irrigated lands. Loss of irrigated agricultural lands will negatively affect~~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 substantial~~significant~~, and in some cases, multiple M&I suppliers have identified the same water supplies as future water sources. 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, as well as~~and~~ use of alluvial aquifers for storage, offer opportunities to expand sustainable water use. Aquifer storage is generally considered to have fewer environmental effects~~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 affect~~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 on~~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. Nevertheless~~However~~, 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 the 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~~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~~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 7760~~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, consist 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 among~~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~~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, 3300~~—3,300~~ acre-feet. In addition, Colorado receives 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~~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 groundwater.~~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.~~Designated Groundwater Basin.~~ The Colorado Groundwater Commission has established eight designated basins and 13 groundwater management districts~~Groundwater Management Districts~~ within such basins. Groundwater management districts~~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 pertaining~~with respect~~ to water management issues over the next 40 years, which are 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 among~~between~~ multiple water rights and administrative authorities (e.g. Colorado Ground Water Commission, Department of Water Resources, Ground Water Management Division, Water Court, among others).~~etc.).~~

North Platte River Basin

Basin Description: The North Platte River Basin, also known as North Park, is a high altitude valley covering about 2000~~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.



North Platte River

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 more than~~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 about 4500~~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~~PRRIP~~, 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, which ~~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 pertaining~~with respect~~ to water management over the next 40 years, which include:

- 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.
- 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 Implemẽntation Programin~~PRRIP 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 effects~~impacts~~.

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, 7700~~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



Rio Grande River

Luis Valley, a principal feature of the Rio Grande Basin, with an average elevation of 75007,500 feet, and precipitation of less than eight inches per year.

Basinwide, land is evenly divided between public and private ownership. Nevertheless, mostHowever, 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 for agricultural use in the central portion of the basin, producers in the valley are the second largest provider of fresh potatoes in the United States. Areas in the valley thatwhich 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.

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 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, such as:

- 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 effectsimpacts of reducing irrigation use of groundwater supplies will be difficult, but working on community-based solutions offers the best hope of minimizing the effectsimpacts.
- Residential growth, primarily in the form of second and vacation homes, especially in the South Fork area, is creating a need for additional 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.

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 draft 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. ~~These themes, along with all other descriptions of the BIPs throughout Colorado's Water Plan are subject to change when the BIPs are finalized in April of 2015.~~

Arkansas Basin

A major emphasis of the Arkansas Basin Roundtable~~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 that~~which~~ underpin the BIP document. These points represent the major challenges and opportunities that~~which~~ the roundtable faces in planning for the water supply future of the Arkansas basin. The roundtable first identified "the interdependence of all water usage types," recognizing the connections among~~between~~ agricultural use, environmental and recreational uses, and the effects~~impacts~~ of ~~municipal and industrial (~~M&I~~)~~ 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 effected~~impacted~~ parties can collaborate before, during, and after such natural disasters.[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] As part of the roundtable's organization of basin needs, projects, and methods, a comprehensive database was created. Projects which met a basin Need were categorized as follows within the database: ~~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]~~

- All Input List
- Preliminary Needs List
- Master Needs List
- IPP List

These different classifications range from a broader range of total input received to a more rigorous definition of IPP, as defined by the CWCB for the next iteration ofthe Statewide Water Supply Initiative.[8] The roundtable also commissioned the creation of a Simplified Water Allocation Model, which demonstrates at a large-scale level water availability and potential future shortages, with an eye to future demands.[9] The creation of the project database and this high-level model are useful tools for future planning efforts in the basin, as well as evaluation of projects and methods by the roundtable.

Click to review the ~~July 31, 2014 draft~~ Arkansas Basin Implementation Plan.

Colorado Basin

In the creation of the BIP, the Colorado Basin Roundtable~~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.[10] 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 a 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.[11] 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 among~~between~~ various water uses, and the potential negative effects~~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.~~Restore Healthy Streams, Rivers, Lakes, and Riparian Areas~~
2. Sustain agriculture.~~Agriculture~~
3. Secure safe drinking water.~~Safe Drinking Water~~
4. Develop local water conscious land use strategies.~~Local Water Conscious Land Use Strategies~~
5. Assure dependable basin administration.~~Dependable Basin Administration~~
6. Encourage a high level~~High Level~~ of basinwide conservation.~~Basinwide Conservation~~[12]

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.[13]

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. Roundtable members went on to take a closer look at identified ~~Also,~~ projects and methods within the subregions, identifiying a few representative "Regional Top Projects" which meet basin themes and criteria proposed ~~identified~~ by subregion stakeholders.[14] These Top Projects were examined in more detail ~~and water providers are listed~~, with ~~some~~ project information sheets providing more information about proponents and the basin needs these projects and methods seek to meet.[15] Looking~~available, as provided.~~[16] ~~Moving~~ forward, ~~the~~ roundtable members have identified several future actions, such as supporting implementation of stream management plans basinwide,~~to refine project~~ and a modeling effort~~method information~~ to gain greater understanding ~~a clearer picture of the future~~ of potential larger-scale hydrologic impacts to the ~~water management strategies within the~~ basin.

Click to review the ~~July 31, 2014 draft~~ Colorado Basin Implementation Plan.

Gunnison Basin

The Gunnison Basin Roundtable~~roundtable~~ began with one primary goal: "Protect existing water uses in the Gunnison Basin."[17] From this foundation, the roundtable established eight additional complementary goals~~,~~ and six~~seven~~ statewide principles.[18] 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 selected ~~chose to analyze identified~~ projects and methods by highlighting those that met (or reflected~~basin goals. These projects and methods were identified as reflecting~~ the concerns and priorities of) basin ~~these~~ goals~~,~~ and ~~were~~ further sorted them according to ~~by~~ their schedule for implementation. The roundtable then identified those that ~~Projects and methods which~~ were "likely feasible by 2025~~2020~~" and represented an "excellent job of meeting basin goals" and~~were~~ classified them as Tier 1 projects.[19] The identified projects and methods are intended to provide solutions to basin water needs, as enumerated within the BIP: agricultural shortages; M&I 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 Basin Roundtable~~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 effects~~impacts~~.[20] Additionally, the statewide principles advocate for local solutions to water needs and the~~,~~ equitable application of conservation strategies~~, and the utilization of scenario planning in water management~~.[21]

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.[22] This modeling exercise aided 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 amongbetween 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."[23]

Click to review the July 31, 2014 draft Gunnison Basin Implementation Plan.

North Platte Basin

The North Platte Basin Roundtableroundtable 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."[24] 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 maintaining healthy rivers and wetlands.[25] The BIP also speaks to statewide issues, advocating for the management of forest health through wildfire and beetle-- kill efforts, as well asand the "equitable statewide application of municipal water conservation."[26]

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.[27]

The North Platte Basin Roundtable chose to address their basin goals through the identification of projects and methods thatwhich 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.

Click to review the July 31, 2014 draft North Platte Basin Implementation Plan.

Rio Grande Basin

The Rio Grande Basin ImplementationWater 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 an explanationa statement on the statewide issue of the Rio Grande Basin's unique challenges and subcommittee

approach to BIP development., ~~transmountain diversions.~~ The basin overview includes an analysis of factors within the basin affecting~~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.[28] This overview provides a backdrop for the parts of the plan~~Plan~~ to follow, and describes the landscape in which the plan~~Plan~~ intends to establish solutions for water-management challenges.

The plan~~Plan~~ goes on to define goals and measurable outcomes, which were informed by the public outreach process that~~which~~ the roundtable undertook, as well as by 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."[29] 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."[30] Goals are further explored, by identifying the particular water needs that~~which~~ each goal meets, be it agricultural, M&I, environmental and recreational, or related to water administration.[31] 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.[32] The fact sheet provides a closer look at the project, with information such as project proponent, estimated budget, and an indication of which the basin goals ~~which~~ the project meets. The plan~~Plan~~ also provides an estimate of funding needs for these identified projects~~,~~ and includes a list of projects that~~which~~ meet environmental and recreational information gaps, paving the way for more informed project identification in the future.[33]

After project and method identification, the plan~~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.[34] These strategies include stakeholder involvement, future modeling improvements, and cooperative in-basin water management efforts.[35] 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.

Click to review the ~~July 31, 2014 draft~~ Rio Grande Basin Implementation Plan.

South Platte Basin (including Metro)

Recognizing the common geography and pertinent issues, the South Platte and Metro Basin 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 balancing~~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.[36]

With this host of challenges, the roundtables recognized 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.[37]

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~~,~~; IPPs~~,~~; agricultural transfers~~,~~; and new Colorado River supplies.[38] Specifically, 11~~ten~~ implementation strategies are listed within the BIP. These strategies mostly follow the "four legs of the stool" discussion, focusing on maximum implementation of IPPs, as well as advancing conservation and reuse efforts.[39] 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.[40] Regarding transmountain diversions, the roundtable advocates the following action: "Simultaneously advance the consideration and preservation of new Colorado River supply options."[41]

The roundtables believe that this suite of strategies is~~are~~ the best approach to meet the varied needs within the basin~~,~~ while addressing the identified challenges presented. Looking ~~Moving forward, the roundtables plan~~ to the future, the roundtable evaluated three representative portfolios, each portraying a different vision of future South Platte/Metro supply~~continue technical work to better understand potential solutions,~~ and demand, to demonstrate the challenges inherent in meeting future needs while maintaining basin values.[42] The roundtable also identified conceptual~~identify~~ projects, for ~~and methods~~ which there is no current project proponent, but the members believed well demonstrated the intent of the basin implementation strategies~~meet the three guidelines above~~.

Click to review the South Platte Basin Implementation Plan

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.[43] Agricultural, M&I, 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 Bsin Roundtable~~roundtable~~ expresses concern regarding new development from that system as part of a new transmountain diversion.[44] 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 beforeprior 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 higher levels of conservation for water providers receiving any new diversion.[45]

Interaction between state and federal entities is also identified as a key concern and opportunity by the roundtable. TheIn the BIP specifies that, 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" regarding federal policies and actions, as well as the issue of tribal water rights."[46] 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.[47]

The Southwest Basin Roundtableroundtable also undertook an ambitious public outreach process, soliciting input from basin stakeholders. From this public outreach and roundtable discussions, the Southwest Basin Roundtable adopted 21 goals and 30 measurable outcomes were adopted.[48] The basin took an aggressive approach to listing new identified projects and processes, identifying 8075 new projects and methods through the input process, bring the total list of IPPs for all sub-basins to about 160130 proposals for meeting future water needs.[49]

Click to review the July 31, 2014 draft Southwest Basin Implementation Plan.

Yampa/White/Green Basin

The Yampa/White/Green Basin Roundtableroundtable 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.[50] 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 M&I, 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 competing needsissue of "downstream states,a new transmountain diversion. Regarding any new supply project from the needs of the urbanized eastern slope of Colorado, and its own in-basin needs."[51] The 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 an "a "negotiated equitable allocation of native flow in the Yampa, White, and Green rivers to meet existing and future in-basin water demands including PBO depletion allowancesapportionment among Colorado River tributary basins."[52] This concept is discussed in more detail in Chapter 8.

The primary goal of the roundtable is to ensure the "maintenancethat existing in-basin needs are met, including "consumptive, environmental, and protection of historical use in the Yampa/White/Green Basin as well as the protection of water supplies for recreational uses."[53]

~~Looking to~~ future in-basin demands."[54] To that end~~uses~~, the roundtable members identified eight primary ~~recognizes that energy needs may play a major role in the~~ basin goals.[55]~~.~~ Within basin goals, the roundtable seeks to address potential shortages~~,~~ and improve the current infrastructure, with an emphasis on water quality and nonconsumptive~~non-consumptive~~ uses.[56]

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.[57] 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.[58]

Click to review the ~~July 31, 2014 draft~~ Yampa/White Basin Implementation Plan.

Conclusion

As demonstrated in this brief overview, each basin features its own remarkable opportunitiesand its own~~opportunities, as well as~~ distinct challenges that make planning for Colorado's water future difficult. Solutions will affect~~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.

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[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]WestWater Research, ~~*Draft*~~ *Arkansas Basin Implementation Plan (2014).*
[4] WestWater Research, ~~*Draft*~~ *Arkansas Basin Implementation Plan. (2014).*
[5] WestWater Research, ~~*Draft*~~ *Arkansas Basin Implementation Plan. (2014).*
[6] WestWater Research, ~~*Draft*~~ *Arkansas Basin Implementation Plan. (2014).*
~~[7] WestWater Research, *Draft Arkansas Basin Implementation Plan (2014).*~~
[8] WestWater Research, CDM Smith, CH2MHILL, Peak Facilitation, *Arkansas Basin Implementation Plan* Executive Summary.
[9] WestWater Research, CDM Smith, CH2MHILL, Peak Facilitation, *Arkansas Basin Implementation Plan.*
[10] SGM, ~~*Draft*~~ *Colorado Basin Implementation Plan* (Glenwood Springs: SGM, 2014)~~,~~ 1.
[11] SGM, ~~*Draft*~~ *Colorado Basin Implementation Plan. (2014).*
[12] SGM, ~~*Draft*~~ *Colorado Basin Implementation Plan, (2014) 3-5.*
[13] SGM, ~~*Draft*~~ *Colorado Basin Implementation Plan. (2014).*
[14] SGM, *Colorado Basin Implementation Plan, 125.*
[15] SGM, *Colorado Basin Implementation Plan, 125.*
~~[16] SGM, *Draft Colorado Basin Implementation Plan (2014).*~~
[17] Wilson Water Group, ~~*Draft*~~ *Gunnison Basin Implementation Plan* (Denver: Wilson Water Group, 2014) Executive Summary.

[18] Wilson Water Group, ~~Draft~~ *Gunnison Basin Implementation Plan.* ~~(2014).~~
[19] Wilson Water Group, ~~Draft~~ *Gunnison Basin Implementation Plan.* ~~(2014).~~
[20] Wilson Water Group, ~~Draft~~ *Gunnison Basin Implementation Plan.* ~~(2014).~~
[21] Wilson Water Group, ~~Draft~~ *Gunnison Basin Implementation Plan.* ~~(2014).~~
[22] Wilson Water Group, ~~Draft~~ *Gunnison Basin Implementation Plan.* ~~(2014).~~
[23] Wilson Water Group, ~~Draft~~ *Gunnison Basin Implementation Plan,* ~~(2014)~~ 8.
[24] Wilson Water Group, ~~Draft~~ *North Platte Basin Implementation Plan* (Denver: Wilson Water Group, 2014~~),~~ 2.
[25] Wilson Water Group, ~~Draft~~ *North Platte Basin Implementation Plan.* ~~(2014).~~
[26] Wilson Water Group, ~~Draft~~ *North Platte Basin Implementation Plan.* ~~(2014).~~
[27] Wilson Water Group, ~~Draft~~ *North Platte Basin Implementation Plan.* ~~(2014).~~
[28] DiNatale Water Consultants, ~~Draft~~ *Rio Grande Basin Water Plan* (Boulder: DiNatale Water Consultants, 2014~~),~~ 121.
[29] DiNatale Water Consultants, ~~Draft~~ *Rio Grande Basin Water Plan,* ~~(2014)~~ 121.
[30] DiNatale Water Consultants, ~~Draft~~ *Rio Grande Basin Water Plan.* ~~(2014).~~
[31] DiNatale Water Consultants, ~~Draft~~ *Rio Grande Basin Water Plan.* ~~(2014).~~
[32] DiNatale Water Consultants, ~~Draft~~ *Rio Grande Basin Water Plan,* ~~(2014)~~ *252.*
[33] DiNatale Water Consultants, ~~Draft~~ *Rio Grande Basin Water Plan,* ~~(2014)~~ 277.
[34] DiNatale Water Consultants, ~~Draft~~ *Rio Grande Basin Water Plan,* ~~(2014)~~ 292.
[35] DiNatale Water Consultants, ~~Draft~~ *Rio Grande Basin Water Plan,* ~~(2014)~~ 292.
[36] HDR, WestSage Water Consultants, ~~Draft~~ *South Platte Basin Implementation Plan* (Denver: HDR, West Sage Water Consultants, 2014~~),~~ Executive Summary.
[37] HDR, ~~Draft~~ *South Platte Basin Implementation Plan.* ~~(2014).~~
[38] HDR, ~~Draft~~ *South Platte Basin Implementation Plan.* ~~(2014).~~
[39] HDR, ~~Draft~~ *South Platte Basin Implementation Plan.* ~~(2014).~~
[40] HDR, ~~Draft~~ *South Platte Basin Implementation Plan.* ~~(2014).~~
[41] HDR, ~~Draft~~ *South Platte Basin Implementation Plan.* ~~(2014).~~
[42] HDR, *South Platte Basin Implementation Plan, 5-15.*
[43] Harris Water Engineering, ~~Draft~~ *Southwest Basin Implementation Plan* (Durango: Harris Water Engineering, 2014~~),~~ w.
[44] Harris Water Engineering, ~~Draft~~ *Southwest Basin Implementation Plan.* ~~(2014).~~
[45] Harris Water Engineering, ~~Draft~~ *Southwest Basin Implementation Plan.* ~~(2014).~~
[46] Harris Water Engineering, ~~Draft~~ *Southwest Basin Implementation Plan.* ~~(2014).~~
[47] Harris Water Engineering, ~~Draft~~ *Southwest Basin Implementation Plan.* ~~(2014).~~
[48] Harris Water Engineering, ~~Draft~~ *Southwest Basin Implementation Plan.* ~~(2014).~~
[49] Harris Water Engineering, ~~Draft~~ *Southwest Basin Implementation Plan.* ~~(2014).~~
[50] AMEC, ~~Draft~~ *Yampa/White/Green Basin Implementation Plan* (Denver: AMEC, 2014) i.
[51] AMEC, *Yampa/White/Green Basin Implementation Plan, Executive Summary.*
[52] AMEC, ~~Draft~~ *Yampa/White/Green Basin Implementation Plan.* ~~(2014).~~
~~[53] AMEC, Draft Yampa/White/Green Basin Implementation Plan (2014).~~
[54] AMEC, *Yampa/White/Green Basin Implementation Plan.*
[55] AMEC, *Yampa/White/Green Basin Implementation Plan, 1-7.*
[56] AMEC, ~~Draft~~ *Yampa/White/Green Basin Implementation Plan.* ~~(2014).~~
[57] AMEC, ~~Draft~~ *Yampa/White/Green Basin Implementation Plan.* ~~(2014).~~
[58] AMEC, ~~Draft~~ *Yampa/White/Green Basin Implementation Plan.* ~~(2014).~~

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Direct 303-866-3441

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 among~~between~~ geography, weather, and legal constraints, all of which influence~~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~~have been~~ described in Chapter 2. The quality of surface water and groundwater also influences the amount available for different types of uses.

Waters of Colorado

Colorado's geography is diverse, with terrain that ranges from the low-lying plains of Holly (3392 feet) to the high peak of Mt. Elbert (14,440 feet), the highest peak in the contiguous Rocky Mountain states. The entire state resides above 3300 feet, with a mean elevation of 6800 feet, the highest of any state.[1] This variability influences precipitation amounts and patterns experienced across the state.

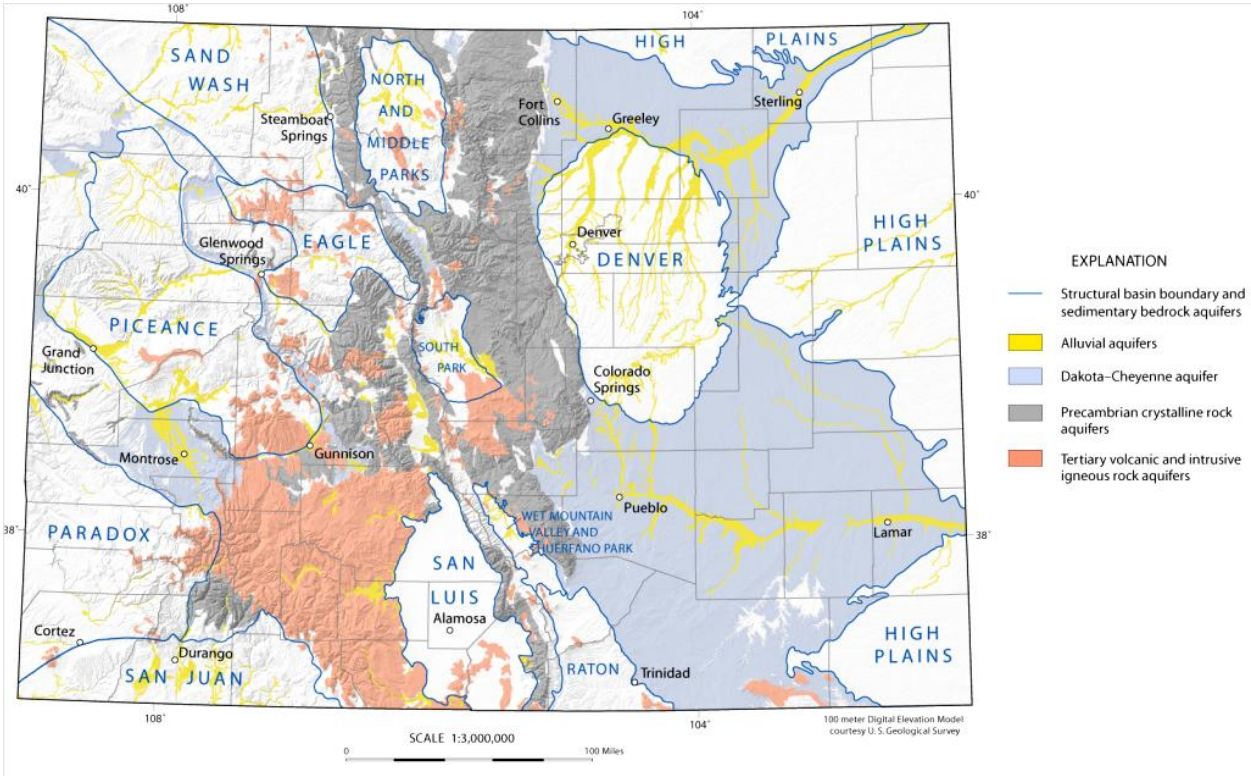
Many major rivers originate in the high Rocky Mountains and collectively account for 70 percent of Colorado's surface water. These rivers flow east, west, north, and south from Colorado's mountains and plains out of the state, through 18 downstream states and Mexico, into the Gulf of Mexico or the Pacific Ocean. 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 the state: 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 on~~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 flows out of Colorado to neighboring states.

The western side of the Continental Divide contains 70 percent of the surface water and 11 percent of the population.[3] 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.[a] 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.

Figure 4-1: Principal Aquifers and Structural Basins of Colorado



Groundwater plays a major role in the statewide water supply. Nineteen of Colorado's 64 counties and about 20 percent of the state's population rely heavily on groundwater.[5] Most of the groundwater use occurs in the eastern part of the state and in the Rio Grande Basin. The western slope has not developed groundwater to the same extent.

Groundwater resources exist throughout the state in alluvial, sedimentary, and crystalline rock aquifers (Figure 4-1).[6] Alluvial aquifers occur along many of the state's streams and are usually tributary to the stream, in which case the groundwater is administered as part of the stream system. Alluvial aquifers in designated groundwater basins are an exception to this and fall under the management and control of the Colorado Ground Water Commission. Designated groundwater

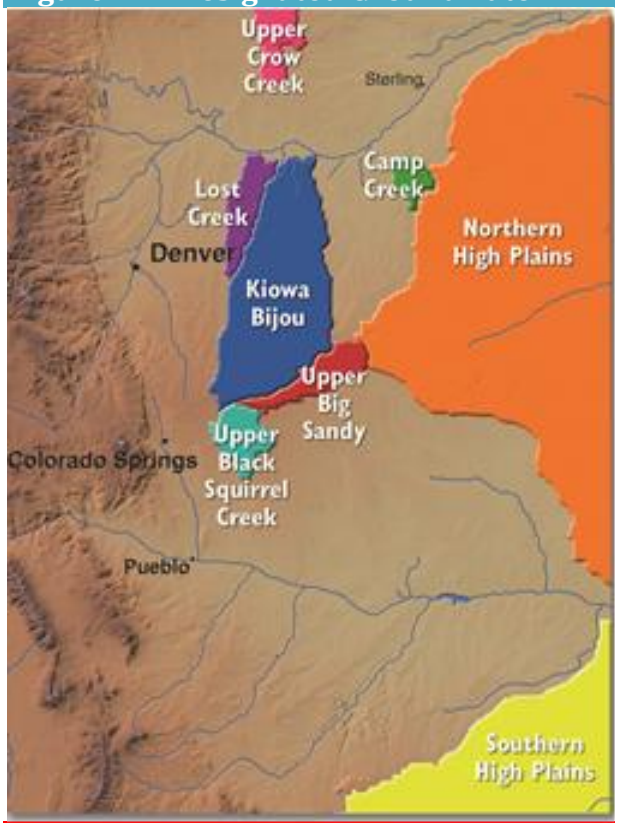
[a] The western slope includes the Gunnison, Colorado, Yampa/White/Green river basins, and the basin of the Southwest, composed of the Dolores, San Juan, and San Miguel Rivers. The Rio Grande, North and South Platte, Arkansas and the Republican River basins are included in the calculations for the eastern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

basins include eight areas in the eastern part of the state that rely primarily on groundwater, having minimal to no surface water supplies (Figure 4-2). Sedimentary aquifers occur throughout the state, and include multi-aquifer systems such as the Denver Basin and Dakota-Cheyenne aquifers. Crystalline rock aquifers are found in most of the foothills and mountainous areas of the state. Primarily recharged by snowmelt into fractures in the rock, these aquifers have a low storage capability and are usually limited to domestic use.

Groundwater aquifers offer benefits through their natural infrastructure and protection from evaporation. Nevertheless, relying on groundwater as a primary supply may be challenging because of uncertain and varied natural recharge rates. In some aquifers such as those in the Denver Basin, the natural recharge rate is very low compared to extraction rates so that it is considered a non-renewable resource.

~~Groundwater plays a major role in the statewide water supply. Colorado has seven principal aquifers, or aquifer systems, both alluvial and bedrock.[7] 19 of Colorado's 64 counties and approximately 20 percent of the state's population rely heavily on groundwater.[8] Certain areas of the state have easier 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). 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.~~

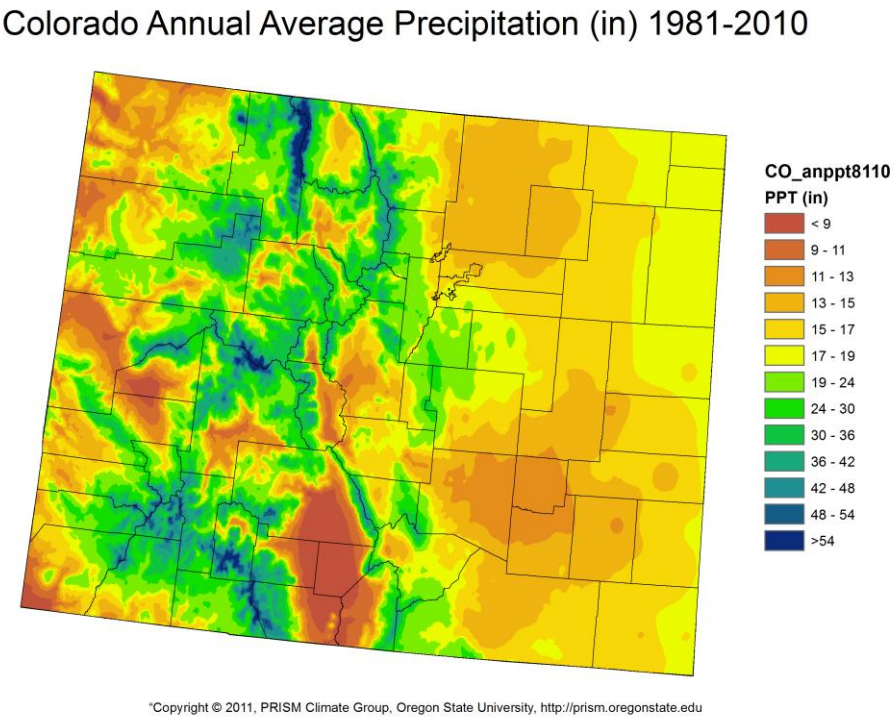
Figure 4-2: Designated Groundwater[5]



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 more than~~over~~ 150 million acre-feet of bedrock aquifer storage. Many potential storage sites, however, 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 nontributary Denver Basin aquifers, but there are currently no comparable rules for storage in alluvial 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). In~~However, in~~ contrast to recharge for

augmentation, storage in alluvial aquifers maycan be more difficult to manage because of the transient nature of groundwater flow in tributary alluvial aquifers, making storage in alluvial aquifers potentially more short-term. ~~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 it to the customer. ~~Groundwater storage potential in Colorado is also limited because two major sources of groundwater in eastern Colorado the Denver Basin and Ogallala aquifers are non-rechargeable.~~

Figure 4-3: Average Precipitation in Colorado 1981-2010 (inches)

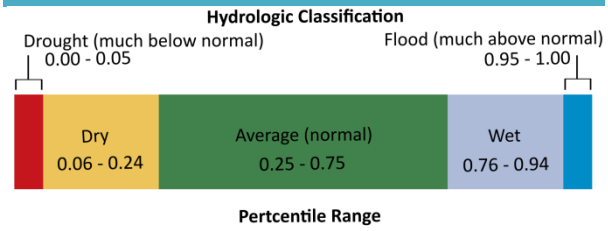


Variability in Water Supplies

Precipitation varies in both amount and distribution across the state and is influenced by the elevation and the orientation of the mountains and valleys (Figure 4-3). 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 more than~~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.[9]

Our state's variable precipitation patternshave 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 maycan differ by thousands of acre-feet. Furthermore, basin streamflow is not equallydistributed 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 (Figure 4-5).

Figure 4-4 Hydrologic Classification Criteria



Percentile range used to define drought, dry, average, wet, and flood condtions.

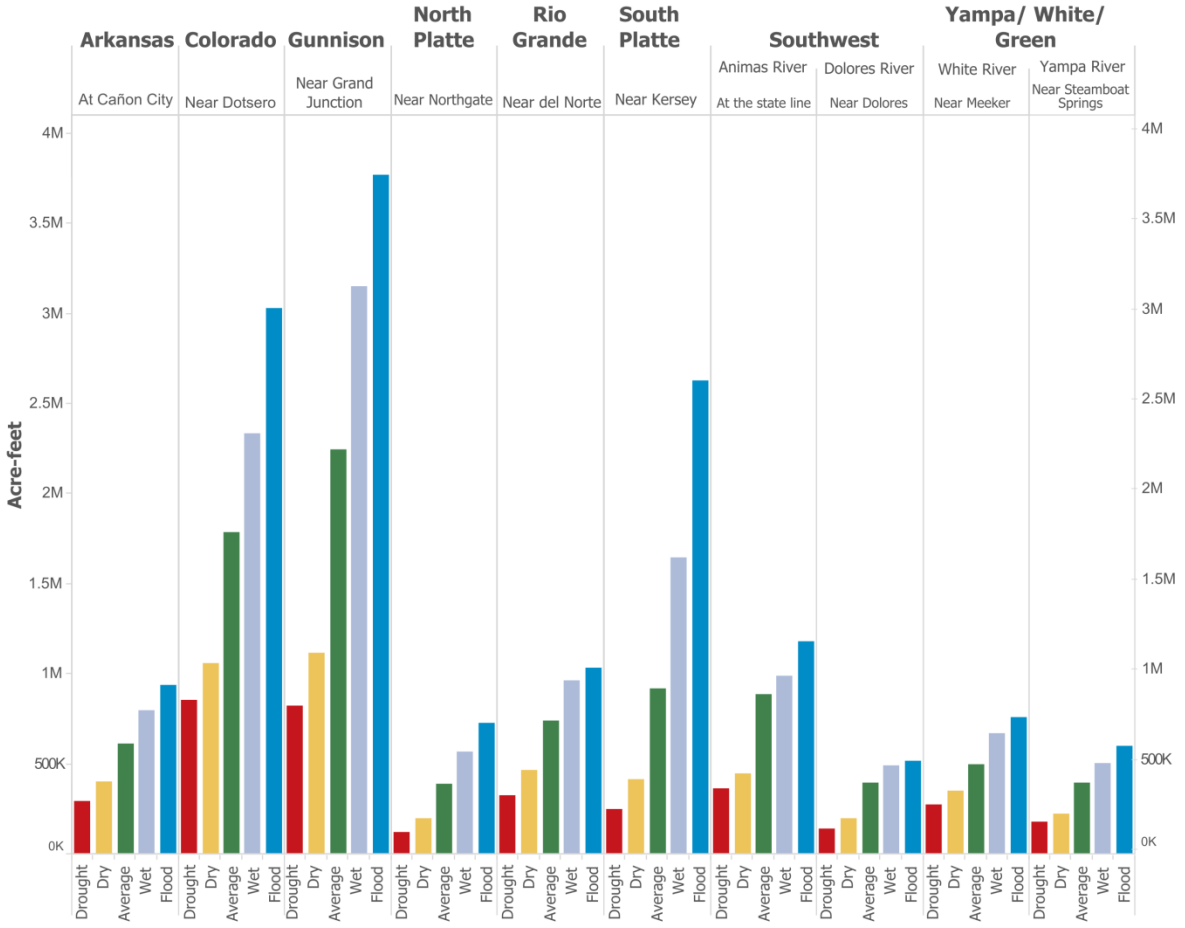
For the purposes of this planreport, hydrologic classifications are assigned based on percentile ranking: drought, dry, average, wet and flood (Figure 4-4). Drought and dry periods have substantialsignificant and lasting effectsimpacts on water supplies and availability for years, while wet years offer 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 4-54). They also have other consequences, such as wildfires and negative economic effectsimpacts.

For example, in 2002, the driest single year on record, Colorado suffered severala number of severe wildfires. The largest of these fires, the Hayman Fire, raised levels of nitrate and turbidity in streams in the burn area that remained elevated for five years after the event.[10] Another example, in 2013, the West Fork Complex fire damaged watersheds and diminishedimpacted water quality in the Rio Grande Basin. Substantial hillside and stream erosion results from such events. Increased levels of debris in reservoirreservoirs affect not only water quality, but also the operations of water supply and treatment infrastructure.[11]

The Colorado Water Conservation Board coordinated field data and assisted in developing reports on the substantial hillside and stream erosion that takes place following medium and high intensity wildfires.[12]

Wildfires can affect~~impact~~ Colorado's economy and may~~can~~ cost the state millions of dollars in response and recovery efforts alone. They may~~can~~ also impact water providers' 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 complete 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.

Figure 4-5 Annual Flow Values for Varying Conditions at Select Gages (Acre-Feet per Year)



Annual flow values for drought, dry, average, wet and flood conditions for 10 locations across the state. This graphic illustrates the variability that exists both within basins and between basins of the state and 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.

Figure 4-6: Average monthly flows by hydrologic classification

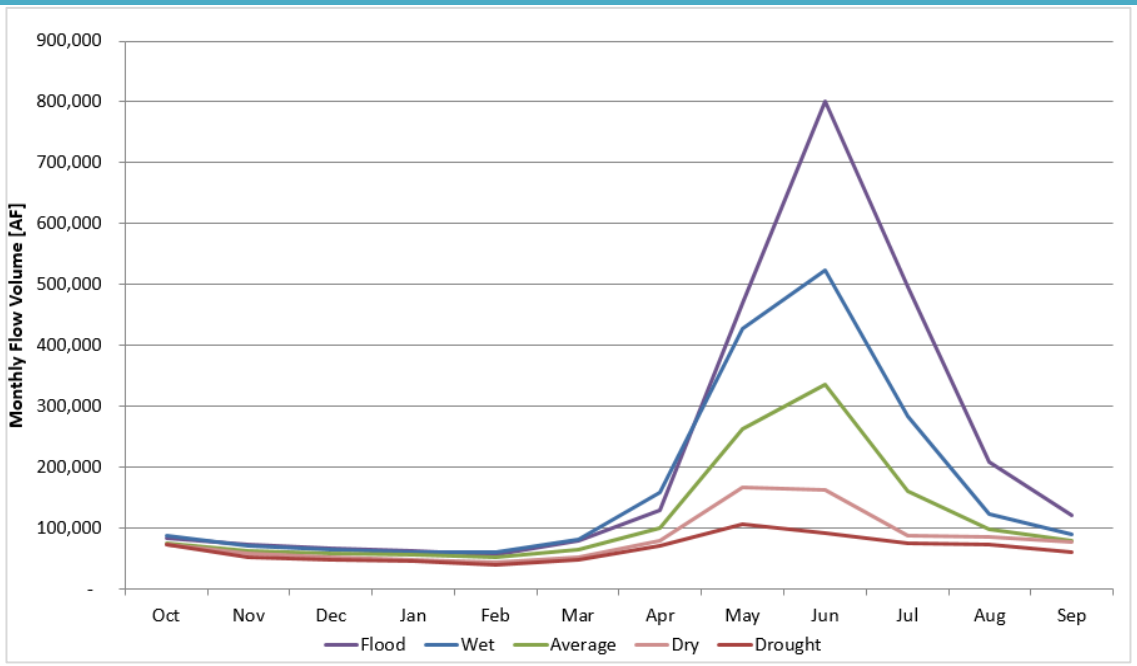
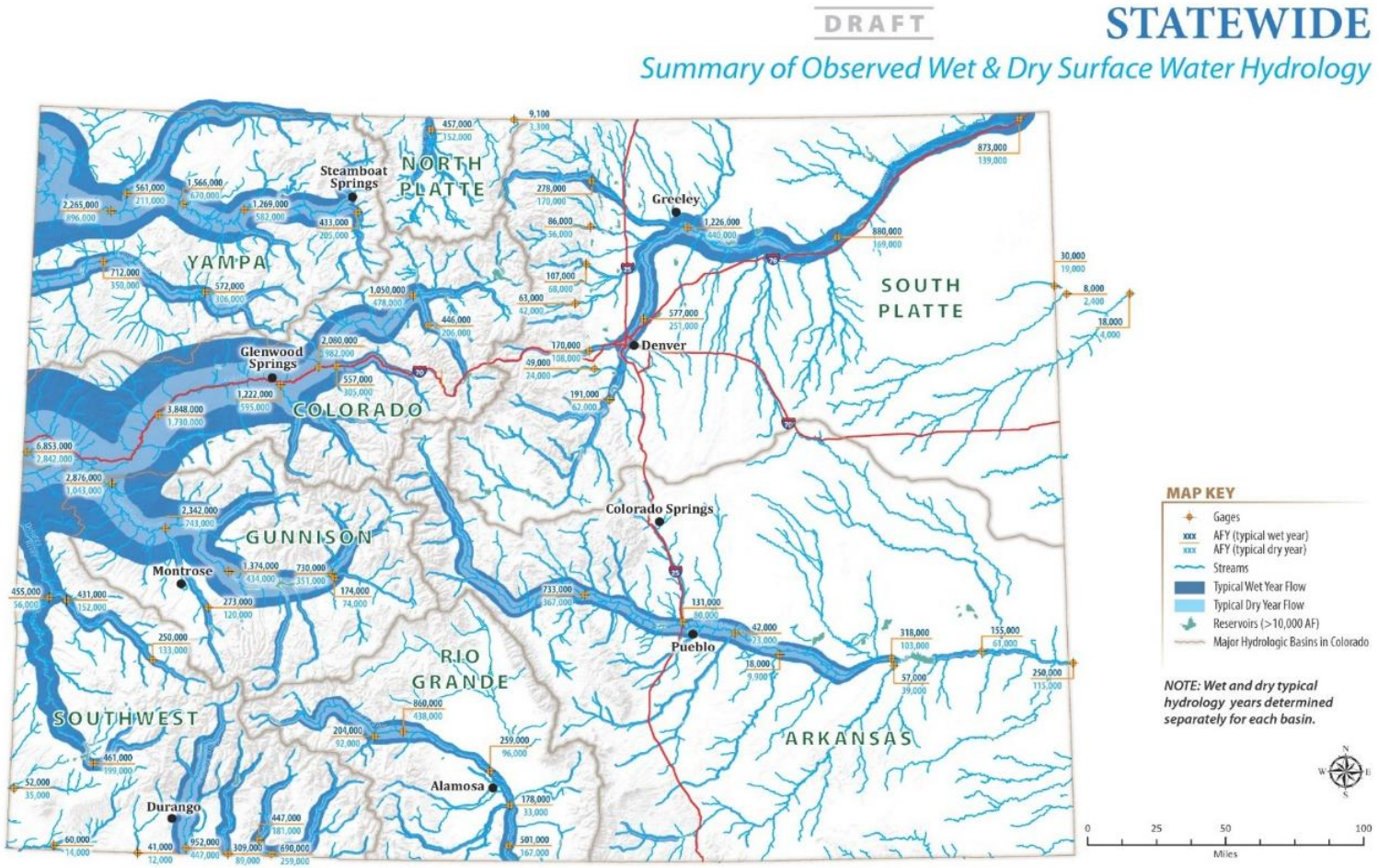


Figure 4-6 uses the same hydrologic classifications as Figure 4-5, but shows average monthly flow volumes on the Colorado River at Dotsero to illustrate the wide variance that can exist among classifications, especially during the runoff season.

Aside from the effects of wildfire, drought can also have substantial fiscal effects~~impacts~~ resulting 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 effects~~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 effect~~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 three of the last 14 years.[17]

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Figure 4-7: Wet and Dry Year Flows at Select Gages



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 more than~~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 because of~~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. These effects may~~impacts can~~ take weeks, months, or years to fully repair, and some damage may be too great to ever repair economically.

Table 4-1: Summary of Projected Changes and Potential Effects to Water Resources for Colorado[21]

Element	Projected changes and potential effects	Studies that have assessed this vulnerability for Colo.
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.	Colorado Water Conservation Board (CWCB) (2012); Bureau of Reclamation (BOR) (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); BOR (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); BOR (2012)
Legal water systems	Earlier and/or lower runoff could complicate 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.	Environmental Protection Agency (EPA) (2013)
Groundwater resources	Groundwater demand for agriculture could increase with warmer temperatures. Changes in precipitation could affect groundwater recharge rates.	
Energy demand and operations 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.	Mackenick et al. (2012)
Forest disturbances in headwaters region	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 affect winter mountain recreation and tourism.	BOR (2012); Battaglin et al. (2011); Lazar and Williams (2008)

Uncertainties Affecting Supply

~~As the climate of Colorado shifts, past variability of stream flows become a less reliable guide for future variability.[23] Table 4-4~~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 experienced warming and will likely continue to do so in the future. Average yearly temperature increased by 2°F in the last 30 years, and 2.5°F in the last 50 years across the state. This affects the timing of snowmelt and peak runoff, which occur earlier, and there is an increase in heat waves and wildfires. 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 an earlier run-off, longer irrigation season, and 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. All of these changes are likely to substantially affect water available for beneficial use in Colorado in the coming decades. Table 4-1 illustrates the potential water-related effects of climate change in different areas and sectors; while Table 4-2 highlights projected effects of increased temperatures on a wide array of indicators, as described in the 2014 Climate Change in Colorado Report.

Table 4-2 Projected Climate and Hydrology Changes[22]

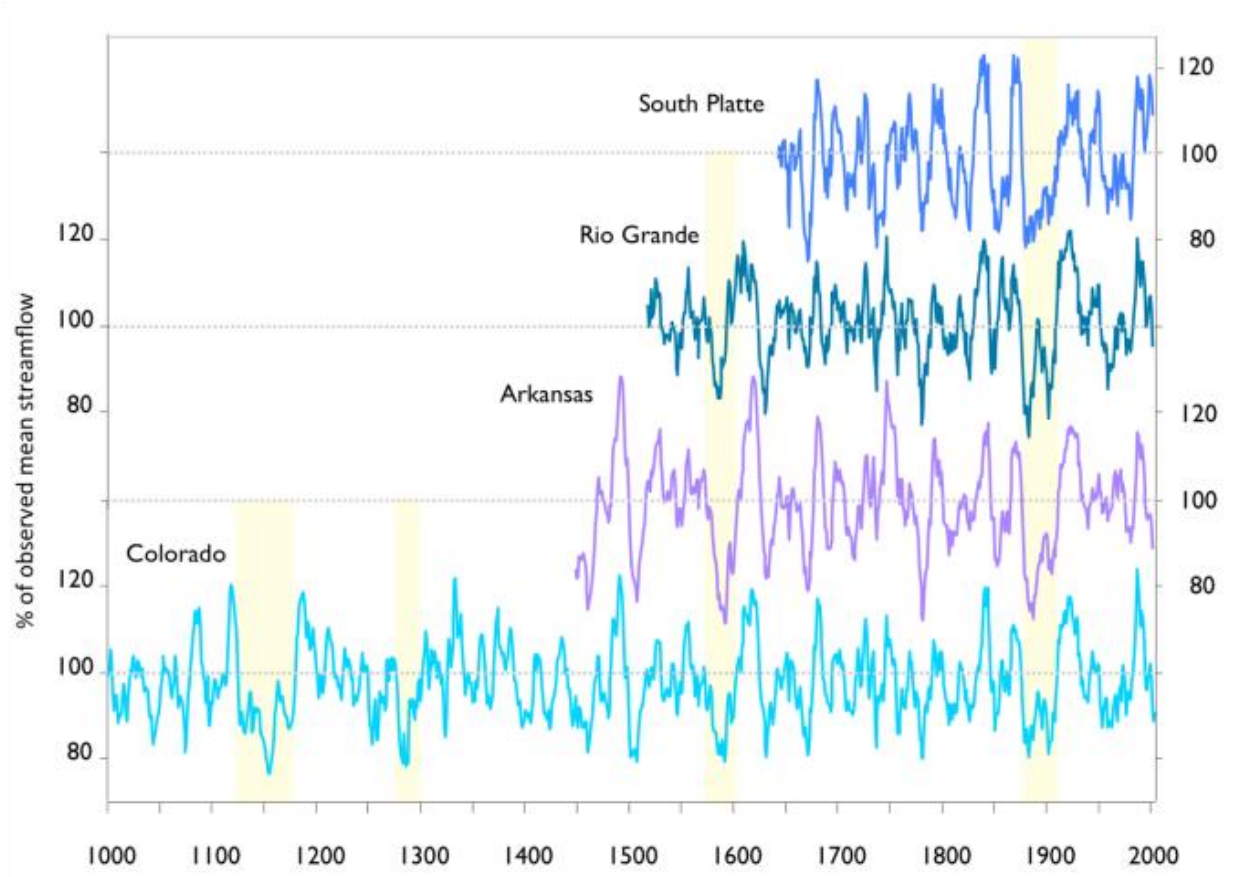
Indicator	Effect of Climate Change
Annual Streamflow	Decrease in most of the climate projections
Peak Runoff Timing	Earlier in all projections
Crop Water Use	Increases
April 1 Snowpack	Decreases in most projections
Palmer Drought Severity Index	More drought
Heat Waves	More frequent
Cold Waves	Less frequent
Frost Free Season	Longer

Colorado is accustomed to dealing with variability and drought over the last 150 years, yet tree ring reconstructed streamflows indicate that the state has endured longer lasting and more severe droughts than we have seen in our relatively brief observed record. In fact the 20th century is unique in that there were two prolonged wet periods and no multi-decadal droughts.[24] Figure 4-8 shows multiple droughts (shaded highlights) that exceed the intensity and duration of our observed record.

As described in Section 6.1, the scenarios developed by the IBCC will help the state prepare for whatever future may unfold, those include three scenarios that have a climate different from what

was observed during the 20th century, including two scenarios that experience "hot and dry" conditions and one scenario with hydrology and climate "between 20th century observed and hot and dry." Figure 4-9 illustrates where these scenarios fall in comparison to the current, or 20th century observed.

Figure 4-8 Tree-ring Reconstructed Water-year Streamflows for Four Major River Basins of Colorado[25]

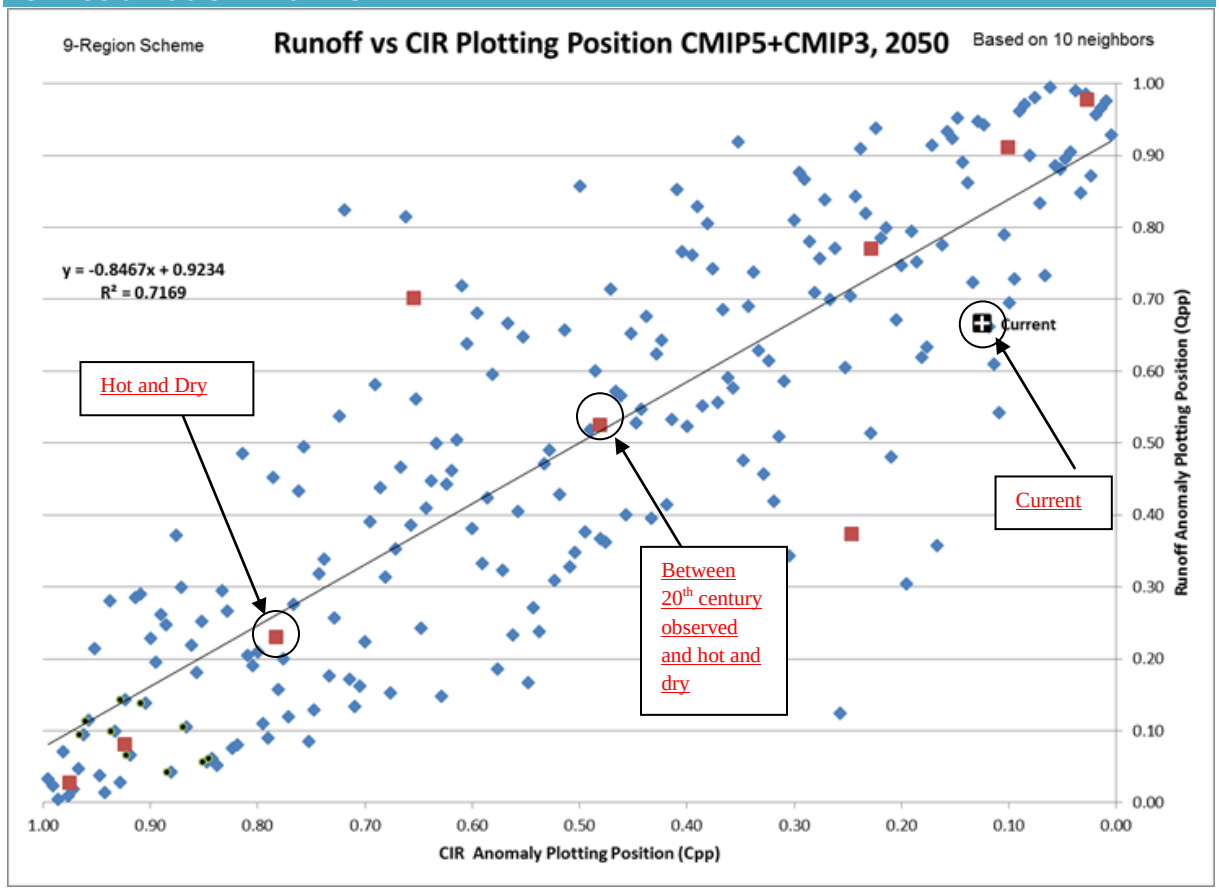


Tree-ring reconstructed water-year streamflows as percent of observed mean, showing the 10-year running average, for four gages representing major Colorado basins: the Colorado River at Lees Ferry, AZ (762–2005, here shown from 1000–2005), the South Platte River at South Platte, CO (1634–2002), the Rio Grande at Del Norte, CO (1508–2002), and the Arkansas River at Salida, CO (1440–2002). All four records show the occurrence of droughts before 1900 that were more severe and sustained than any modern droughts. The yellow shading highlights several notable multi-decadal paleodroughts, in the mid-1100s, the late 1200s, the late 1500s and the late 1800s. The 20th century was unusual in having two persistent wet periods and no droughts longer than 10 years. (Data: TreeFlow web resource; http://treeflow.info)

Having quantitatively defined the scenarios, the data were used to determine the effect on streamflow. Figure 4-10 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, indicating~~. Under those scenarios the negative projection indicates~~ that some users, both senior and junior,~~established uses~~ would be unable to obtain their historical supply of water.[26] Both the Arkansas and the Rio Grande Rivers are~~have~~ projected to experience these conditions~~depleted flows of less than zero~~ under both ~~projected~~ climate scenarios; the South Platte is~~has a negative~~ projected to experience these conditions~~depleted flow~~ under the "hot & dry" climate scenario. While these basins are accustomed to calls dating back well into the 19th century,

climate change has the potential to substantially alter the amount of water available to even those with well-established senior water rights. 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.

Figure 4-9 Plot of Runoff Vs. Crop Irrigation Requirements Utilizing the Bureau of Reclamation Archive

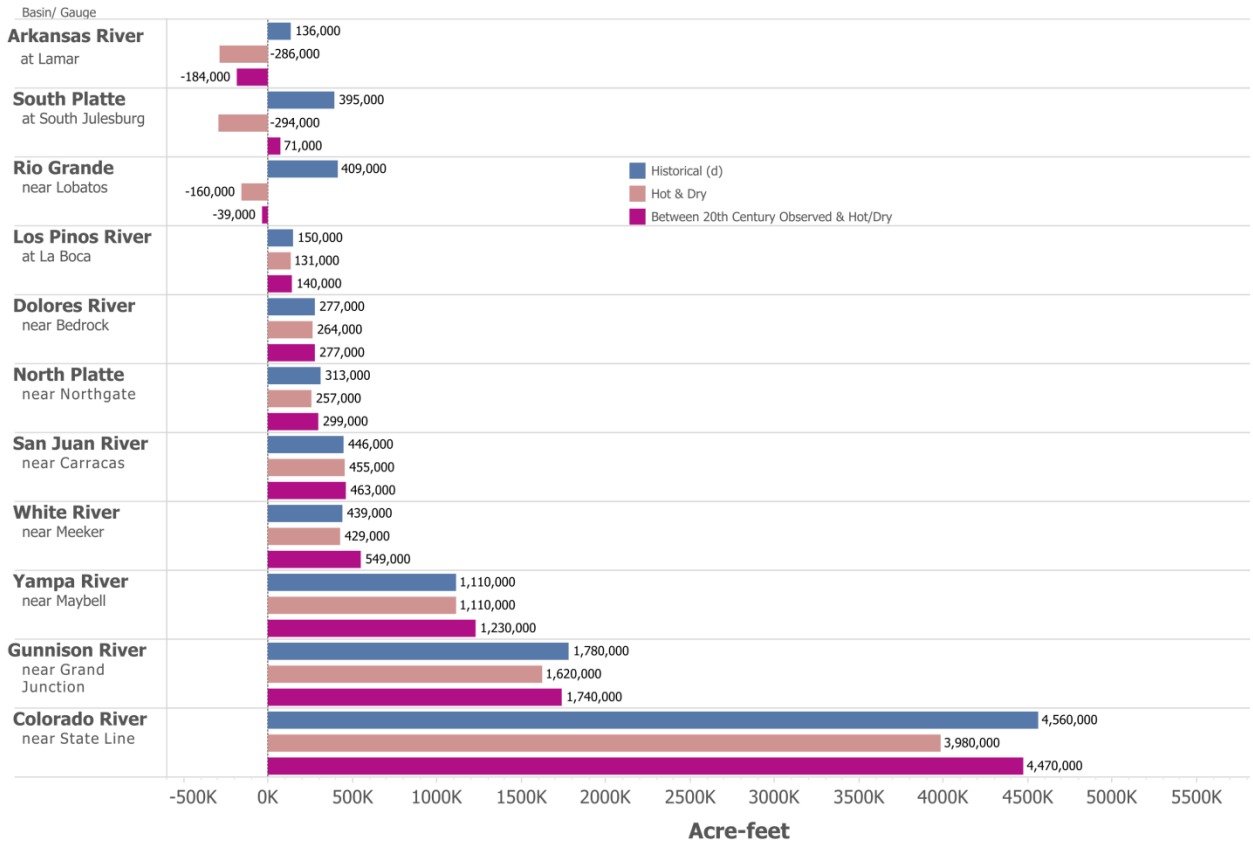


Hot and dry is defined as the 75th percentile of climate projections for crop irrigation requirement (water use), and the 25th percentile for natural flows. In other words, only 25 percent of projections have lower natural flows and 25 percent of projections have a higher crop irrigation requirements. 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. Historical or current conditions, which is no change in runoff or crop irrigation requirement fall at roughly the 9th and 67th percentiles; this means that 91 percent of runs show increases in crop irrigation requirement and about two thirds show reductions in runoff.

In addition to the work the state did on climate change, several of the basin roundtables also incorporated the uncertainties posed by climate change into their Basin Implementation Plans. Many basins now recognize that previous assumptions used for planning purposes are no longer sufficient because of climate change. For example, the Colorado Basin recognizes that relying on previous firm dry yields will not provide reliability for the future and is therefore encouraging

water providers update their master plans accordingly (and consider interconnected water systems to help mitigate the influences of climate change). The South Platte, Arkansas and Rio Grande Basins all recognize they must plan for a decrease in water supplies because of the effects of climate change, the latter of which highlighted that they expect to see their water resources reduced by as much 30 percent in the next 50 to 100 years. In response, the Arkansas Basin is looking into conjunctively using tributary and non-renewable sources to alleviate the effects of reduced yields from climate change and the potential for dry up of non-tributary sources.

Figure 4-10: Projected depleted flows for 2050 (acre-feet per year)



Projected depleted flows for 2050 in acre-feet per year at eleven different sites around the state using the aforemntioned classifications of historical, hot and dry and between 20th century observed and hot and dry.

Almost all Basin Implementation Plans, including that of the North Platte, specifically address the need to continue to monitor the effects climate change will have on the respective basins. The Gunnison Basin, for example, referenced throughout their plan the need to study effects of climate change as a means to achieve their primary and complementary basin goals and identify actions to protect existing uses. The *Research and Public Education on Anticipating, Mitigating and/or*

Adapting to Climate Changes, is one way they propose to meet this goal. Education and outreach is another goal indentified by several basins. The Southwest Basin, for example, committed to educating their roundtable members on climate change as a way to better refine their present and future water planning efforts.

Several basins, including the South Platte/Metro, Yampa/White/Green, Arkansas, and Southwest, incorporated scenarios or projected and potential effects of climate developed by the state into their own planning processes.

Dust on Snow Events

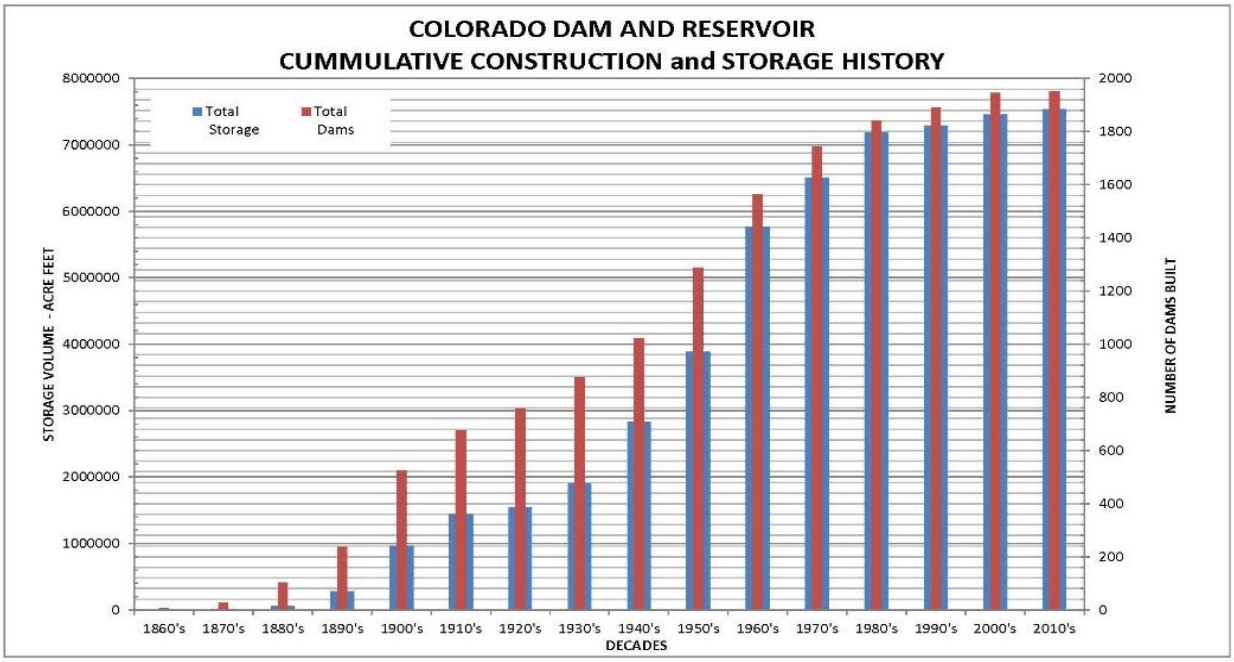
So called "Dust-on-snow" events also introduce uncertainty into managing water supplies. Dust-on-snow events occur when wind deposits dust from southwestern deserts (, and other loose-soil surfaces lackingthat lack vegetation), onto mountain snowpack. This increases the effect of solar radiation, which 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] Dust-on-snow events can result in peak runoff occurring three weeks earlier than normal; this shift is independent of climate change, which may also result in earlier snowmelt patterns.[28] Since 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.[29] 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.[30]

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.[31] Colorado's total storage capacity is approximately 7.5 million acre-feet within 1953 reservoirs (Figure 4-11). 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. Water-storage Proper infrastructure allows Colorado to use its legal entitlements before water flows out of the state. In addition, water-storage 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 stream systems in order to allowmaintain compliance with water use by water users that would otherwise not have a right to divert in the prior appropriation systemadministration. 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 4-12). In fact, construction of storage has declined so much that our current rate of building storage capacity resembles that of the Great Depression.

Figure 4-11: Colorado dam and reservoir cumulative construction and storage history



While storage is a critical element for managing Colorado's future water supplies, new storage projects may~~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 threats~~impacts~~.

The Colorado Division of Water Resources'~~Resources uses information contained in the~~ dams database contains information that can be used to examine enlargement potential for existing reservoirs and dams. The database of dams in Colorado contains information on the volume of water a reservoir can hold when filled to the~~at the spillway, or~~ normal high-water line, and the volume of water that would be present if the reservoir filled to its capacity~~the dam crest~~. The difference between the volume of normal storage and of maximum storage is called the storage delta. For many reservoirs the ~~The~~ storage delta is "flood storage"~~typically~~ needed for

Figure 4-12: Colorado dam and reservoir construction history and volume by decade

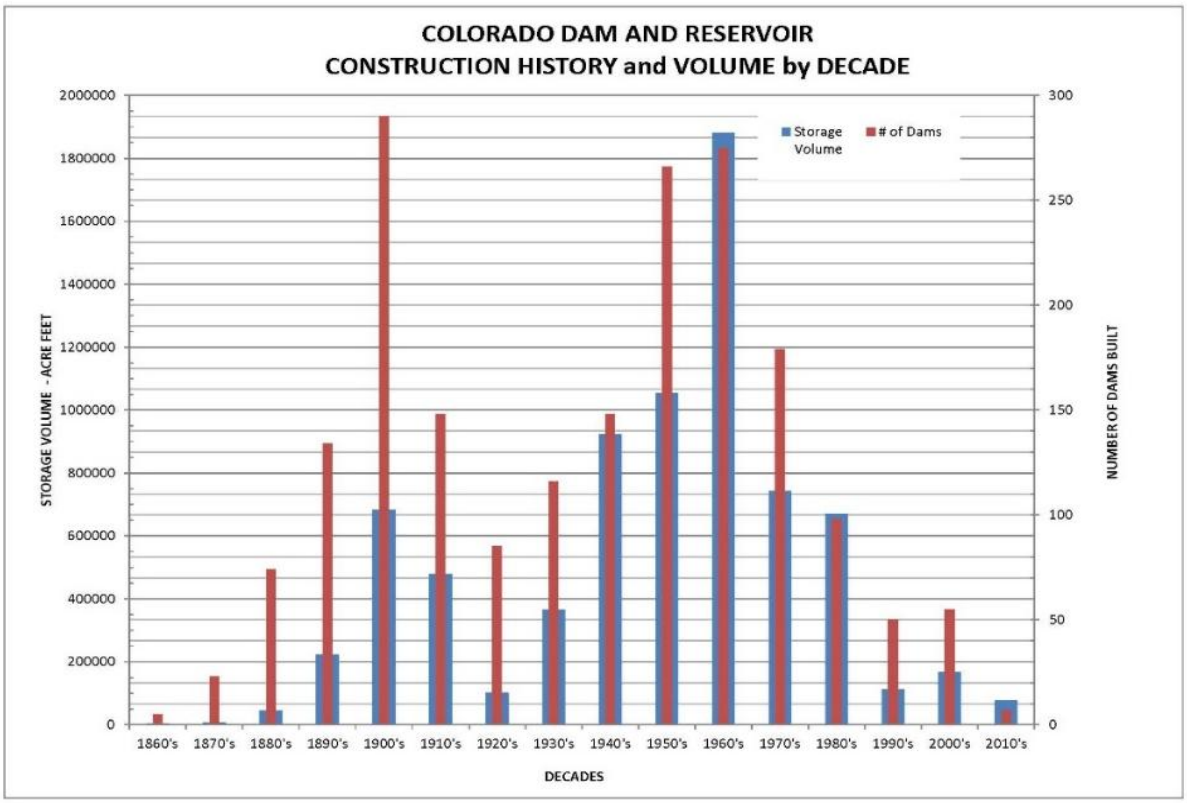


Figure 4.12 does not include storage capacity associated with flood control reservoirs because it can only be used on a limited basis for water supply storage.

containing~~routing~~ floods flows and, therefore, is~~so the dam does~~ not available for enlargement of storage. Nevertheless, advances~~overflow. Advances~~ in meteorology, hydrology, and dam engineering make it possible to reassess reservoirs and potentially use existing~~capture excess~~ flood storage for ~~use as~~ active storage. The portion~~storage delta section~~ of the reservoir associated with the storage delta ~~basin~~ has the largest surface area; therefore, a relatively small increase in the water surface elevation~~vertical height of the reservoir~~ will result in a large increase in water storage capacity. 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.[b]

Table 4-3 shows maximum storage, normal storage, and surface area for the reservoirs on the potential enlargement list as developed from the dams database. While it is certainly not the only indicator regarding the potential for enlargement, a large storage delta is a threshold criteria. An existing reservoir is understood to have the potential to inundate a known land area that includes

[b] This table shows *potential* reservoir storage increase. Agreements, interstate compact obligations and other constraints, notably the unavailability of flood storage and the need to retain freeboard for dam safety purposes, may make the potential increase not usable.

the area associated with its maximum capacity. Therefore, a~~A~~ reservoir with a large storage delta can expand its additional storage capacity without increasing the area potentially inundated and minimizing~~by the dam, which minimizes~~ the associated environmental effects~~impacts~~. The most efficient way to generate a list of dams and reservoirs that can be considered for enlargement~~enlarged~~ is to use the database to evaluate the storage delta. Table 4-4 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 4-13 shows the geographical distribution of the dams by the range of potential storage that exists.

Table 4-3: Largest Potential Reservoir Storage Increase by Storage Delta Factor[32]

Name	Division	Max Storage	Normal Storage	Storage Delta	Surface Area	Managing Organization
JOHN MARTIN	2	805,440	232,942	572,498	8955	U.S. ARMY CORPS OF ENGINEERS
CHERRY CREEK	1	265,770	13,226	252,544	852	U.S. ARMY CORPS OF ENGINEERS
GRANBY	5	752,048	539,800	212,248	7260	U.S. BUREAU OF RECLAMATION
PUEBLO	2	535,507	357,678	177,829	4646	U.S. BUREAU OF RECLAMATION
ANTERO	1	115,000	26,500	88,500	2600	DENVER BOARD OF WATER COMMISSIONERS
BEAR CREEK	1	81,075	2000	79,075	110	U.S. ARMY CORPS OF ENGINEERS
BLUE MESA	4	1,019,748	940,800	78,948	9180	U.S. BUREAU OF RECLAMATION
GREEN MOUNTAIN	5	222,645	154,600	68,045	2130	U.S. BUREAU OF RECLAMATION
MCPHEE RESERVOIR	7	440,000	381,100	58,900	4300	U.S. BUREAU OF RECLAMATION
CUCHARAS #5	2	64,820	7414	57,406	915	TWO RIVERS WATER COMPANY
TWIN LAKES	2	141,000	86,000	55,000	2805	U.S. BUREAU OF RECLAMATION
TRINIDAD	2	169,370	119,877	49,493	2018	U.S. ARMY CORPS OF ENGINEERS

In general, the reservoirs with the largest storage delta are those owned by the federal Bureau of Reclamation and the U.S. Army Corps of Engineers. The Bureau of Reclamation ~~(Corps). BOR~~ reservoirs are primarily for storage of project waters, not for flood storage. Conversely, the U.S. Army Corps of Engineers dams are dual purpose and have the largest storage deltas because they include dedicated flood storage capacity.[33]

Table 4-4: Number of Dams by Water Division That Fall Into the Various Ranges of Storage Delta

Water Division	STORAGE_DELTA Range (acre-feet)						Division Totals
	501-1000	1001-5000	5001-10,000	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

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 results with no documented negative environmental effects from using silver iodide for cloud seeding.[34] 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.[35]

Water Quality

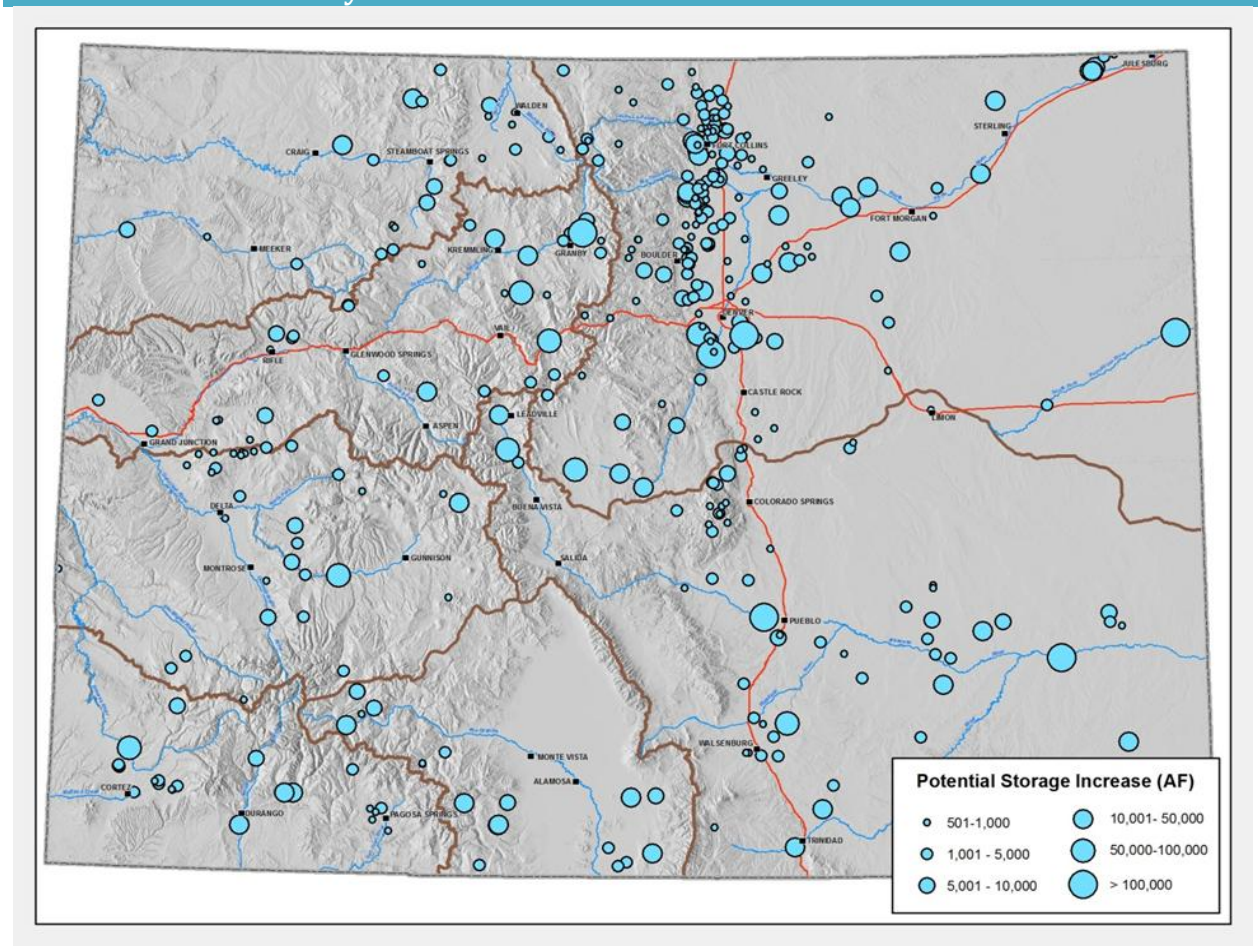
Water quality and quantity are inextricably connected. Understanding water supply and demand alone is an incomplete picture. There must be enough water available for use with suitable quality for irrigation, drinking water, recreational uses, and the protection of aquatic life. This section

briefly outlines some of the key connections between quality and quantity while Section 7.3 provides a more detailed discussion.

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 pollutants (i.e., they are impaired water bodies).[36]

Figure 4-13: Potential Statewide Reservoir Storage Increase Based on Storage Delta Factor Only



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 supply decisions need to include~~Quality Control Act includes the following goals:~~

- ~~Achieve the maximum practical degree of~~ water quality management considerations~~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 sustain and improve ~~provide for the prevention, abatement and control of new or~~ existing statewide water quality conditions. A more specific discussion about the relationships between~~pollution; and to cooperate with other states and the federal government in carrying out these objectives.~~[37]

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

~~A primary goal of the Water Quality Control Act~~ is provided in Section 7.3~~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] U.S.~~[1] US~~ Census Bureau, "Statistical Abstract of the United States; Table 366. Extreme and Mean Elevations by State and Other Areas," (2012). ~~[Online].~~ https://www.census.gov/compendia/statab/2012/tables/12s0366.pdf.

[2] U.S.~~US~~ Geologic Survey, *Water Fact Sheet: Largest Rivers in the United States, (USGS, 1990).* ~~Online.~~ http://pubs.usgs.gov/of/1987/ofr87-242/pdf/ofr87242.pdf.

[3] B. Harding, *Analysis for CWCB (*2014).

[4] B. Harding, "DRAFT Technical Memo: SWSI Climate Impact Support, Development of Projected Gauged Flows," October 8, 2014.

[5] Colorado Geologic Survey, "Groundwater," 2014. http://coloradogeologicalsurvey.org/water/groundwater/.

[6] Colorado Geological Survey. CGS Groundwater Atlas. accessed June 24, 2015 http://coloradogeologicalsurvey.org/apps/wateratlas/images/fig1_2.pdf

~~[7] Colorado Geologic Survey, "Groundwater," 2014. [Online]. Available: http://coloradogeologicalsurvey.org/water/groundwater/.~~

~~[8] Colorado Geologic Survey, "Groundwater," 2014. [Online]. Available: http://coloradogeologicalsurvey.org/water/groundwater/.~~

[9] N. J. Doesken, 2003. http://climate.colostate.edu/climateofcolorado.php.
[10] Doesken, Pielke Sr., and Bliss, *Climate of Colorado,* ~~[Online]. Available:~~ http://climate.atmos.colostate.edu/climateofcolorado.php.~~:~~ Charles C. Rhoades, Deborah Entwistle, and Dana Butler, "The influence of wildfire extent and severity on streamwater chemistry, sediment and temperture following the Hayman Fire, Colorado," *International Journal of Wildland Fire* 20 (2011)~~,~~: 430-442.
[11] Denver Water, *2010 Comprehensive Annual Financial Report* (Denver~~: Denver~~ Water, 2011), I-17.
[12] David L. Rosgen, *The Trail Creek Watershed Master Plan for Stream Restoration & Sediment Reduction*, (Fort Collins: Wildland Hydrology, 2013).
[13] Denver Water, *2010 Comprehensive Annual Financial Report,* I-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), 9-10.
[15] Pritchett, Goemans, and Nelson, *Estimating the Short and Long - term Economic & Social Impacts of the 2012 Drought in Colorado*, 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] U.S.~~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), 3.~~
~~[20] Division of Water Resources, "Halligan Reservoir Diversion Records," 2013.~~
[21] Lukas, *Climate Change in Colorado*, 84.
[22] Lukas, *Climate Change in Colorado, 25-34.*
~~[23] Colorado Water Conservation Board, "Colorado Drought Mitigation and Response Plan," 2013.~~
[24] Lukas, *Climate Change in Colorado*, 36.
[25] Lukas, *Climate Change in Colorado*, 36.
[26] B. Harding, "DRAFT Technical Memo: SWSI Climate Impact Support, Development of Projected Gauged Flows," October 8, 2014.
[27] T. Painter, et al, "Impact of disturbed desert soils on duration of mountain snow cover," *Geophysical Research Letters,* 2007.~~:~~ Painter, et al, "Response of Colorado River Runoff to Dust Radiative Forcing in Snow."
[28] Painter, et al, "Response of Colorado River Runoff to Dust Radiative Forcing in Snow."; Lukas, *Climate Change in Colorado*, 84.
[29] Center for Snow and Avalanche Studies, "Colorado Dust-on-Snow Program WY2013 Summary," 2013, 84. ~~[Online]. Available:~~ http://snowstudies.org/dust/SBBSA/summary_2013.html.
[30] Painter, et al. "Response of Colorado River Runoff to Dust Radiative Forcing in Snow."; Cooperative Institute for Research in Environmental Sciences (CIRES)~~,~~ Robbing the West, Dust on Snow Depletes Colorado River Runoff~~. Video~~. http://cires.colorado.edu/news/press/2010/dustonsnow.html. 2010
[31] Natural Resource Conservation Service, "Basin Wide Reservoir Summary," June 2014.
[32] 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.
[33] 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.
[34] World Meterological Orginization, " DOCUMENTS ON WEATHER MODIFICATION," in *Updated in the meeting of the Expert Team on Weather Modification Research*, Abu Dhabi, 2010.; Weather Modification Association, "Position Statement on the Environmental Impact of Using Silver Iodide as a Cloud Seeding Agent," July 2009.
[35] http://cwcb.state.co.us/water-management/water-projects-programs/pages/%C2%ADweathermodificationprogram.aspx
[36] State of Colorado, Water Quality Control Division, Colorado Department of Public Health and Environment, ~~"~~*Integrated Water Quality Monitoring and Assessment Report: 2012 Update to the 2010 305(b) Report* ~~(,"~~ 2012)~~, pg~~ ES8-9.
~~[37] § 25-8-102, C.R.S~~

coloradowaterplan.com
cowaterplan@state.co.us
Direct 303-866-3441

5. Water Demands

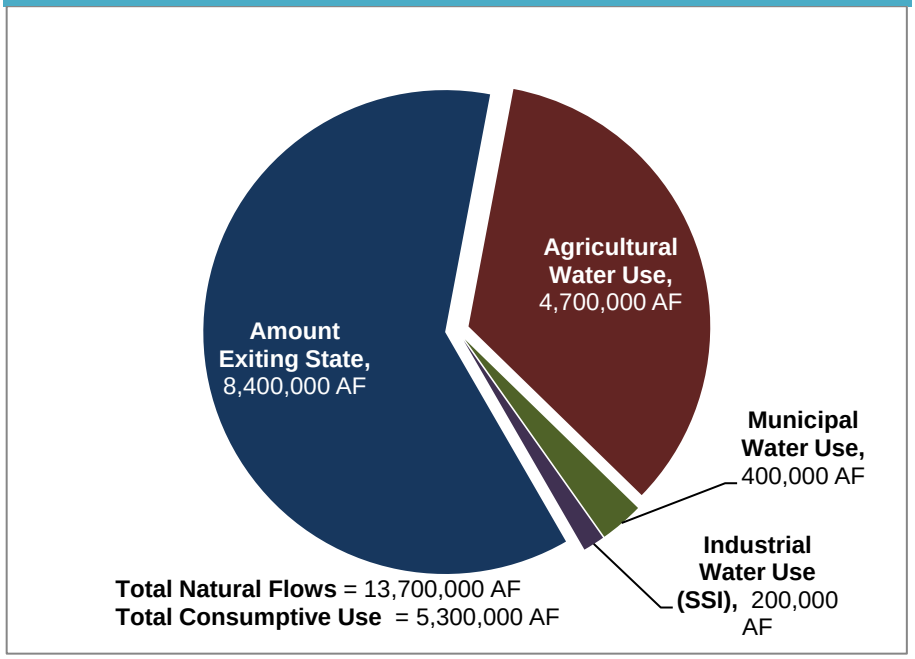
This chapter provides an overview of Colorado's current and projected municipal, industrial, agricultural, environmental, and recreational uses. ~~Colorado's Water Plan identifies our water resource challenges.~~ To assess the road ahead, it is essential to understand the many ways that water is used throughout the state and how these uses are connected. As municipal and industrial (M&I) 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.

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. On average, Colorado consumes 5.3 million acre-feet per year, but this water can be used multiple times as described ~~in the sequence of 1-4~~ above, with total diversions of ~~equivalent to~~ 15.3 million acre-feet per year.

Figure 5-1: Statewide Consumptive Water Use[1]



The total amount of water that originates within Colorado averages ~~is on average~~ 13.7 million acre-feet per year. More

than. Over 60 percent of this water exits the state to be used by downstream users, leaving less than 40 percent or. The 5.3 million acre-feet on average per year, consumed in Colorado totals less than 40 percent of all of waters originating within the state.[2] Of the water consumed, 89 percent is for agricultural use, followed by municipalities at 7 percent and large industries at 4 percent (Figure 5-1).[3] [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.

Overview of M&I 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 gross domestic product (GDP) (total state GDP in 2013 was more thanover $273 billion) and represented more thanover 58,000 jobs and $4.7 billion in annual wages.[5] 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.[6] This growth, in part, drives M&I water demands.

Municipal Needs

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

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.[7] Current indications show that Colorado has one of the fastest growing state economies nationwide, even receiving the top ranking in some analyses.[8] 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.[9] Such growth will mean additional revenue for education and services and less unemployment, but it will also increase water demands. The total change in water demands will also be affectedeffected by further increases because ofdue to climate changes and decreases from water conservation actions (see Section 6.3).

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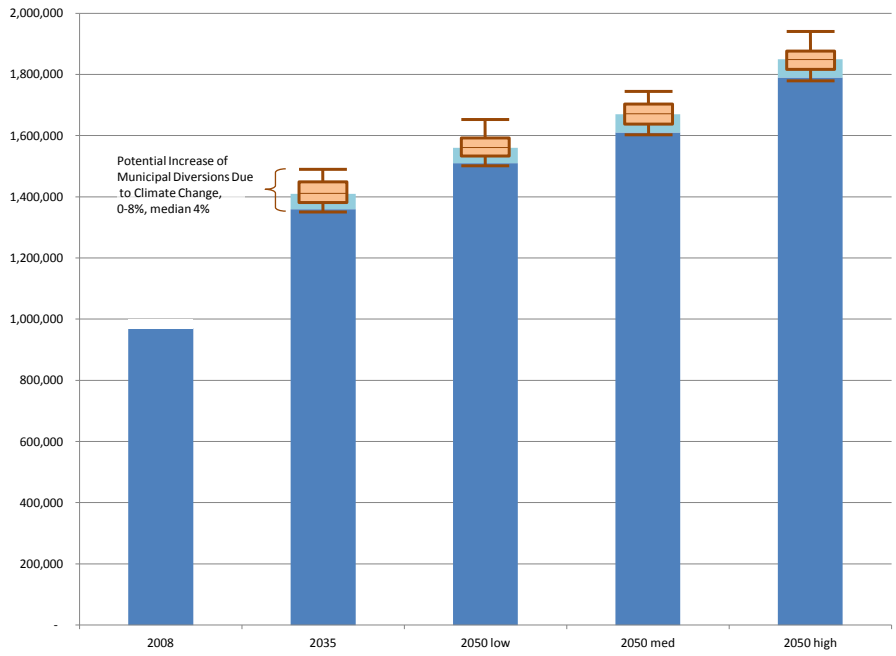
[a] For the purposes of the CWCB's technical work, conservation savings were divided into two categories. The first is passive conservation, which was used to reduce demand projections. Passive conservation results from the replacement of old indoor fixtures and appliances with newer, more efficient 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.

Colorado's growing economy leads to population growth in two primary ways. First, Coloradans haveare having children who attend college in the state and are able to remain as working adults andwho 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, natural beauty, and a high quality of life, draw people and businesses to the State and keep them here.[11]

A growing and changing population often drives further growth as people migrate to Colorado to fill jobs.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]

Population growth for the state is inevitable, but Colorado state and local governments can influence how and where 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 asof much as 8 percent (Figure 5-2).[13] If Colorado experiences a future where the population rises while the climate becomes hotter and dryer, (a scenario known as hot growth)[b] nearly 1more than a million acre-feet per year

Figure 5-2: Projected M&I Water Demands (acre-feet) with Range of Climate Change Increases



[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.

could~~may~~ be needed by 2050 beyond the 2008 demand levels.[14] 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]

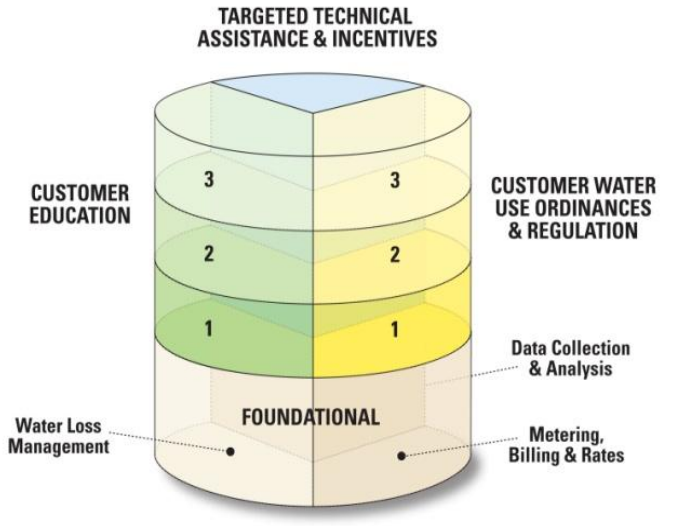
The degree to which climate change could affect~~impact~~ municipal demands varies considerably across the state because of differences in the amount of outdoor irrigation, potential temperature increases, and potential changes in precipitation patterns ~~throughout the state~~.[16] Increases in demand from climate change do not take into account potential hydrological changes, which could further decrease municipal supply, thus further exacerbating ~~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 substantial~~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

Colorado communities plan to build upon the success of existing conservation and efficiency programs to further reduce per person water needs. Since the year 2000, Colorado as a whole reduced these per capita demands by 20 percent, and some communities by as much as 30 percent.[17] To continue this trend, additional best practices will need to be implemented.

Figure 5-3: SWSI Levels Analysis Framework



In 2010, the Colorado Water Conservation Board (CWCB) funded a first *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.[18]

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 5-3). 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 achieve~~attain~~ the more difficult activities.[19]

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 M&I 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 level. Water is saved by municipal customers, but customers can be aided in the effort. State polices 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 5-1).[20]

Table 5-1: Potential Water Savings for 2030 and 2050 in SWSI 2010

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). This~~While this~~ practice makes the most~~may not make~~ sense for water~~every provider, it may for the majority of~~ providers that have customers with large lots and commercial properties that have outdoor space. 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 that~~and therefore~~ maintain property values and continue to help reduce increased urban temperatures.

Additional focus on outdoor conservation is needed because indoor water use consumes approximately 5 percent of the water used while outdoor water use consumes 70 to 85 percent. 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.

A minimum of low to medium levels of active water conservation practices was identified as a no-and-low regret, which is further described in section 6.1. In addition, an aspirational goal of 400,000 acre-feet, equivalent to medium to high levels, was identified by the IBCC, and is further described in Section 6.3.

Initial estimates by the roundtables indicate that between 50 and 60 percent of conserved water could be used to meet future growth. [21]

Table 5-2: 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**
System-wide conservation measures with potential to affect~~impact~~ all customers			
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.
Residential indoor savings and measures			
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 affected~~impacted~~	50-70% of state affected~~impacted~~	70-100% of state affected~~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	33% savings -passive from	37% savings -passive from	43% savings -passive from

Table 5-2: 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**
side leakage	toilet replacement	toilet replacement and active repairs	toilet replacement and active repairs
Non-Residential indoor savings and measures			
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 affected~~impacted~~	50-70% of state affected~~impacted~~	70-100% of state affected~~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
**Landscape conservation savings and measures*			
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
Utility Water Loss Control			
Improved utility water loss control measures	**<=7% real losses**	**<=6% real losses**	**<=6% real losses**
*Landscape water demand reductions include the expected effects~~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.

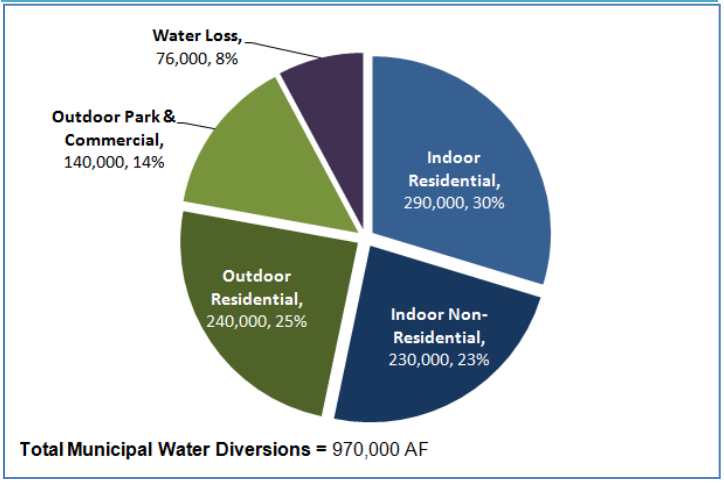
~~Initial estimates by the roundtables indicate that between fifty and sixty percent of conserved water could be used to meet future growth. Through the stakeholder engagement process described Section 6.3, it was determined that approximately 170,000 acre-feet was the plausible amount that could be 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 active conservation savings~~this amount~~, another 150,000 acre-feet of savings will likely accrue by 2050 because of natural replacement rates of fixtures and appliances.[24] These passive water conservation savings occur when home and property owners replace their indoor water fixtures and appliances. Their choices save water as a result 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 Senate Bill 14-103, as described further in Section 6.3.

Looking forward, additional technical work is needed to better inform the statewide discussion. The 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 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. These~~This~~ data will result in updated water demand projections~~, and will be available by early 2015~~.

Figure 5-4: Statewide Municipal Use Patterns[25]



Colorado's current municipal diversions total approximately 970,000 acre-feet annually.[27] This use is split among~~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 because ofdue to water loss (Figure 5-4).[c]

Municipal Reuse

According to the SWSI 2010, the reuse of existing supplies has been projected to provide 43,000 to 61,000 acre-feet of water per year, which accounts for about 10 percent of the total Identified Projects and Processes (IPP) projected yield.[28] 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 Waterwater:** 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 Groundwatergroundwater:** 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.[29]

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 various commercial and industrial uses such as cooling tower use, dust control, soil compaction, mechanized street cleaning, fire protection, and zoo operations.[30]

Municipal Land Use

Land use patterns affect how much water is used by a community. Land use tools, such as higherHigher density development saves water compared to traditional developments or tap fee incentives for waterand has other benefits, such as more efficient developments, save water by increasing the efficiency of water distribution systems, limiting lawn size, and using efficient indoor

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

fixtures and appliances.~~infrastructure.~~ The 2009 California Water Plan Update showed that a 20 percent increase in housing density could yield a 10 percent water savings,[31] and initial data from Colorado confirm these results [reference density paper].~~.~~[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 parks and landscapes will not disappear with denser urban development, because healthy urban landscapes enhance the livability of a city or town and are a crucial asset for urban populations.

Large Industry

Large~~The types of large~~ industries located in Colorado include breweries, snowmaking, energy and mining extraction, power generation, food processing, and a multitude of others.~~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~~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]

Summary

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 Section 6.3.

Overview of Agricultural Needs

Statewide, agriculture diverts 34 percent of the total amount of water originating within Colorado, which is 89 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:

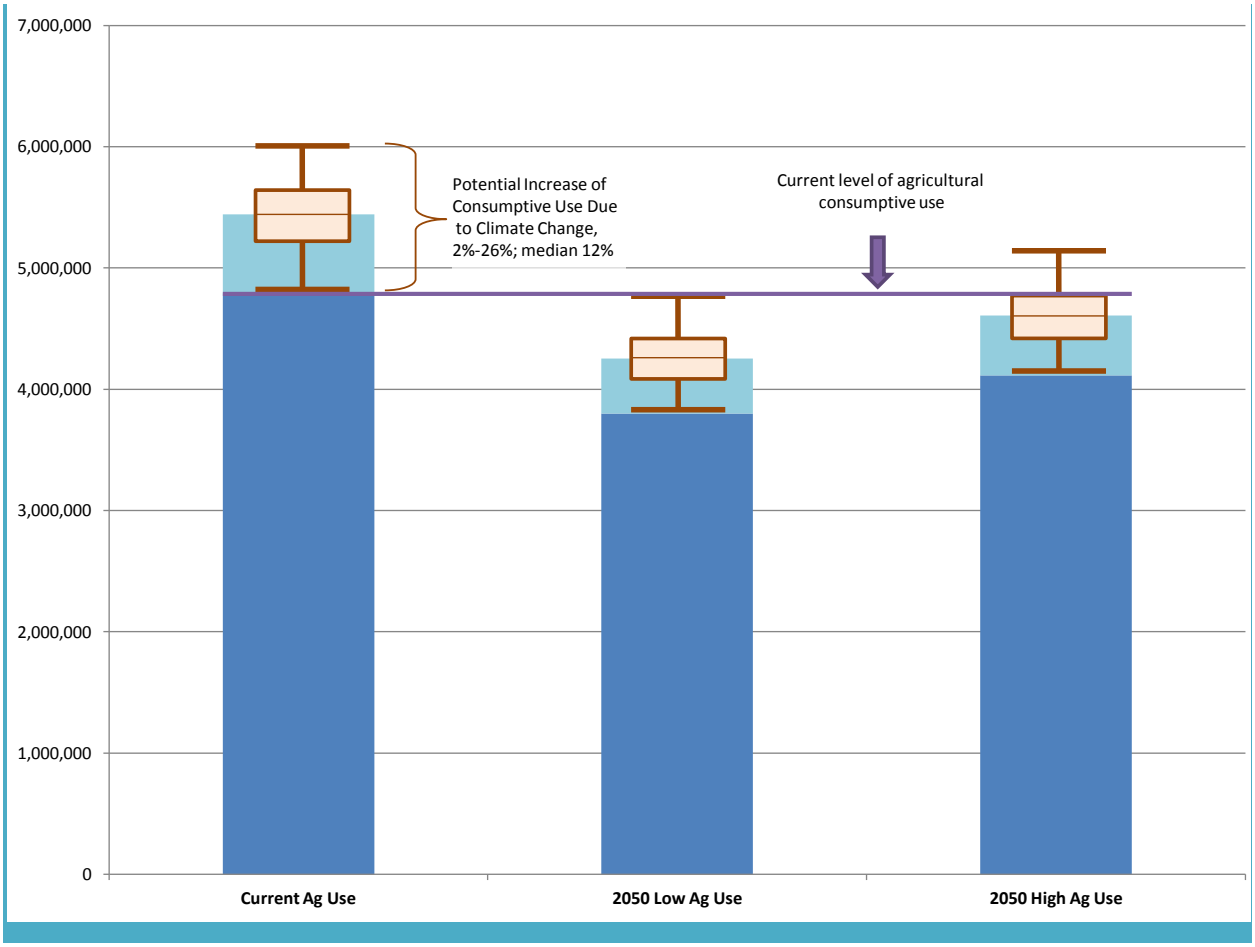
- Many municipalities turn to agricultural water rights as an affordable, reliable source of water and purchase them from willing sellers.
- Urban areas expand onto irrigated farmlands, thus urbanizing those agricultural lands.

- Because of~~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~~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 5-5).~~.~~[40] More frequent or severe droughts could also affect~~impact~~ agricultural production and slow economic agricultural activity. During the 2012 drought the state experienced a loss of agricultural revenues of $409 million and an additional loss of $317 million in secondary spending in local communities.[41]

Figure 5-5: Projected Agricultural Water Demands (acre-feet) with Range of Potential Climate Change Increases



As part of the Basin Implementation Plans, ~~(BIPs),~~ 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. Below is a brief summary of agricultural needs, as identified in the Basin Implementation Plans~~BIPs~~.

Table 5-3: Summary of agricultural goals indicated in the Basin Implementation Plan

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~~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

Overview of Environmental and Recreational Needs

River flows~~recreational attributes are not solely based on the amount of water needed. Water supply~~, aquatic and riparian habitat, water quality, bank stability, stream access, water temperature, and habitat connectivity are all critical when determining environmental and recreational needs. ~~.~~

~~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.~~

Therefore, river-based environmental and recreational needs are often represented by the~~in~~ number of stream miles or acres of wetland that have~~, featuring~~ important attributes and~~which~~ need protection or restoration. A collaborative effort between the CWCB and the basin roundtables, as part of the SWSI 2010, identified 13,500 perennial stream miles in Colorado that have important attributes, and were therefore selected as "focus areas."[42] Examples of important attributes include imperiled fish species, outstanding examples of riparian habitat, and important boating and fishing

areas[d]. Figure 5-6 shows these ~~the important~~ areas as identified by the basin roundtables. The work of the basin roundtables was not meant to include every stream with important attributes in every basin. Additional analysis to define what is needed in the~~The~~ focus areas and identifying other streams with substantial values will continue to~~area information can~~ be important. ~~further broken down by attribute. For instance:~~

Analyzing the focus areas is a critical step to describing the needs of specific attributes, and ultimately developing strategies to address these environmental and recreational needs. Below are some examples of this analysis:

- 2260~~2,260~~ perennial stream miles of Colorado River and greenback cutthroat trout habitat were identified in focus areas across the state.
- 3164~~3,164~~ perennial stream miles of warm-water fish habitat were identified in focus areas. These reaches include endangered, threatened, or imperiled fish species.
- 7642~~7,642~~ perennial stream miles of substantial~~significant~~ riparian areas and wetlands were identified. These include occurrences of exemplary plant communities as well as rare plant communities.

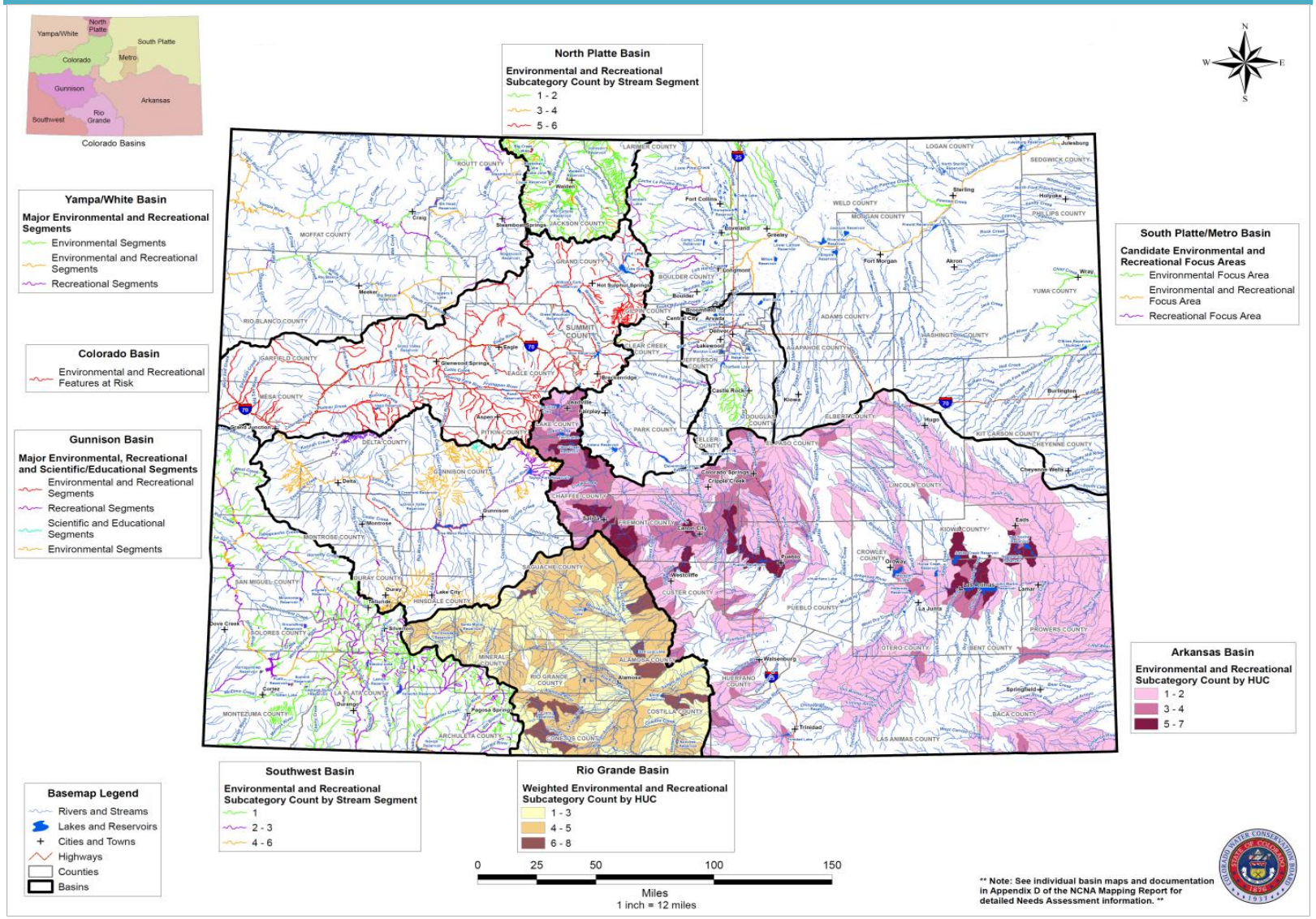
The number of water rights appropriated for instream flows, natural lake levels, and recreational in-channel diversions demonstrate some of the ongoing flow~~existing~~ needs for the environment and recreation:

- In stream flow: 9180~~9,180~~ stream miles for 1595~~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 1800~~1,800~~ cubic feet per second.

Environmental and recreational water needs often overlap. For example, keeping a stream flowing can be beneficial for aquatic life as well as for anglers. Boulders and other structures used~~It is critical~~ to enhance boating experiences can be placed to also improve aquatic habitat for fish. However, in some cases, needs conflict, such as when there are different optimal flow levels for rafting and fishing.

[d] Recreation in Colorado's Water Plan includes boating, fishing, camping, wildlife viewing, and waterfowl hunting. Many other recreational activities in Colorado require water in some form, but are counted as part of other uses. The irrigation of sports fields, golf courses, and parks are primarily served by municipal water providers and are included as a municipal use. Likewise, skiing depends on snowmaking, and the water rights associated with this use are typically owned by resort operators. Therefore, snowmaking is classified as an industrial use.

Figure 5-6: Statewide Environmental and Recreational Needs[43]



Section 6.6 explores tools, projects, and methods to meet Colorado's~~note that water is not consumed by~~ environmental and recreational needs.

The term "nonconsumptive" can be found in this document and in the Basin Implementation Plans, and it is used to refer to environmental and ~~or~~ recreational uses. However these uses often consume water, such as through evaporation or evapotranspiration. For both environmental and recreational uses, water is ~~, but rather~~ held in streams and designated for those specific uses. This water is often reused multiple times downstream by agricultural, municipal, or industrial water users.

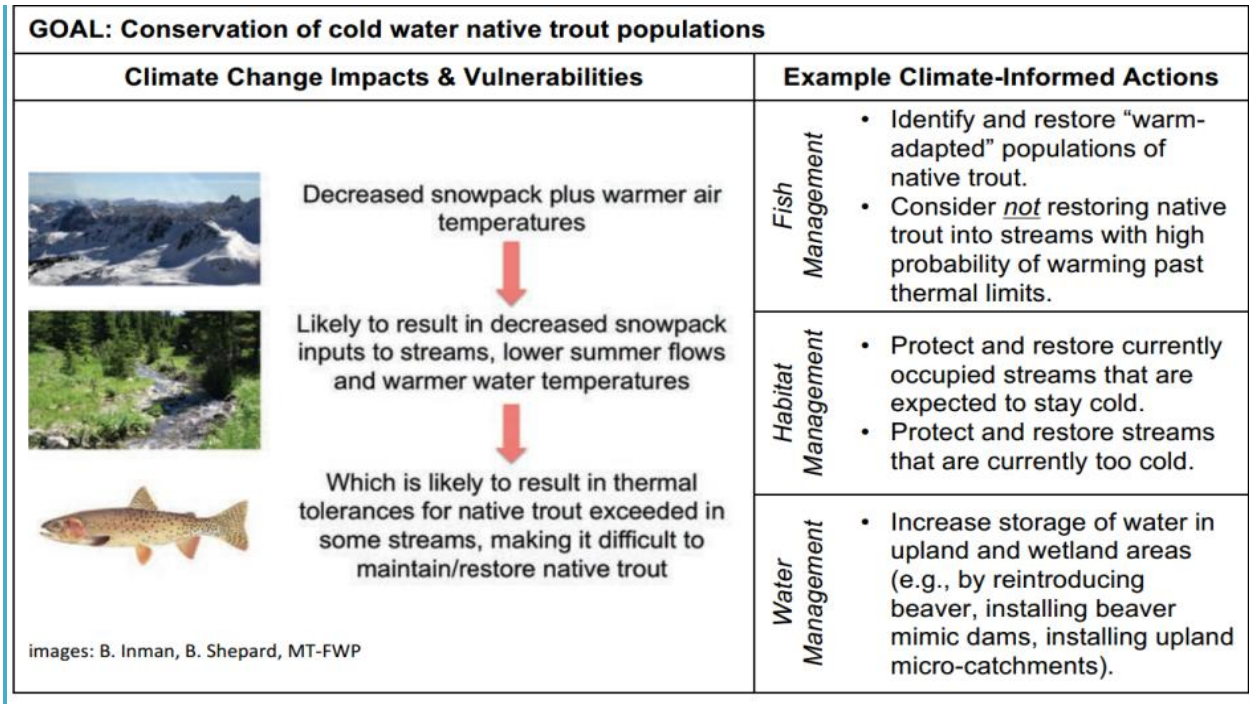
The ability to decree water using instream flows and recreational in-channel diversions provides Colorado with important, effective tools for meeting environmental and recreational needs and for supporting state and federal values.

Climate change could affect~~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 5-7). Rising temperatures could also adversely affect plant communities.[44] 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.[45]

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 5-7 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

Figure 5-7: Illustrative Climate-Informed Actions in Response to Climate Change Effects on the Availability of Suitable Habitat for Cold Water Native Trout[46]



~~Figure 5-7: Illustrative climate-informed actions in response to climate change impacts on the availability of suitable habitat for cold water native trout[47]~~

[1] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010* (Denver, 2011), 4-29. ; Ben Harding, *SWSI Climate Impact Support, Development of Projected Gauged Flows Draft Technical Memorandum* (Denver, 2014), 1.

~~[2] United States Geological Survey, *Estimated Use of Water in the United States in 2005* (Reston, 2005), 6.~~

[3] United States Geological Survey, *Estimated Use of Water in the United States in 2005*, 7.

~~[4] United States Geological Survey, *Estimated Use of Water in the United States in 2005*, 7.~~

[5] United States Department of Commerce, Bureau of Economic Analysis; Jobs and Wages, QCEW 2012.; U.S. Department of Commerce, Bureau of Economic Analysis, Advance 2013 and Revised 1997-2012 Statistics of GDP by State, http://www.bea.gov/newsreleases/regional/gdp_state/gsp_newsrelease.htm.

[6] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, 4-3.

[7] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, 4-5.

[8] 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.

[9] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, 4-5.; Colorado Department of Local Affairs; State Demographer's Office, *2050 Low, Medium, and High Population Projections* (Denver, 2014), 1.

[10] Elizabeth Garner, Colorado State Demographer's Office, Presentation, 2011.

[11] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, Appendix H.

[12] Colorado State Demographer's Office, Personal Communication, 2014

[13] Harding, *SWSI Climate Impact Support, Development of Projected Gauged Flows Draft Technical Memorandum*, 1.
[14] Colorado Water Conservation Board, ~~CWCB, "~~*SWSI 2016 Initial Draft Chapter 7: Scenario Planning & Adaptive Management* ~~,"~~ CWCB, ~~Denver,~~ 2014~~).~~
[15] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, 4-11.
[16] Harding, ~~Ben.~~ *SWSI Climate Impact Support, Development of Projected Gauged Flows Draft Technical Memorandum*~~. (Denver, 2014),~~ 1.
[17] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, 4-11
[18] Colorado WaterWise and Aquacraft, Inc. *Best Practices Guidebook for Municipal Water Conservation in Colorado* (Denver: Colorado WaterWise, 2010). http://coloradowaterwise.org/BestPractices.
[19] Colorado Water Conservation Board, *SWSI Water Conservation Levels Analysis* (2010), 31. http://cwcb.state.co.us/public-information/publications/Pages/StudiesReports.aspx.
[20] Colorado Water Conservation Board, *Appendix L~~AppendixL~~: SWSI 2010 Municipal and Industrial Water Conservation Strategies* (2011), 12. http://cwcb.state.co.us/water-management/water-supply-planning/Documents/SWSI2010/AppendixL_SWSI2010MunicipalandIndustrialWaterConservationStrategies.pdf.
[21] Interbasin Compact Committee, *Draft No & Low Regrets Action Plan* , 3.; Interbasin Compact Committee, *Draft Conceptual Agreement*, 15.
~~[22] Interbasin Compact Committee, *Draft No & Low Regrets Action Plan* , 3.~~
~~[23] Interbasin Compact Committee, *Draft Conceptual Agreement* , 15.~~
[24] Colorado Water Conservation Board, *Appendix L~~AppendixL~~: SWSI 2010 Municipal and Industrial Water Conservation Strategies*, 10.
[25] Colorado Water Conservation Board, *Appendix L~~AppendixL~~: SWSI 2010 Municipal and Industrial Water Conservation Strategies*, 43.
[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*, 4-11.
[28] Colorado Water Conservation Board, *SWSI 2010 Consumptive Projects and Methods* (2010), 5-4 – 5-5. http://cwcb.state.co.us/water-management/water-supply-planning/Documents/SWSI2010/SWSI2010Section5.pdf.
[29] M. o. R. R. Committee, Interviewee, *Reuse discussion.* [Interview]. April 2014.
[30] Colorado Department of Public Health and Environment Water Quality Control Commission, *Regulation No. 84 Reclaimed Water Control Regulation* (2013). https://www.colorado.gov/pacific/sites/default/files/Regulation-84.pdf.
[31] C. D. o. W. Resources, "California Water Plan Update," *Integrated Water Management Bulletin* 160-09, 2009.
~~[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*, 4-16.
[34] Colorado Basin roundtable and Yampa/White/Green Basin roundtable, *Energy Development Water Needs Assessment Phase 3 Final Report,* June 30, 2014.
[35] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, 4-29.
[36] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, 4-29.
[37] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, 4-26.
[38] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, 4-28.
[39] HDR Engineering and West Sage Water Consultants, ~~*Draft*~~ *South Platte Basin Implementation Plan* (Denver and Longmont, 2014).
[40] Harding, *SWSI Climate Impact Support, Development of Projected Gauged Flows Draft Technical Memorandum*, 1.
[41] James Pritchett, ~~James,~~ Chris Goemans and~~,~~ Ron Nelson, *Estimating the Short and Long-term Economic & Social Impacts of the 2012 Drought in Colorado*, 8.
[42] Colorado Water Conservation Board, CDM Smith, and The Nature Conservancy, *Nonconsumptive Toolbox* (Denver, 2013), pg 3.

[43] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010*, Figure 2-15. http://cwcb.state.co.us/water-management/water-supply-planning/Documents/SWSI2010/S2%20Maps_Statewide.pdf

[44] Great Northern Landscape Conservation Cooperative Rocky Mountain Partner Forum Workshop, *Summary Report for the Climate Change and Cold Water Systems Workshop* (Bozeman: GNLCC, 2013), 9. http://ecoadapt.org/data/documents/RMPF_climate_workshopreport_FINAL_small.pdf

[45] Great Northern Lanscapes, *Summary Report for the Climate Change and Cold Water Systems Workshop,* 9.

[46] Great Northern Lanscapes, *Summary Report for the Climate Change and Cold Water Systems Workshop,* 9.

[47] Great Northern Lanscapes, *Summary Report for the Climate Change and Cold Water Systems Workshop,* 9.

coloradowaterplan.com
cowaterplan@state.co.us
Direct: 303-866-3441

6. Water Supply Management

Chapter 6 discusses the dynamic strategy needed to meet Colorado's future water needs. This chapter~~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 discuss~~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 or environmental and recreational 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 (BIPs) 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 & 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 public~~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 (TMD) as described in Chapter 8.~~),~~ and even higher

levels of conservation to meet future municipal and industrial (M&I) needs while concurrently implementing environmental and recreational projects and continuing to support agriculture.[1][2]

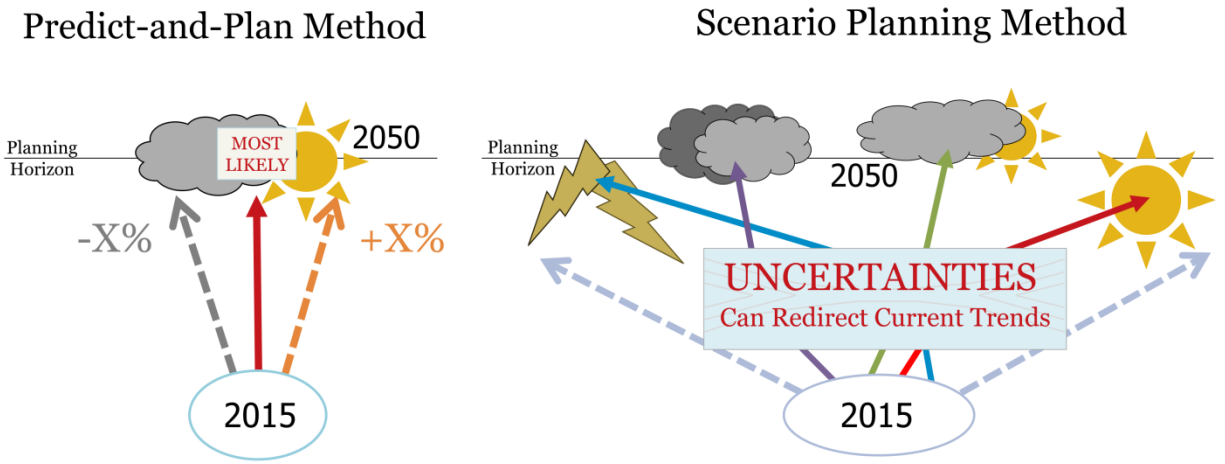
The elements of Colorado's adaptive strategy arose from significant technical work and the early and ongoing engagement of stakeholders. In developing Colorado's Water Plan and Statewide Water Supply Initiative~~Initative~~ (SWSI) 2016, the Colorado Water Conservation Board (CWCB), basin roundtables, 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.[3] These groups worked together to explore how to meet increasing water needs of growing communities while balancing water interests.[4] Of particular concern, Colorado must contend with the significant and growing municipal water needs by 2050.[5] 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~~emplyong~~ the scenario planning approach.

Rather than trying to predict the future by looking at the past, scenario planning allows us to identify and account for key uncertainties

Scenario Planning: *Planning for multiple futures*

Given the uncertainties of future water supply and demands, the CWCB adopted a planning approach ~~now~~ used by many major water planners across the West~~west~~: scenario planning.[6] The use of scenario planning assumes that the future is unknown and provides flexibility in responding to various future conditions.[7] 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

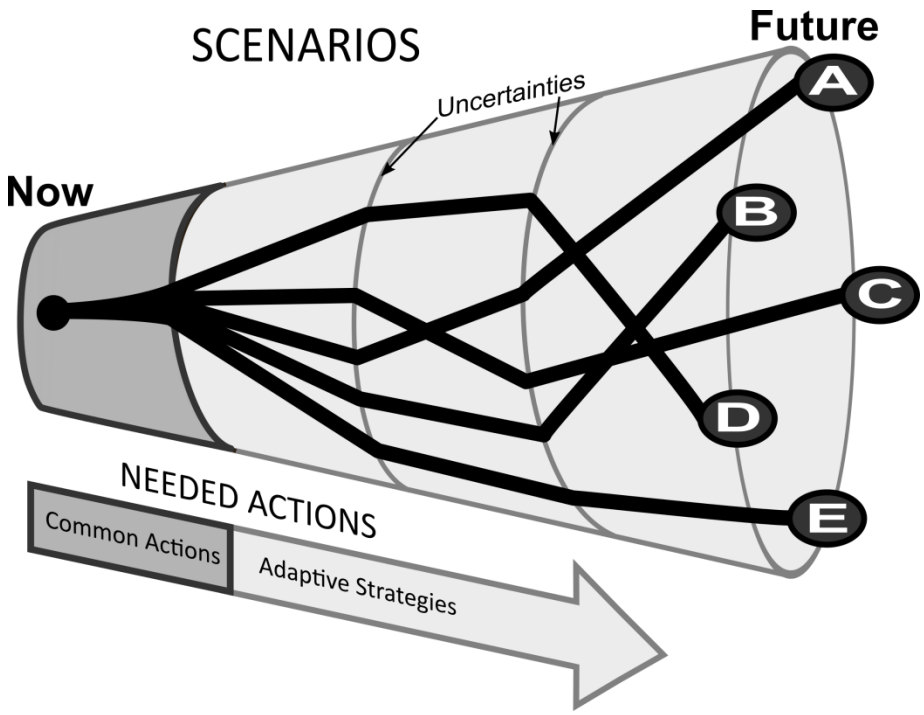


Adapted from Global Business Network, 2012 & Marra, 2013.[8]

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. The CWCB explored with stakeholders the implications of multiple plausible futures. Given the unpredictability of factors driving Colorado's future, such as climate change, economic and population growth, and social values, the ability to plan for multiple scenarios presents a much more comprehensive tool to plan and prepare for Colorado's future. Descriptions of several futures Colorado could face 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 and can be planned for and prioritized first while still monitoring uncertainties that can redirect recent trends.

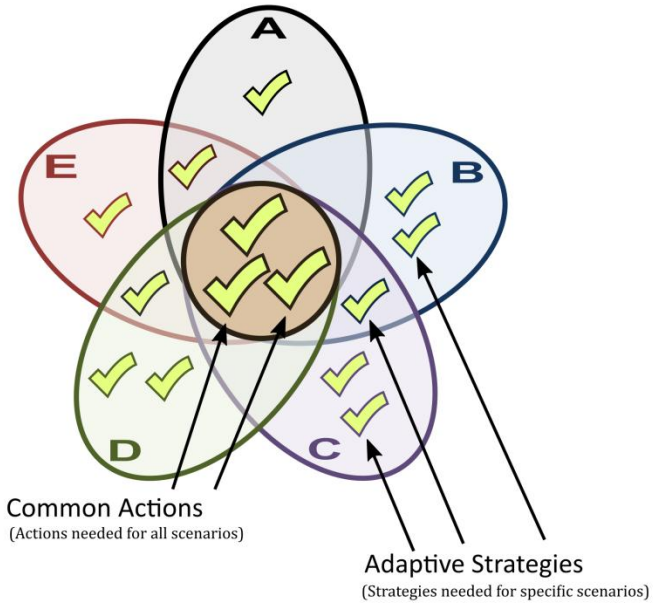
By implementing successive sets of common actions over time, decision makers can have greater confidence that the policies and investments made in the near term will also be viable in the longer term. The near and longer term actions combine with the scenarios to create a forward-looking pathway of actions 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, 2009.[9]

Figure 6.1-3: Common Actions and Adaptive Strategies in Scenario Planning



In the near term, our way forward is to implement actions common to all or most of the envisioned futures. These common actions have broad applicability, as is shown on Figure 6.1-3. The common actions are needed no matter which scenario is eventually encountered and can be implemented immediately, whereas the adaptive strategies are dependent on the specific scenario and will be evaluated based on future information. In the mid- ~~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 needs, 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.[10]

Developing Alternative Water Supply Portfolios

The SWSI 2010 report 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~~transfered~~ out of the agricultural sector to satisfy M&I water supply needs. This transfer would result in a substantial~~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.[11]

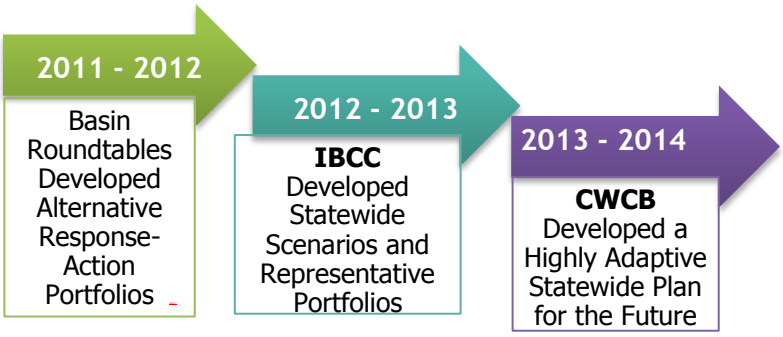
Given these concerns, the CWCB initiated a multi-year, stakeholder--plan development process with the nine basin roundtables and the IBCC. Each basin roundtable represents the water interests of a specific region within Colorado, and the IBCC facilitates conversations among the basin roundtables and addresses broader statewide water issues. The plan development process is summarized in Figure 6.1-4~~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 communities.[12]~~communities[13].~~

Each portfolio constitutes a unique combination of possible strategies that could be used to meet a range of projected M&I water needs. The strategies included conservation, reuse, agricultural transfers, development of water projects within each basin, and transmountain water diversions. The CWCB developed an interactive tool that quantified tradeoffs~~trade-offs~~ associated with Colorado's Water Values that would result from each portfolio—effects on~~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 M&I 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 6.1-4: Summary of the Stakeholder and Plan Development Process

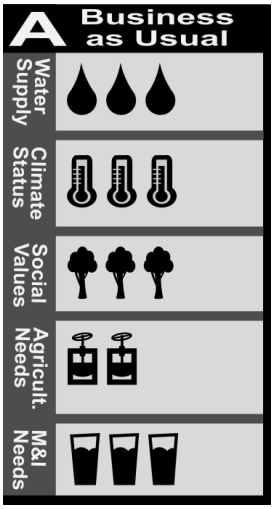


Formulating plausible scenarios

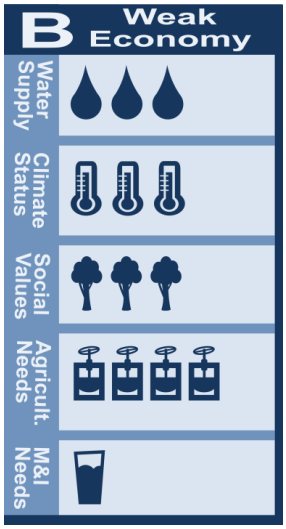
Potential changes in future M&I water demand and available water supply were among the most important drivers considered by all the basin roundtables when developing their portfolios. Some of the basin roundtables also considered changing societal values and other drivers outside the control of the water 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. M&I Water Demands
9. Availability of Water Efficient Technologies

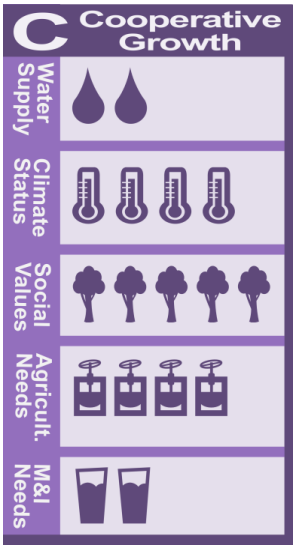
Using these drivers, the IBCC developed five scenarios that represent plausible futures, noted below, and matched them with five of the ten representative portfolios of solutions thatwhich best met the needs described in each scenario and aligned with Colorado's Water Values. The scenarios, summarized 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 summary of the scenarios here also includes a visualization of the five of the main drivers listed above. The chart for each scenario shows the relative increase/decrease in levels from current levels (three out of five). The descriptive names given to the scenarios portray the overall essence embodied in their respective views of the future.[14]future[15]. 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 of 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 agricultural land around cities are developed by 2050. Transfer of water from agriculture to urban uses continues. Efforts to mitigate the effectsimpacts 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.

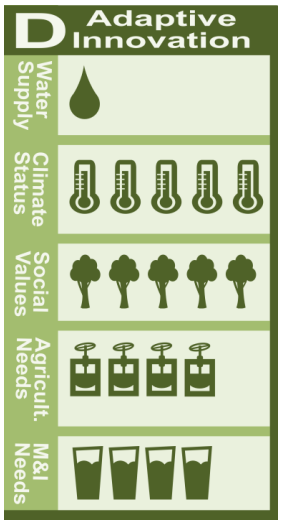


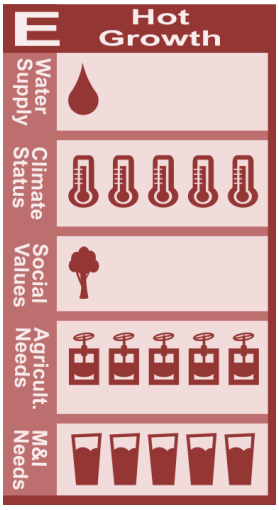
B. Weak Economy: The world's economy struggles, and the state's economy is slow to improve. Population growth is lower than currently projected, slowing the conversion of agricultural land to housing. Maintaining infrastructure, including water facilities, becomes difficult to fund. Many sectors of the 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 because ofdue 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 is 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 effects~~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, affecting~~impacting~~ stream flows and supplies. This dynamic reinforces the social value of widespread~~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 dominant~~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~~Colordo~~ for future projects and methods that may be needed in one or more futures~~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.~~

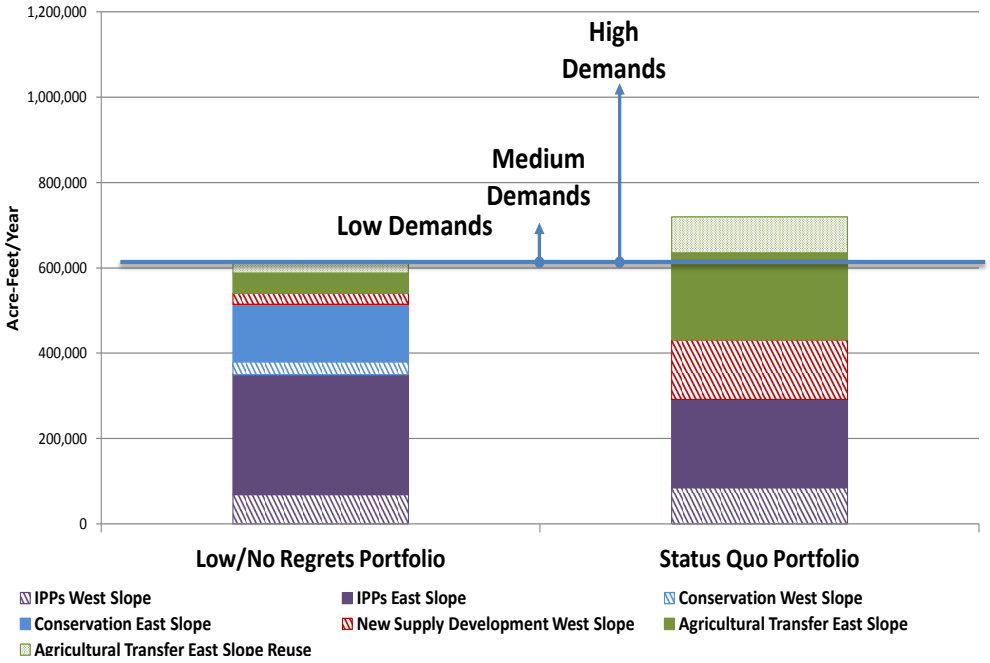
In~~Comparatively,~~ this context, a "regret" is entering a future where there are either:

1) Water shortages because of an insufficient number of implemented necessary projects and methods,
2) Significant consequences to Colorado's agriculture, environment, or economy because Colorado's water community did not implement projects and methods consistent with Colorado's water values, or
3) Too many unneeded and costly projects.

By implementing the no-and-low-regrets actions sooner rather than later, Colorado will be prepared for any future and at the same time not engender serious trade-offs.

Figure 6.1-4 shows how the no-and-low-regrets portfolio compares to the status quo.

Figure 6.1-5: No-and-Low-Regrets Portfolio versus the Status Quo Portfolio



The No-and-Low-Regrets Portfolio reduces potential effects to the environment and agriculture (compared to the Status Quo Portfolio) by increasing the success of planned projects and levels of water conservation. By doing so, the no-and-low-regrets portfolio is aligned with Colorado's water values and avoids the unacceptable consequences of continued drying up of Colorado's irrigated agriculture and using more Colorado River water. Nevertheless, the No-and-Low-Regrets Portfolio only meets the low-demand scenario (as shown on Figure 6.1-5) and additional water supplies or increased conservation will be needed if Colorado faces ~~future~~ medium or high water demands. In addition, there are several portfolios that address higher demands while continuing to align with Colorado values, which are explored below.~~maintaining Colorado's Water Values by reducing environmental and agricultural impacts.~~

The recommended no--and--low-regrets ~~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 unappropriated~~unallocated~~ waters:** Develop additional water supplies from unappropriated~~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 TMD, should a future scenario necessitate such a project through the conceptual agreement parameters described in Chapter 8.

- **Establish medium-high conservation strategies:** Implement strategies to meet medium-high levels of conservation and apply at least half of these savings to meet future M&I needs to support approximately 1 million people and the jobs needed to support them in the near future (200~~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 Section 6.5.
- **Implement water reuse strategies:** Implement strategies that encourage increased use of recycled water, as described in Section 6.3.

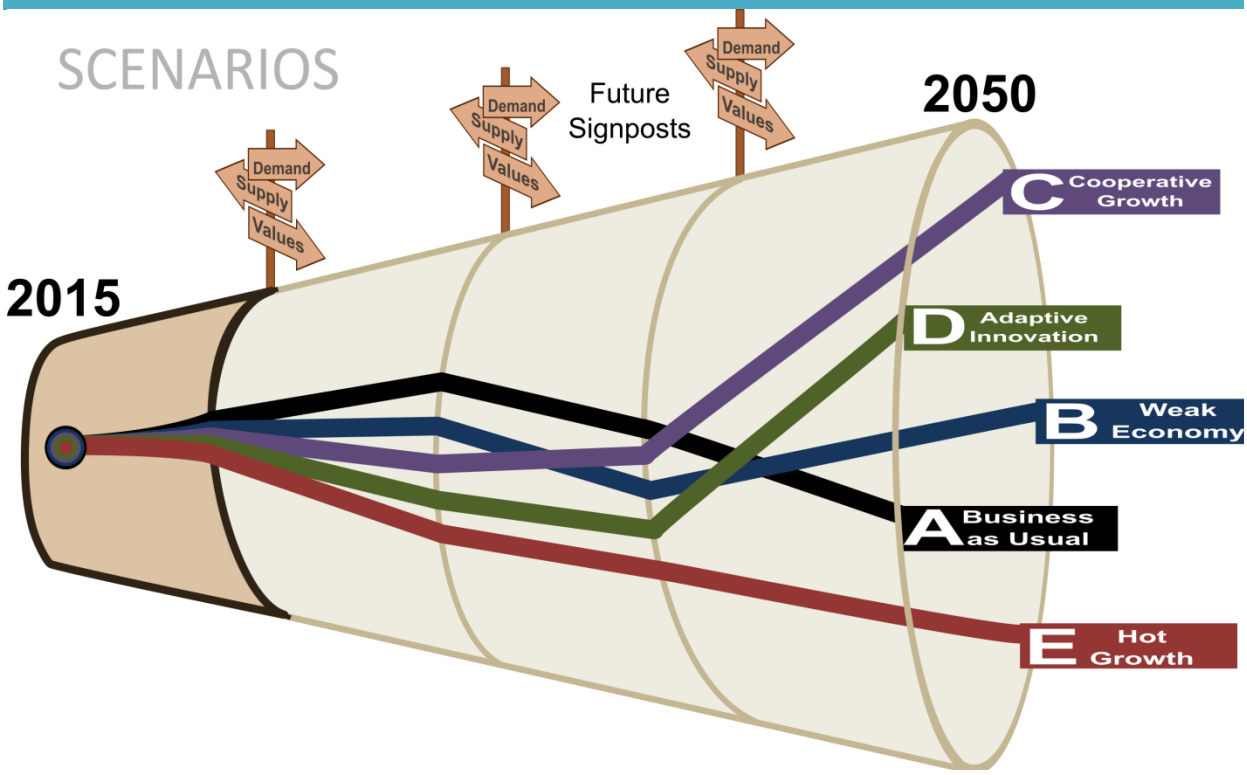
The "no- and- low- regrets portfolio" only satisfies the M&I water supply needs of the "weak economy" scenario and this would only be possible if the portfolio were successfully implemented in the near term. If medium or high water demands had to be met as envisioned in the other scenarios, additional 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-~~"no~~ and-Low-Regrets Portfolio ~~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 *M&I water demands*~~Water Demands~~ may trend "lower" or "higher" relative to the mid-level water demand forecasts used in previous SWSI 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*~~Supply Availability~~ may similarly trend "lower" or "higher" depending on climate change, watershed hydrology, and legal constraints associated with Colorado's interstate compacts, water law, and environmental regulations. Water supply availability~~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*~~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 reuse~~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 M&I water demands.

Figure 6.1-6: Colorado's Scenarios and their Matching Portfolios



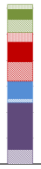
This scenario-based framework allows for incremental implementation of future portfolio response actions beyond the ~~"~~no~~-~~-and~~-~~-low-regrets~~ regret"~~ actions recommended in the near term (Figure 6.1-6).~~.~~ Pre-positioned portfolio actions–such as increased levels of conservation, agricultural transfers, or TMDs–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

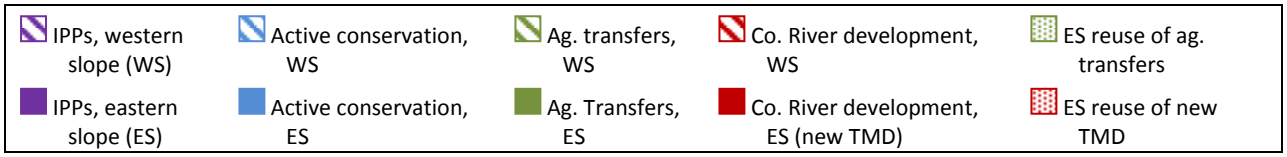
certainty as the future continues to unfold. Water demands, water supply, and social values are used as critical drivers.[16]

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.

The no-and-low-regrets ~~regret~~ actions will not be easy to accomplish. Nevertheless~~However~~, if these are not implemented in the next fifteen years, ~~then~~ the effects~~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-regrets ~~regret~~ actions are not fully implemented, the State would have to implement projects and methods beyond anything the basin roundtables have planned for as part of the portfolio development process. Depending on the scenario, this~~envisioned would need to implemented. This~~ could be an even larger TMD, 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-regrets ~~regret~~ actions are implemented.

Table 6.1-1: Scenarios and their Matching Portfolios

		Scenarios				
		B Weak Economy	C Cooperative Growth	A Business as Usual	D Adaptive Innovation	E Hot Growth
Scenario Drivers	Water Demand	Lower	Lower	Higher	Higher	Higher
	Water Supply	Higher	Lower	Higher	Lower	Lower
	Social Values	No Change	"Green"	No Change	"Green"	"Resource Utilization"
Portfolios of Solutions *(Height indicates how much additional water is needed, and color represents the source of water supplies.)*		 Low Demand Conservation Portfolio / No-and-Low Regrets Portfolio	 Mid Demand Conservation Portfolio	 Mid Demand Mixed Portfolio	 High Demand Conservation Portfolio	 High Demand Mixed Portfolio



Section 6.2 assesses whether or not the BIPs 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 vagariesvagarities 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. **Support the implementation of the no-and-low-regrets:** The CWCB, in partnership with other state agencies, will commit state financial, technical, and regulatory resources to the near-term implementation of prioritized water management projects, as specified in the no-and-low-regrets actions. As part of this work and in partnership with the basin roundtables, the CWCB will evaluate progress toward achieving the no-and-low-regrets actionsthe no and low regrets.
2. **Monitor drivers:** To determine which scenario Colorado will most likely face, the CWCB will work with partners, such as the Climate Change Technical Advisory Group, to continue to monitor the critical drivers of water supply, demand, and the level of "green" versus "full resource use" values through future Statewide Water Supply Initiative updates and other technical work. As part of this work the 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 work with stakeholder groupsevaluate progress toward achieving the no and low regrets.
2. CWCB will encourage the basin roundtables to update the scenarios and adaptive strategies.
4. **Promote use of**utilize a **scenario planning & adaptive strategies:** The CWCB and framework at the basin level as part of their BIPs.
5. In parterhship with the basin roundtables will continue to use and promote scenario planning and the use of adaptive strategies to respond to, mitigate for, and prepare for climate change. Theand IBCC, CWCB will alsoupdate the scenarios and adaptive strategies as scientific information improves and changes.
6.3. 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.
7.4. The CWCB and the Division of Water Resources (DWR) will continue to develop and support Colorado'sthe Colorado Decision Support Systems (CDSS) to encourage data-driven planning and decision makingSystem.

6.2 Meeting Colorado's Water Gaps

Colorado's Water Plan uses a grassroots approach to formulate projects and methods that avoid some of the undesirable outcomes of the supply-demand gaps. The plan addresses the gap from multiple perspectives (e.g.,~~to close~~ water storage, reuse, recycling, integrated~~gaps with more agile, informed, and responsible~~ water management, restoration and conservation).~~. 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.~~

Overview

This section describes how the basin roundtables'~~ draft~~ BIPs meet Colorado's growing municipal, industrial, agricultural, environmental, and recreational water needs. This section describes the BIP goals and measurable outcomes and identifies by basin the remaining needs that must be met to accomplish those objectives. These remaining needs are referred to as "gaps." The section relies on previous technical work conducted in the~~the~~ 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 prescribe or 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 that~~which~~ add up to a vision for how each basin plans to support each major sector. While a water supply gap for 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.

Goals and Measurable Outcomes~~measurable outcomes~~ by Basin~~basin~~

The degree to which the BIP goals and measurable outcomes demonstrate concurrence across Colorado is remarkable. The CWCB developed several long-term themes to meet the objectives outlined in the Governor's Executive Order.[17] 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~~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.

Table 6.2-1: Common Themes 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 thoughout 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	✓	✓	✓	✓	✓	✓	✓	✓

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~~roundtables~~. The Southwest and South Platte BIPs focus on implementing already specified Identified Projects and Processes (~~identified~~ IPPs) from SWSI 2010. The Southwest and the Colorado BIPs also identify additional projects and methods. 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~~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~~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 groundwater depletions.

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.

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~~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 TMDs.
- **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~~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.

Meeting M&I Water Needs Throughout Colorado

In the BIP process, the CWCB identified three statewide long-term goals to meet community water needs throughout Colorado:[18]

- 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 M&I 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.

To~~In order to~~ address at least the minimum water gap, the basin roundtables and the IBCC, developed several no-~~-~~and-~~-~~low-~~-~~regrets goals and measurable outcomes, as described in Section 6.1. For M&I uses, examples of measurable outcomes that would meet these no-~~-~~and-~~-~~low-~~-~~regrets actions were described for developing IPPs, and in many cases were broken out by basin. These measurable outcomes include actions such as reuse, conservation, agricultural transfers, and Colorado River supplies:~~,~~:[19]

- *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~~Gap~~, equivalent statewide to 67,000 acre-feet per year by 2030 and 167,000 acre-feet by 2050.
    - 2050 conservation~~bonservation~~ savings by basin:

- Arkansas: 36,000 acre-feet
- Colorado: 15,000 acre-feet
- Gunnison: 43004~~,300~~ acre-feet
- North Platte: 85 acre-feet
- Rio Grande: 32003~~,200~~ acre-feet
- South Platte(including Metro Area): 97,000 acre-feet
- Southwest: 75007~~,500~~ acre-feet
- Yampa/White/Green: 37003~~,700~~ acre-feet

- *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 acre-feet
    - Colorado: 45,000 acre-feet
    - Gunnison: 12,000 acre-feet
    - North Platte: 100 acre-feet
    - Rio Grande: 60006~~,000~~ acre-feet
    - South Platte(including Metro Area): 200,000 acre-feet
    - Southwest: 13,000 acre-feet
    - Yampa/White/Green: 70007~~,000~~ acre-feet
- *Implement Reuse Strategies*
  - 25,000 acre-feet per year of yield resulting from new agricultural transfer and TMD 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.
  - Develop a conceptual agreement among~~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 8)

Many of the BIPs seek to meet these short- and long-term M&I goals; this subsection reviews BIPs 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 M&I No-and-Low-Regrets ~~regrets~~ and Gapsgaps

Basin	2050 New Needs (acre-feet)[20]	2050 Gap (acre-feet)[21]	BIP ID'd Potential New P&M acre-feet~~AF~~[a]	# of New Projects w/ acre-feet info	Are No/Low Regrets Likely Met?	Notes
Arkansas	110,000 - 170,000	59,500[22] (M&I Shortage)	125,000~~In Process~~	10~~0~~	Yes: Conservation~~Uncertain: still in process w/~~	Projects listed in the BIP were

Table 6.2-2: Summary of BIPs Addressing the M&I No-and-Low-Regrets ~~regrets~~ and Gapsgaps

Basin	2050 New Needs (acre-feet)[20]	2050 Gap (acre-feet)[21]	BIP ID'd Potential New P&M acre-feetAF[4]	# of New Projects w/ acre-feet info	Are No/Low Regrets Likely Met?	Notes
		45,000 - 94,000 (SWSI 2010)			~~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; basin goal to increase surface storage by 70,000 acre-feet	prioritized in a IPPs list.~~The Draft BIP will develop additional detail by April 2015~~[23]
Colorado	65,000 - 110,000	26,000 - 48,000	40,272 (20,272 in projects & 20,000 from high active conservation) ~~534,000 – 564,000~~	3 ~~52~~	Yes: high conservation; some IPP success; identify additional Colorado River Basin supply projects~~; plans to discuss conceptual agreement~~	The ~~Draft~~ BIP identified priority projects by region, and the largest project has a large agricultural component, so it is unclear if the gaps will be fully met with only the priority projects.~~each region sufficiently meets their M&I gap~~[24]
Gunnison	16,000 - 23,000	3700 - 6100~~3,700 - 6,100~~	17,500(12,000 in projects & 5500 from high active conservation)~~300~~	4~~2~~	Yes: high~~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"[25]
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[26]
Rio	7700~~7,700~~	2300 -	800~~None~~	1~~0~~	Partially: little	Because the

Table 6.2-2: Summary of BIPs Addressing the M&I No-and-Low-Regrets ~~regrets~~ and Gapsgaps

Basin	2050 New Needs (acre-feet)[20]	2050 Gap (acre-feet)[21]	BIP ID'd Potential New P&M acre-feet~~AF~~[a]	# of New Projects w/ acre-feet info	Are No/Low Regrets Likely Met?	Notes
Grande	- 13,000	5100~~2,300 - 5,100~~	~~Identified~~		conservation discussion; some IPP success~~; support conceptual agreement in concept~~	basin is focused on groundwater sustainability, the~~The Draft~~ BIP did not identify additional acre-feet for municipal projects[27] Quantification based on current information provided by basin.~~, but described several potentials~~[28]
South Platte	340,000 - 505,000	428~~203~~,000[29] ~~- 312,000~~	77,495~~In Process~~	15~~6~~ projects + 3 Portfolios	Partially: largely conceptual, some conservation, ~~some~~ IPP success, ~~additional~~ reuse success, some agricultural transfers~~IPPs~~, support conceptual agreement in concept	The ~~Draft~~ BIP developed portfolios~~will develop additional detail by April 2015~~[30]
Southwest	20,000 - 31,000	8800~~8,800~~ - 16,000	40,354~~32,000~~	6~~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"	Projects and methods identified will meet M&I gap as well as the infrastructure needs of the basin [31] ~~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~~[32]
Yampa / White / Green	34,000 - 95,000	24,000 - 83,000	201~~211~~,000	8~~6~~	Yes~~Mostly~~: some conservation; high IPP success; develop additional Colorado River Basin supplies; discusses some similar	The BIP plans to update aM~~Conducted a thorough M~~&I shortage analysis~~,~~

Table 6.2-2: Summary of BIPs Addressing the M&I No-and-Low-Regrets ~~regrets~~ and Gapsgaps						
Basin	**2050 New Needs (acre-feet)[20]**	**2050 Gap (acre-feet)[21]**	**BIP ID'd Potential New P&M acre-feet~~AF~~[a]**	**# of New Projects w/ acre-feet info**	**Are No/Low Regrets Likely Met?**	**Notes**
					concepts to conceptual agreement and will continue to engage	~~which shows there are still some M&I shortages of up to 10% with climate change~~.[33]
TOTALS	592,800 – 947,300	552,310 – 645,730	502,421	47 projects and 3 portfolios		

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 to 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.[34] 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.[35]

Arkansas goals and measurable outcomes

To address this municipal gap, the Arkansas BIP identifies four goals related to meeting M&I needs.[36] These goals and the associated measurable outcomes are:

- Meet the municipal supply gap in each county within the basin.
  - Generate a study by December~~,~~ 2015~~,~~ determining surpluses and deficits within sub-regions~~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~~r~~ regional use of identified IPPs such as Southern Delivery System.
  - New Water Supply Reserve Grant (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 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 of water, particularly in drought conditions.
  - Pilot project implemented as reported annually.
  - Engineering template implemented by the DWR to expedite temporary transfers at reduced cost.
- Increase surface storage available within the basin by 70,000 acre-feet by the year 2020.
  - Storage capacity and percentage of stored water annually from 2015 to 2020.
- Annual reporting of projects that have been permitted and/or constructed

Meeting the Arkansas' M&I ~~-~~gaps

The BIP supports the three primary recommendations to address the M&I supply gap in the Arkansas Basin as outlined in the 2010 SWSI:[37]

- The Arkansas Basin Roundtable acknowledges a limited number of ~~is still in the process of exploring additional projects and methods to meet its future municipal needs beyond the~~ identified projects and processes may be able to meet most of~~in SWSI 2010.[38] However,~~ the gap.
- Storage is essential to meeting all~~Arkansas Basin supports development~~ of the basin's consumptive, environmental, and recreational needs. In addition to traditional storage, aquifer storage and recovery must be considered and investigated as a future storage option.
- The roundtable~~four strategies~~ identified a critical gap as the need to replace nonrenewable groundwater and augment the sustainability of designated basins. ~~during SWSI 2010:[39]~~

The basin has identified six projects that address M&I needs, four that address both M&I and agricultural needs, and one conservation project within their 2015 IPPs list, which include a measure of acre-feet. The M&I projects identify 77,500 new acre-feet, the combined M&I and agriculture projects identify 48,000 new acre-feet, and the conservation project may reduce 500 acre-feet by 2030. Basin M&I gaps are met through these projects. Additionally, the BIP identifies examples of rehabilitation of nonfederal reservoirs in the Arkansas basin to modern standards. If all potential rehabilitations were implemented, 220,775 acre-feet would be affected and the estimated costs of the repairs would be $37,500,000.[40]

Actions to meet the basin goal of increasing surface storage available within the basin by 70,000 acre-feet by 2020 include:

- Implement a critical IPP .
- Work with the State Engineer's Dam Safety Program to identify storage projects for restoration, rehabilitation, and increased capacity.
- Support funding, including grant contributions where appropriate, for storage restoration and expansion projects.

These actions will work to meet both M&I and agricultural gaps.

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 fallowing rotations. The roundtable moved forward on three tracks simultaneously: technical studies, public policy investigations and pilot projects to test these strategies. Although this was a 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."~~[41]



Colorado

The Colorado Basin faces a gap that could begin as early as 2030 in Mesa County.[42] 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.[43]

Colorado goals and measurable outcomes

To address this municipal gap, the Colorado BIP identifies seven goals related to meeting M&I needs.[44] These goals and the associated measurable outcomes are:

- 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 a 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, and climate change, among others.
  - Every basin water provider has a reliable redundant water supply to meet 2050 demands.
  - Colorado Basin Roundtable or the CWCB to establish a biannual basin conference on natural disaster planning for water providers and government officials.
- Improve~~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 a reservoir project to less than~~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.
  - Revised~~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 M&I conservation.
  - Achieve and sustain a high level of conservation by all basin water providers and industrial users.

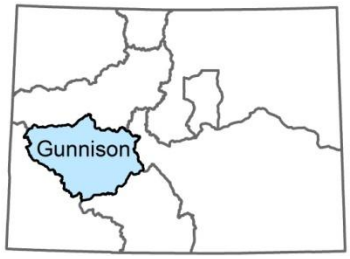
Meeting the Colorado's M&I gaps

The Colorado Basin went through a prioritization process to identify high ranking projects to include in their BIP. From this initial list of high priority projects, 20,272 acre-feet of additional supplies beyond the IPPs, were quantified to meet both M&I and agricultural gaps. This value does not exceed the amount needed under no-and-low regrets or the high potential M&I gap of 48,000 acre-feet identified in SWSI 2010.[45] However, the basin's full project list from the~~The Colorado~~ BIP developed an extensive list of potential M&I projects by interviewing more than 60 water providers

throughout the basin.[46] 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.[47][48] In addition, each geographic region identified in the BIP could meet its future needs if the listed projects were implemented.[49] However, uncertainty exists aboutas to whether each municipality would be able to access these water supplies projects' viability and given that many have not identified a project proponent. The projects from the first draft's list will most likely need to be implemented in addition to those identified as high priority to meet basin M&I goals.

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 from the draft and high priority project lists, then the M&I gap should be fully met. However, there is uncertainty regarding the viability 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 County.[50] 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.[51] In addition, the Gunnison BIP states that demands in Ouray County may be higher than indicated in SWSI 2010.[52]

Gunnison goals and measurable outcomes

To address this municipal gap, the Gunnison BIP identifies one goal related to meeting M&I needs.[53] That goal and the associated measurable outcomes are:

- 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, with the goal being highproducing 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.

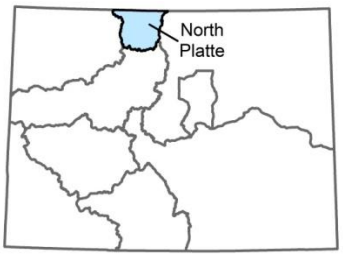
In addition, the Gunnison BIP outlines the following statewide principles related to municipal conservation, including implementation steps:[54]

- 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~~roundtable~~ identified two water conservation activities and four~~two~~ projects ranked as tier 1 (implementation likely feasible by 2025; project does excellent job of meeting Basin Goals) that were not identified in SWSI 2010 that would help meet future M&I needs. The four~~two~~ projects would provide approximately 11,547 to 11,647~~300~~ acre-feet if implemented.[55] This~~.~~[56] ~~While this~~ volume ~~does not~~ fully meets~~meet~~ the gap identified in SWSI 2010. The~~, the~~ Gunnison BIP states that "M&I needs … are generally expected to be managed with sufficient existing supplies and/or through planned projects."[57] Given this analysis, the Gunnison Basin's M&I gap is considered ~~partially~~ met.

In addition to these projects, the Gunnison BIP also advocates for high conservation standards, as identified in SWSI 2010. This would likely result in another 5500 acre-feet of saved water from active conservation that could be applied to meet future demands.



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."[58]

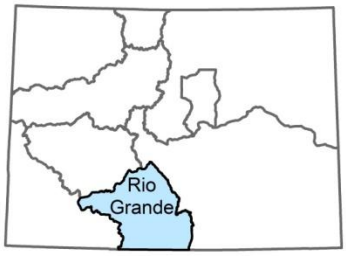
North Platte goals and measurable outcomes

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

- 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

As stated previously, the North Platte's future M&I needs haveneedshave been met.



Rio Grande

The Rio Grande Basin has a relatively small, though important M&I gap. According to the CWCB's~~CWCB~~ analyses, this gap could begin as early as 2025 in Costilla County.[59] These studies indicate that future needs in the Rio Grande are likely to increase by 7700~~7,700~~ to 13,000 acre-feet and currently planned projects leave a municipal water supply gap within the Rio Grande Basin of between 2300~~2,300~~ to 5100~~5,100~~ acre-feet.[60] This assumes that identified projects and processes are implemented at a relatively high success rate.[61] 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 expected~~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:[62]

- 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, M&I, 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.
    - Reduce 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.

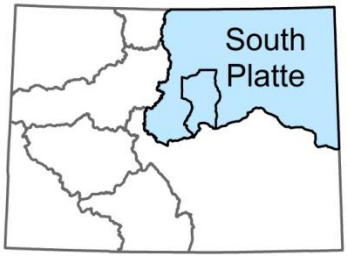
- Develop an M&I plan that addresses water needs, availability, and a strategy for meeting the needs for M&I while sustaining agricultural water use and minimizing effects on~~impacts to~~ other uses.

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 only one~~none~~ of these provides~~provide~~ additional acre-feet to meet 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 M&I pumping depletions can be determined in amount, timing, and location.[63]

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 M&I 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. When taking into account the need to replace nontributary groundwater, in the South Metro area, that gap already exists.[64] 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.[65]

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 needs:[66]

> 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),~~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 Basin:[67]

- 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 substantial~~significant~~ differences in climates, cultures, and economic conditions throughout the South Platte River Basin.
  - Enhance~~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.
  - ~~o~~ Encourage multi-purpose 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. Aquifer storage and recharge (ASR) and alluvial recharge) storage.~~ 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.
- Maintain, enhance and proactively manage water quality for all use classifications.
  - Maintain or improve the delivery of safe water supplies throughout the basin.
  - Monitor, protect and improve watershed water quality and identify and document progress and improvements.

- Improve areas where water quality may be limiting the suitability of focus areas identified by BRTs through environmental and recreational mapping efforts.

- 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 stateState investment; and 4) provide enough certainty in conditions to substantiallysignificantly lessen current trends of traditional buy-and-dry transfers from agricultural uses to M&I uses.
  - Through the IBCC, negotiateNegotiate 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

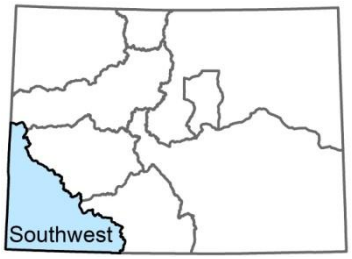
The Draft South Platte BIP developed a list of potential M&I projects, a conservation strategy, and some initial portfolio development to accomplish these goals and meet the identified M&I gaps.[68] The South Platte BIP used similar categories to the no-and-low-regrets work described in Section 6.1 and a comparison is provided below:

- The BIP partially meets the no-and-low regrets goals associated with conservation. The Metro and South Platte Basins are estimated to further reduce per capita M&I demand to 129 gallons per day per capita (GPCD) and 146 GPCD, respectively. The BIP applies 5036 percent of Metro and 10 percent of South Platte active conservation savings plus all passive savings to meet future needs in their portfolio work. Out of a total of 211210,000 acre-feet of quantified potential savings, 105110,000 acre-feet is passive, and another 5350,000 acre-feet of active conservation savings is applied to future needs. A substantiallysignificantly 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 goalgoals associated with having a high success rate for the IPPs, indicating a yield of 179,000 acre-feet compared to 199,000 acre-foot yield.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 TMDs. The South Platte BIP assumes a 6560 percent success rate and Metro assumes an 80 percent success rate. In addition, the BIP identified a total of 16six new projects (seventhree for reuse, fourone agricultural transferstransfer, and fivetwo in basin projects) that were not previously in SWSI 2010. The total yield from the basin IPPs more than meets the no-and-low-regrets goals, yielding about 225,000 acre-feet.
- 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 TMD projects. The BIP proposes

45,010 new acre-feet of water from re-use.- 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 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 456030,000 acre-feet of alternative transfer methods (ATMs).- It also identified that with conservation applied to meet new demands, between 2513,000 and 90170,000 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. In portfolios B and C, about 35,000 acre-feet of alternative transfer method water was identified. The BIP also includes recommendations to streamline transaction costs for ATMs.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.[69] 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 88008,800 to 16,000 acre-feet. This assumes that identified projects and processes are implemented at a relatively high success rate.[70]

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 below:[71]

- 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 4041 IPPs aimed at meeting municipal water needs.
- Provide safe drinking water to Southwest 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 one 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 defined as requiring a water court change case state by 2030.

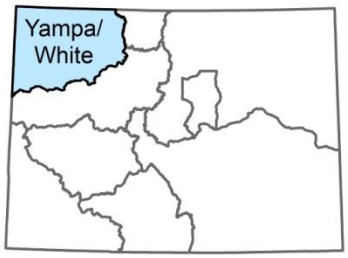
- Implement three informational events about water reuse efforts, tools, and strategies.
- The water providers in the state that are using dry up of agricultural land[1] and/or pursuing a new TMD[2] shall have a higher standard of conservation. The goal for these water providers is a 70/30 ratio by 2030. This is a prerequisite for the roundtable to consider support of a new TMD.

- Support and implement water reuse strategies.

Meeting the Southwest's M&I gaps

The Southwest BIP developed a list of potential M&I projects by interviewing providers in each sub-basin.[72] The Southwest BIP identified seven~~37~~ new projects that include components that would meet future municipal supply needs, and several others that would address other infrastructure needs within the basin. Of these projects, eight~~seven~~ quantified acre-feet, totaling nearly 40~~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.[73]

The Southwest Basin Roundtable~~roundtable~~ acknowledged that while not every identified project was quantified in the BIP, the projects and methods identified would fully meet their M&I 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.[74] 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 will likely be revised downward since all indications are that oil shale will not become commercially viable by 2050.[75] 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.[76]

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 below:[77]

- Protect and encourage agricultural uses of water in the Yampa/-White/-Green Basin within the context of private property rights.
  - Process
    - Identify agricultural water shortages and evaluate potential cooperative and/or incentive programs to reduce agricultural water shortages.

[1] Defined~~defined~~ as requiring a water court change case.

[2] As~~as~~ defined by the IBCC to be a new western slope to eastern slope diversion project.

        - 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.
        - Encourage and support M&I projects that have components that preserve agricultural water uses.
    - Outcomes
        - Preserve the current baseline of about 119,000 irrigated acres and expand by 12 percent by 2030.
        - Encourage land use policies and community goals that enhance agriculture and agricultural water rights.
- Identify and address M&I water shortages.
    - Processes
        - Identify specific locations in the Yampa/White/Green Basin~~basin~~ where M&I shortages may exist in drought scenarios and~~,~~ quantify the shortages in time, frequency, and duration.
        - Identify effects~~impacts~~ throughout the Yampa/White/Green Basin~~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-purpose~~use~~ storage projects.
        - Support efforts of water providers to secure redundant supplies in the face of potential watershed effects~~impacts~~ from wildfire.
        - Encourage municipal entities to meet some future municipal water needs through water conservation and efficiency~~.~~
    - Outcomes
        - Reliably meet 100 percent of M&I demands in the basin through the year 2050 and beyond through the following processes:
- Maintain and consider the existing natural range of water quality that is necessary for current and anticipated water uses.
    - Processes
        - Encourage and support water quality protection and monitoring programs in the sub-basins of the Yampa/White/Green Basin through watershed groups, municipalities, land management agencies and other efforts.
    - Outcomes
        - Consider and maintain the existing water quality necessary for current and future water uses when reviewing IPPs.
          Support the implementation of water quality monitoring programs to create quality-controlled baseline data for all sub-basins of the Yampa/White/Green Basin.

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 Yampa/White/Green~~YWG~~ Basin. Under Baseline Conditions, no shortages exist to M&I demand nodes because of~~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 percent. Under both scenarios, District 43 existing M&I in Rio Blanco County (Rangely 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 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. Using historical data~~In the model~~, hypothetical shortages would have occurred for the ~~both locations in a dry month in March 1961 but become nearly negligible (0.14 percent for~~ Hayden Station in the dry months of August 1961, March 1962, September 1977, and September 2002)~~0.12 percent for units 1~~ and for the~~2 at~~ Craig Station in the dry months of November 1963, September 1977, December 2002, and a few months~~under both scenarios) when averaged over the 56-year period of record used~~ in 1949~~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 because of~~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.[78]

Overall, the BIP modeled nine M&I~~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. The~~Most of the~~ acre-feet quantified are associated with eight of the projects, and meet~~meeting~~ the potential needs of the energy industry. The total newly quantified acre-feet adds up to 201~~211~~,000 acre-feet to meet M&I

needs.[79] ~~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.[80]~~ In conclusion, the BIP identified projects that ~~mostly~~ meet future M&I demands~~ in Rangley, Meeker, and Steamboat Springs, and fully meet future demands in Craig~~.

Meeting Colorado's Agricultural Needs

The agricultural gap is defined as the difference between what a basin indicates it wants to achieve consideringwith 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.[81] 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, the CWCB identified three statewide long-term goals:[82]

- 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 needs~~demands~~.
- Implement efficiency and conservation measures to maximize beneficial use and production.

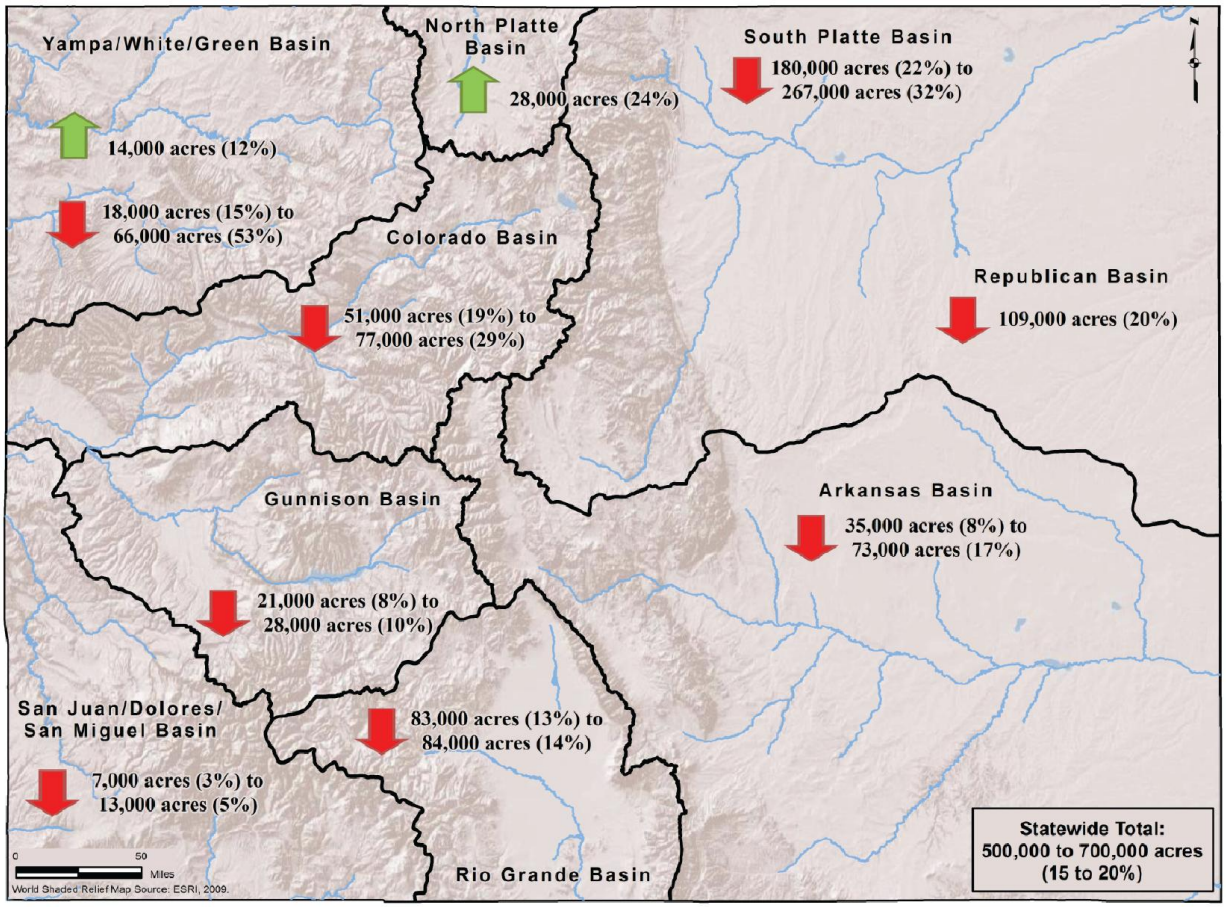
Before~~Prior to~~ exploring how the BIPs developed solutions to meet these and other local goals, it is important to understand some of the statewide issues related to shortages and a decline in irrigated acres. Irrigated acres are expected to decline for three primary reasons:[83]

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.[84] ~~The importance of~~ Colorado's agricultural production is also vital locally. As described in Chapter 3, in some counties 50 percent of jobs are related to agriculture.

From a statewide perspective, it is important to provide options and incentives that help maintain or even increase Colorado's agricultural economy and production~~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.

Figure 6.2-~~2~~1 Potential changes in irrigated acres by 2050[85]
(⬆ = increase in irrigated acres; ⬇ =decrease in irrigated acres)



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 factors:[86]

> **Physical shortages** are because of~~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 (CIR)~~]~~ for the entire growing season even in wet years.

Legal shortages are those because of~~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 before~~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[87]	Shortage (acre-feet/year~~AFY~~)[88]	Potential New acre-feet~~AF~~	# of New Projects	Summary of How BIPs Met Their Agricultural~~Ag~~ Goals / Gap
Arkansas	428,000	30,000 – 50,000 (augmentation gap)[3]	89,000~~In process~~	11~~0~~	Yes ↓ shortages; potential to~~Not~~ sustain agricultural~~ag~~ $1.5B economy w/ actions~~, but establish tracking~~; not develop specific augmentation water projects; policies and projects support rotational fallowing, policies to support agricultural~~ag~~ related recreational~~rec~~ and environmental with conservation~~env. w/ cons~~

[3] 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.

					easements
Colorado	268,000	100,000	453,000 – 483,000	41	Partially~~Yes~~ ↓ shortages; some~~no specific~~ efforts to develop incentives and~~or~~ ↓ urbanization and agricultural~~ag~~ to urban transfers
Gunnison	272,000	116,000~~111,000~~[89]	126,209 - 129,384~~123,000~~	17~~16~~	Yes ↓ shortages, partially discourage agricultural transfers through~~transfer out of ag w/~~ policies
North Platte	117,000	110~~89~~,000	12,000	12	↑ Irrigated~~irrigated~~ acreage to partially meet 17,000 acre goal; ↑ storage to partially meet 37,000 acre-feet~~AF~~ goal
Rio Grande	622,000	428,000	N/A	N/A	Yes, improve infrastructure; partially improve agricultural~~ag~~ economy
South Platte	1,381,000 (831,000 SP, 550,000 Republican)	434~~579~~,000 (160~~379~~,000 SP, 274~~200~~,000 Republican)	0~~In process~~	0	Partially ↓ permanent dry up w/ conceptual ATMs & alternative sources, not ↓ urbanization or shortages
Southwest	259,000	198,000	41,354~~7600~~	5~~4~~	Partially ↓ shortages; Yes, ↑ efficiency w/ ~~10~~ IPPs; policy to minimize acres transferred, no agricultural~~ag~~ sharing IPPs
Yampa / White / Green	119,000	54,000	24,875~~54,000~~	3~~5~~	↑ Number~~#~~ of irrigated acres to partially meet 15,000acre~~000 acre~~ goal; partially ↓ shortages by 46 ~~10~~%
TOTAL	3,466,000	1,470~~589~~,000 – 1,490~~609~~,000	746,438 – 779,613~~537,000~~	89~~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).[90] In addition, irrigated acres are likely to decline by eight to seventeen percent.[91] 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 3,000 (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.[92] These goals and the associated measurable outcomes are:

- Sustain an annual $1.5 billion agricultural economy in the basin.
    - Increase in measured economic productivity by update of Colorado State University study~~Study~~ in 2020.

- Provide ~~increasing quantities of~~ augmentation water as needed to support~~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 for agriculture.
    - Report on pilot projects underway as of December 2015.
    - Complete and present report by December 2015.
    - Survey of permanently retired acreage as of year~~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.
- Increase surface storage available within the basin by 70,000 acre-feet by the year 2020.
    - Storage capacity and percentage of stored water annually from 2015 to 2020.
- Annual reporting of projects that have been permitted and/or constructed.

Meeting the Arkansas' agricultural gap

The primary goal is to support the $1.5 billion agricultural economy in the face of agricultural loss.[93] 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."[94]

The Arkansas Basin has identified seven projects focusing primarily on agricultural and four focusing on agricultural and M&I needs, with identified acre-feet. If all 2015 IPPs with measurables are implemented the basin would reduce its agriculture gap by 89,000 acre-feet. One of these multipurpose projects, which meets both agricultural and M&I needs, will also irrigate 2,000 new acres. A recent study prepared by Adaptive Resources, Inc. for the Lower Arkansas Valley Water Conservancy District shows that 25,000 to 30,000 acre-feet are needed for augmentation today, growing to more than 50,000 acre-feet by the year 2050. If the basin implements the identified project they will meet the basin's high defined augmentation agricultural gap.

Actions to meet the basin goal of increasing surface storage available within the basin by 70,000 acre-feet by the Year 2020 include:

- Implement a critical IPP.
- Work with the State Engineer's Office of Dam Safety to identify storage projects for restoration, rehabilitation, and increased capacity.

- Support funding, including grant contributions where appropriate, for storage restoration and expansion projects.

These actions will work to meet both M&I and agricultural gaps.

Actions to meet the basin goal to provide augmentation water as needed to support increased farm efficiencies include:

- Establish long-term sources of augmentation water through leasing, water banks, or interruptible supply agreements.
- Construct recharge facilities to capture and retime fully consumable water supplies.

~~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).[95] In addition, irrigated acres are likely to decline by nineteen to twenty-nine percent.[96] These declines are primarily because of urbanization, which account for 65 to ~~-~~80 percent of the loss, or 40,000 to 50,000 acres. The remaining agricultural loss is because of~~due to~~ agricultural to municipal transfers.[97]

Colorado goals and measurable outcomes

To address these pressures, the Colorado BIP identified four goals related to sustaining agriculture.[98] These goals and the associated measurable outcomes are:

- 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.

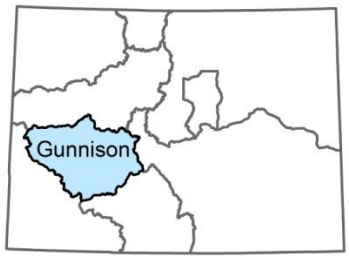
  - Promote conservation easements with the anticipated~~expected~~ result that they will be more widely considered by the agricultural community.
- Develop incentives to support agricultural production.
  - Reimburse agriculture for value added to the environment including, water quality, wildlife, and 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.
  - Revise 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 21 high-priority projects that meet basin theme 2: sustain agriculture. The high-priority projects quantified 20,272 acre-feet to meet both agricultural and M&I gaps. While this is insufficient to fully address agricultural shortages in the basin, the Colorado BIP Appendix D~~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 because of~~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 basin will~~BIP most~~ likely need to implement both high priority and BIP-identified projects to fully address its ~~addresses the basin's~~ agricultural shortages and partially address~~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).[99] In addition, irrigated acres are likely to decline by eight to ten percent.[100] These declines are primarily because of

urbanization, which could take 20,000 to 26,000 acres out of production.[101]

Gunnison goals and measurable outcomes

To address these issues, the Gunnison BIP identified two goals related to sustaining agriculture.[102] These goals and the associated measurable outcomes are:

- Improve agricultural water supplies to reduce shortages.
  - Reduce basin-wide agricultural shortages by developing 10 projects from the list of recommended solutions in the Gunnison BIP~~GBIP~~ by the year 2030.
  - Implement the Inventory of Irrigation Infrastructure Improvement Needs projects from the list of recommended solutions in the Gunnison BIP~~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 183~~50~~,000 protected acres in the Gunnison Basin and expand the participation in conservation easements by five percent by 2030 through programs like the Gunnison Ranchland Conservation Legacy.

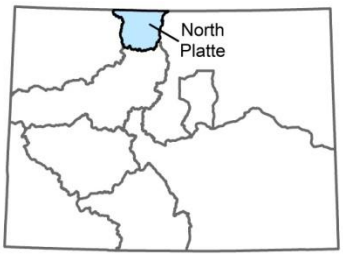
Meeting the Gunnison's agricultural gaps

The Gunnison Basin Roundtable~~roundtable~~ identified 17~~16~~ projects that it expects to be implemented in the near-term that~~which~~, if implemented, would reduce shortages in the basin by 126,209 to 129,384 acre-feet.~~.~~ In addition, there are infrastructure improvement projects that~~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~~roundtable~~ would like to see another 9150~~2,500~~ 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.[103] 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.[104] 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.[105] 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.[106] In the Republican Basin, the loss of over 100,000 irrigated acres is related to factors associated with sustainable groundwater and compact related issues.alternate transfer methods (ATM), and development of new Colorado River supplies.~~

~~ATM. However, the BIP also lists several barriers to ATMs, which need to be overcome.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~~



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 the~~those~~ historical levels defined in the decree. The North Platte BIP has indicated an interest in irrigating more lands.[107]

North Platte goals and measurable outcomes

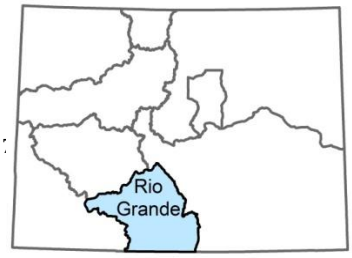
To address this issue, the North Platte BIP has two goals related to sustaining agriculture.[108] These, along with the associated measurable outcomes are:

- 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, more than~~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, about~~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.[109] 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. To~~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.[110] The purpose of the rules and regulations is as follows:

> The overall objective of this subdistrict plan~~Subdistrict Plan~~ is to provide a water management alternative to state-imposed regulations that limits the use of irrigation wells within the subdistrict~~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.[111]

Rio Grande goals and measurable outcomes

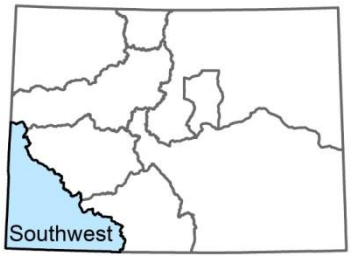
To address these issues, the Rio Grande BIP identified two goals related to sustaining agriculture.[112] These goals and the relevant measurable outcomes are:

- 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 M&I 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~~.



South Platte/Metro/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.[113] The BIP projects a gap of 160,000 acre-feet in the South Platte and 274,000 acre-feet in the Republican. 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.[114] The South Platte BIP reexamined potential loss of irrigated lands in the South Platte Basin based on past trends, and indicated a range of 10 to 20 percent for the South Platte Basin.[115] These declines are primarily because of 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.[116] In the Republican Basin, the loss of more than 100,000 irrigated acres is related to factors associated with sustainable groundwater and compact related issues.

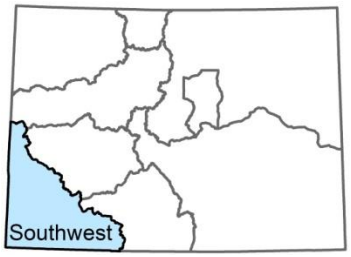
South Platte goals and measurable outcomes

To address these issues, the South Platte BIP identified one goal related to sustaining agriculture.[117] This goal and the associated measurable outcomes are:

- 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 ATM, 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 ATMs. However, the BIP also lists several barriers to ATMs, which need to be overcome. The BIP also includes recommendations on streamlining transaction costs for ATMs and ATM grant programs that are occurring in the South Platte Basin. In addition, the BIP discusses the need to preserve the option for developing additional TMD 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 about 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.



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).[118] In addition, irrigated acres are likely to decline by three three to five percent.[119] These declines are primarily because of urbanization, although if Colorado River supplies are not available, some agricultural to urban transfers may be necessary.[120]

Southwest goals and measurable outcomes

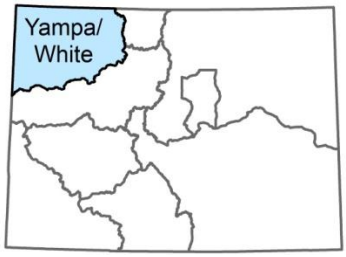
To address these issues, the Southwest BIP identified three goals related to sustaining agriculture.[121] These goals and the associated measurable outcomes are:

- 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 and/or pursuing a new TMD shall~~TMDshall~~ 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 10~~four~~ projects that have a combined 40,000 of new acre-feet

associated with them, although of these projects only one is not also counted for M&I uses. 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 one of the least amount of acres under irrigation of the Colorado basins, and the third lowest percentage of shortages as a basin (23 percent).[122] In addition, irrigated acres could either increase by 12twelve percent with adequate investment or decrease by 15 to 53 percent.[123] 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. Additional declines in irrigated acres are related to urbanization of agricultural lands.[124]

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.[125] These goals and the associated measurable outcomes are:

- 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 and expand by 12 percent by 2030. 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 mModeled level of shortages that still exist within the basin after the BIP's planned projects are implemented in a dry future. There are six agricultural projects proposed in the BIP that include measurable. These estimate almost 25,000 new acre-feet and 41,000 affected acre-feet. 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

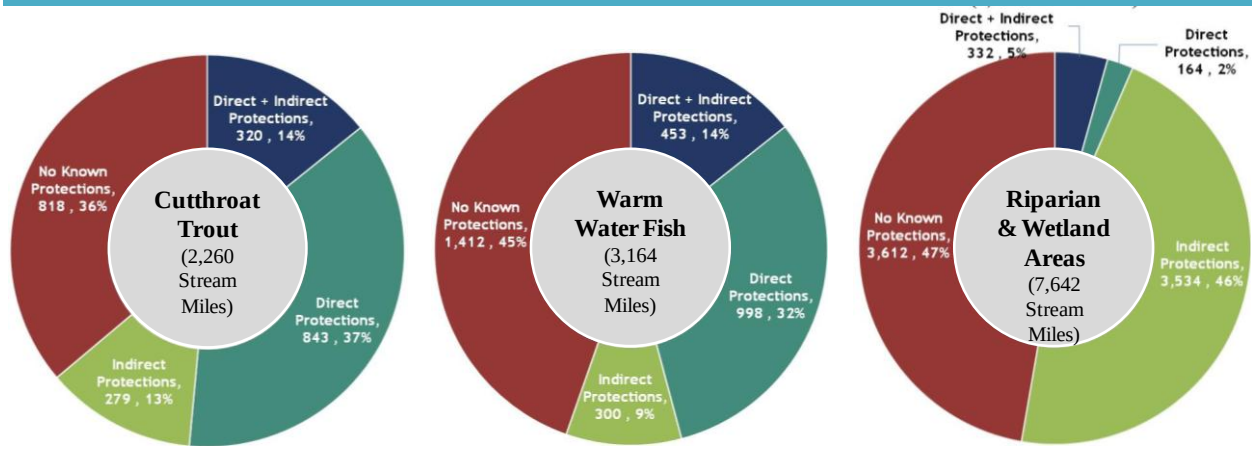
planned for in the BIP. While the document stresses the need for land use policies that support agriculture, no specific policies are identified. All in all, the BIP mostly meets its defined agricultural gaps, and the basin~~Basin~~ roundtable plans to continue to refine this work for the final version.

Meeting 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.[126] While every basin indicated that meeting its environmental and recreational needs is an important aspect of its BIP, this definition allows for considerable variability among~~between~~ basins, which face different issues related to the environment and recreation.

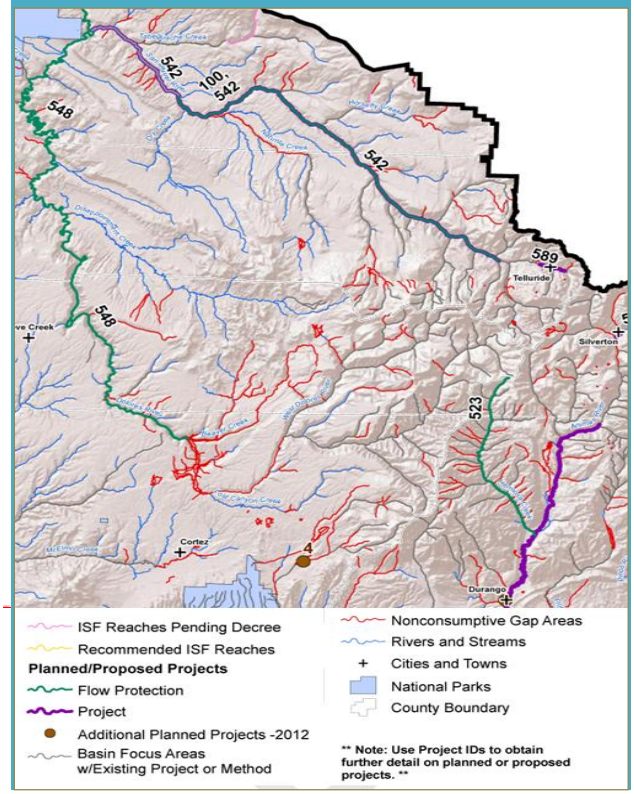
Colorado's environmental and recreational needs can be met through protection or restoration projects and methods. These projects and methods could have flow, habitat, water quality, species connectivity, or non-native species management components. In some cases, senior water rights holders help meet 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 ~~f~~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 is shown on Figure 6.2-4.[127]

Figure 6.2-2: 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 assessing the locations of potential environmental and recreational gap areas. The CWCB is currently working to further refine this methodology and include the additional projects and methods identified in the BIPs.

Figure 6.2-4: Nonconsumptive Toolbox



To address the challenges in meeting the needs of the environment and recreation, the CWCB identified five statewide long-term goals to accomplish this work:[128]

- 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 substantial~~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 How Each Basin Meets Its Environmental and Recreational Gaps*

*NOTE: The % of streams with no known protections do not represent 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	31243,124	13721,372 (44%)	301	3823	IPPs support greenback cutthroat trout, southern red belly dace, Arkansas darter, and other target speciesThe Arkansas is still in progress
Colorado	17621,762	844 (48%)	03	None identified32	Partially through support of projects and methods; not identify new funding source or how establish regional cooperatives
Gunnison	11061,106	270 (24%)	0	None identified	Yes, identified: 4 environmental10 projects, 30 to be implemented, 5 multi-purpose projects, support federally listed endangered fishcutthroat trout conservation strategy; explored some alternative funding sources
Metro/ South Platte	959	325 (34%)	02	None identified2.5	The Metro/South Platte Basin support greenback cutthroat trout, boreal toad, common shiner, plains minnow, and other target aquatic speciesroundtables 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 percent% if implemented
Rio Grande	27352,735	397 (15%)	51	45	Partially through project implementation, but quantification of how meet goals and measurable outcomes not performed until final
Southwest	24332,433	100941,009 (41%)	96	202183	Partially through project implementation, and further quantification of how meet goals and measurable outcomes will be provided
Yampa / White / Green	485	155 (32%)	160	371None 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 environmental and recreational interests
TOTAL	**13,558557**	**4,601602 (34%)**	**6013**	**577225.5**	



Arkansas

In the 2011 needs assessment, the Arkansas Basin Roundtable~~roundtable~~ identified 342 perennial stream miles with Arkansas darter, 371 with greenback cutthroat trout, and 1,811 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 directly through flow protection or aquatic habitat restoration or indirectly through land ownership geared toward wildlife protection or riparian projects.~~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 nine~~seven~~ goals:[129]

- ~~•~~ Maintain or improve ~~Preclude federal endangered listing of~~ native fish
- ~~Restore state imperiled fish species~~ populations
- ~~•~~ Maintain, improve, or restore habitats for fish species
- Maintain or improve ~~and increase~~ recreational fishing opportunities
- Maintain or improve boating opportunities, including kayaking, and other nonmotorized and motorized boating~~and restore riparian habitats~~
- Maintain or improve areas of ~~important~~ avian (including waterfowl) breeding, migration, and wintering ~~areas associated with water~~
- ~~•~~ Maintain or improve riparian habitat and aquatic habitat, and restore riparian and aquatic habitat that would support environmental features and recreational opportunities
- ~~•~~ Maintain or improve wetlands, and restore wetlands that would support environmental features and recreational opportunities
- ~~•~~ Maintain, improve, or restore watersheds that could affect environmental and recreational resources
- ~~•~~ Improve water quality as it relates to the environment and/or~~Maintain and restore wetlands~~
- ~~Maintain, improve, and increase flat water~~ recreation

Meeting the Arkansas' environmental and recreational gaps

The Arkansas BIP has listed 15 environmental and recreationally projects~~indicates~~ that have identified quantifiable stream improvements. Projects include, but are not limited to water quality improvements, invasive species remove, and fish habitat restoration and passage, across 382 stream miles.

The Nonconsumptive Subcommittee has identified the following priority objectives adapted from previous mapped 12-digit hydrologic unit codes, which outlined areas with high concentrations~~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 attributes, primarily in three locations: 1) the mainstem Arkansas River upstream of Pueblo; 2) Fountain Creek watershed; and 3) areas around major reservoirs on the Lower Arkansas River between Las Animas and Eads. Priority objectives include:[130]

- Lake Isabel is an important fishing lake with multiple associated recreational activities that has insufficient water resources to cover evaporative loss. Because of limited water rights, the lake level has been lowered, thereby diminishing fishing and other recreational opportunities and risking deleterious impacts associated with this reduced water level. It is a priority to obtain additional water rights to allow the lake to be raised to its full, functioning level.
- Grape Creek is an important fishery that runs through the Grape Creek Wilderness Study Area, which adds to its importance as a nonconsumptive resource that has suffered from inadequate flow. Efforts are ongoing with DeWeese-Dye Ditch & Reservoir Company to re-operate the ditch to provide additional water flow through the stream during crucial periods.
- Important wetland resource evaluation needs to be accomplished. Although some information exists on the wetlands in this basin, it is not available basin-wide.
- Chilili Ditch, a canal that runs through the center of Trinidad in Las Animas County, is extremely outdated and in serious need of renovation to improve nonconsumptive resources. This priority would involve a project that addresses both consumptive and nonconsumptive needs, including an update to the ditch diversion to make it fish friendly through the use of fish ladders or other methods that allow fish to move up and down the stream more easily.

The Nonconsumptive Needs Subcommittee will continue to identify priority areas as additional data and information are obtained from current projects and studies, stakeholder input, and from the public.

The basin supports the framework used to evaluate the level of protection a project provides to environmental and recreation attributes as presented in the Gap Analysis Framework.[131] Projects identified through the basin's IPPs list~~gaps~~ will be categorized as Information/Knowledge/ISF/RICD, Implementation, or Stewardship, before using the Framework to analyze the projects to assign levels of protections to individual attributes.[132] Not all attributes require protection, and projects and methods may not be necessary~~assessed~~ at this ~~that point in~~ time for select areas. This analysis will be supported by input from stakeholders, subject matter experts, and basin roundtable members. ~~.~~



Colorado

In the 2011 Needs Assessment, the Colorado Basin Roundtable~~roundtable~~ identified 676 perennial stream miles with Colorado River cutthroat trout, and 435 with imperiled warm water fish, including endangered fish species. An additional 1,098 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, more than~~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 below:[133]

- 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, ecologically impacted, recreationally 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 to mitigate 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 Watershed Flow Evaluation Tool (WFET) work.
    - Protect access and flow levels for 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 an 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 efficiencies~~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.

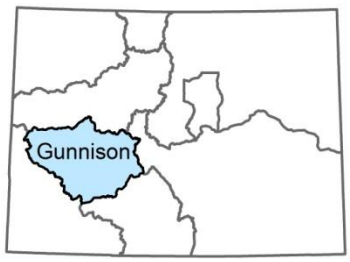
Meeting the Colorado Basin's environmental and recreational gaps

The BIP identified four top priority~~59~~ projects that are explicitly environmental and recreational projects. The BIP listed 59 total projects, and an additional ~~In addition another~~ 13 that address recreational needs and 13 more that address water quality. Many of these are associated with the Colorado River Cooperative Agreement (CRCA) 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, "The most important project identified by the environmental and recreational PLT and the Colorado Basin Roundtable members is to continue assessing the systemic riverine environmental needs of the basin on-the-ground through the creation of a basin-wide stream management plan (SMP). The purpose of a SMP is to provide the framework for maintaining healthy stream systems while also protecting local water uses and planning for future consumptive and nonconsumptive water needs. SMPs identify environmental and recreational flow needs and assist in identifying areas where historical alterations of stream flows most likely affected the ecological resource conditions." ~~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."~~[134]

The BIP further contends that that "all basins statewide should make~~must have a number one priority of~~ protecting and improving the health of our rivers and streams a top priority."[135]

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~~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 outcomes:[136]

- Quantify and protect environmental and recreational~~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 among~~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 demonstrate the beneficial relationship among agricultural, environmental, and recreational uses.~~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 27 focus segments. The GBRT added to the 21 segments identified in Phase 2 NCNA process.[137] Many of these segments offer the opportunity for multipurpose projects beneficial to both nonconsumptive and agricultural and municipal interests. Four planned inventory projects in different sub-basins were designed to assess the feasibility of specific potential projects for meeting needs in the focus segments.~~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~~Aspinal~~ Unit to meet environmental flow requirements to support these species. This reoperation was first tried in 2014, and will continue to be monitored and adapted 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."

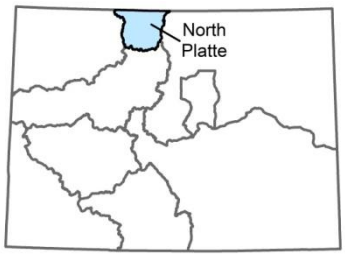
The BIP indicated that the ongoing work associated with the Colorado River Cutthroat Trout Conservation Strategy adopted by Colorado, Utah, and Wyoming, was likely sufficient to meet cutthroat trout habitat needs.

There is an interstate Three Species Agreement in place to protect the three warm water fish species: bluehead sucked, flannelmouth sucker, and roundtail chub, 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'~~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) becomes~~become~~ an important means of maintaining the native fishery."[138]

In addition to these ongoing efforts, the BIP identified several additional efforts. Out of the 49~~38~~ projects and methods assigned to tier 1, which are planned to be completed by 2020, 25~~14~~ have nonconsumptive components that meet one or more of the BIPs identified environmental and recreational goals. The BIP also identified 34~~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 include:[139]

- 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~~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. More than~~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 below:[140]

- 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.

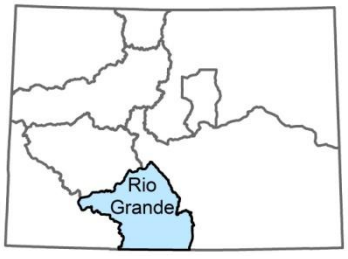
Meeting the North Platte Basin's environmental and recreational gaps

To better determine where the basin~~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."[141]

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 among~~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 identity other multi-purpose project opportunities.[142]

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~~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. More than~~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 more than~~over~~ 40 percent of the 2,138 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 uses~~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

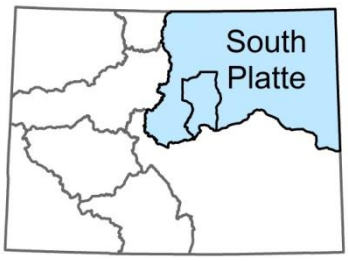
To address its environmental and recreational needs, the Rio Grande BIP identified four goals. These goals and the associated measurable outcomes are below:[143]

- 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 stream flows~~thatenhance streamflows~~ through re-operations while ensuring full compliance~~fullcompliance~~ 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 15~~eight~~ projects that address environmental and recreational information gaps, which will further clarify the environmental and recreational gaps. These projects add a total of almost 410 new stream miles and 60,650 acre-feet. 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~~roundtables~~ identified 628 perennial stream miles with warm water imperiled plains fish species; approximately two-thirds of which have some level of protection. Approximately 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 below:[144]

- 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:
        - Maintain or increase the habitat for federally and state-listed threatened and endangered species or plant communities.
        - 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.
        - Maintain or increase the wetland, lake, or stream habitat used by migratory and breeding birds.
        - Develop tools and methodologies to adequately assess what is needed to maintain or increase aquatic, riparian, and wetland habitats throughout the basin.
    - 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
        - Maintain or increase the surface area, stream miles, or public access for recreational opportunities of high economic value.
        - Maintain or increase the miles and general appearance of trails and greenways to promote aesthetic values and enhance quality of life.
        - Maintain or increase public access to fishing opportunities in lakes and streams.
        - Maintain or increase the total area for birding, waterfowl hunting, and wildlife viewing.
        - Maintain or improve the amount of river miles or flatwater surface acres available to river and flatwater boaters.
        - Develop tools and methodologies to adequately assess what is needed to maintain or improve recreational opportunities derived from ecosystems throughout the basin.
    - 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 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.
        - Maintain or improve fish habitat by providing habitat enhancements, eliminating dry up points, and promoting connectivity.

- Maintain or improve watershed health through source water protection, wildfire mitigation, sedimentation control, and erosion control.
- Encourage existing and develop new innovative tools to protect instream flows where appropriate.
- Develop tools and methodologies to adequately assess what is needed to protect, maintain or improve conditions of aquatic, riparian, and wetland habitat throughout the basin.

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)

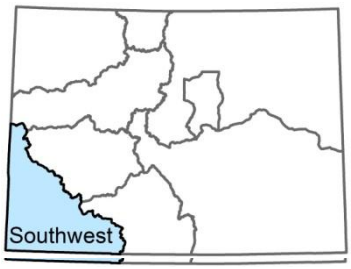
For each of these regions a suite of project types (e.g., instream flows, stewardship projects, species reintroduction, fish passages, modification or improvements to dry-up points or diversion structures that inhibit fish passage, stewardship programs, and instream flow programs with water rights components thatwhich 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. Only three of these projects included measurable in the BIP. Collectively they included 1000 new acre-feet and 1 stream mile.

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:[145]

- 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 effects onimpacts 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~~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 BIP~~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~~roundtable~~ identified 834 perennial stream miles with imperiled warm water fish species, including the flannelmouth sucker, bluehead sucker, and roundtail chub. The 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 less~~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 below:[146]

- 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.

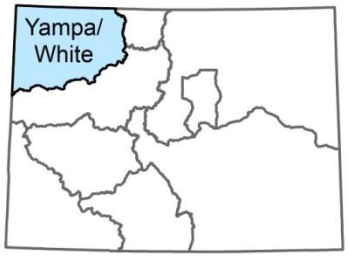
- Encourage and support restoration, recovery, and sustainability of endangered, threatened, and imperiled aquatic and riparian-dependent species and plant communities.
    - Implement 15 IPPs to directly restore, recover, or sustain endangered, threatened, and sensitive aquatic and riparian-dependent 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 nine~~six~~ environmental and recreational projects and methods that included stream mile information, which cover more than 200~~over 180~~ miles of stream. This is a subset of the 12 environmental and recreational or multiuse~~71~~ projects identified with any included measurables; 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.[147] 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~~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. More than~~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 below:[148]

- 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

nonconsumptive~~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 because of~~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)."[149] IPPs appear to have little effect on the environment for

most locations (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).

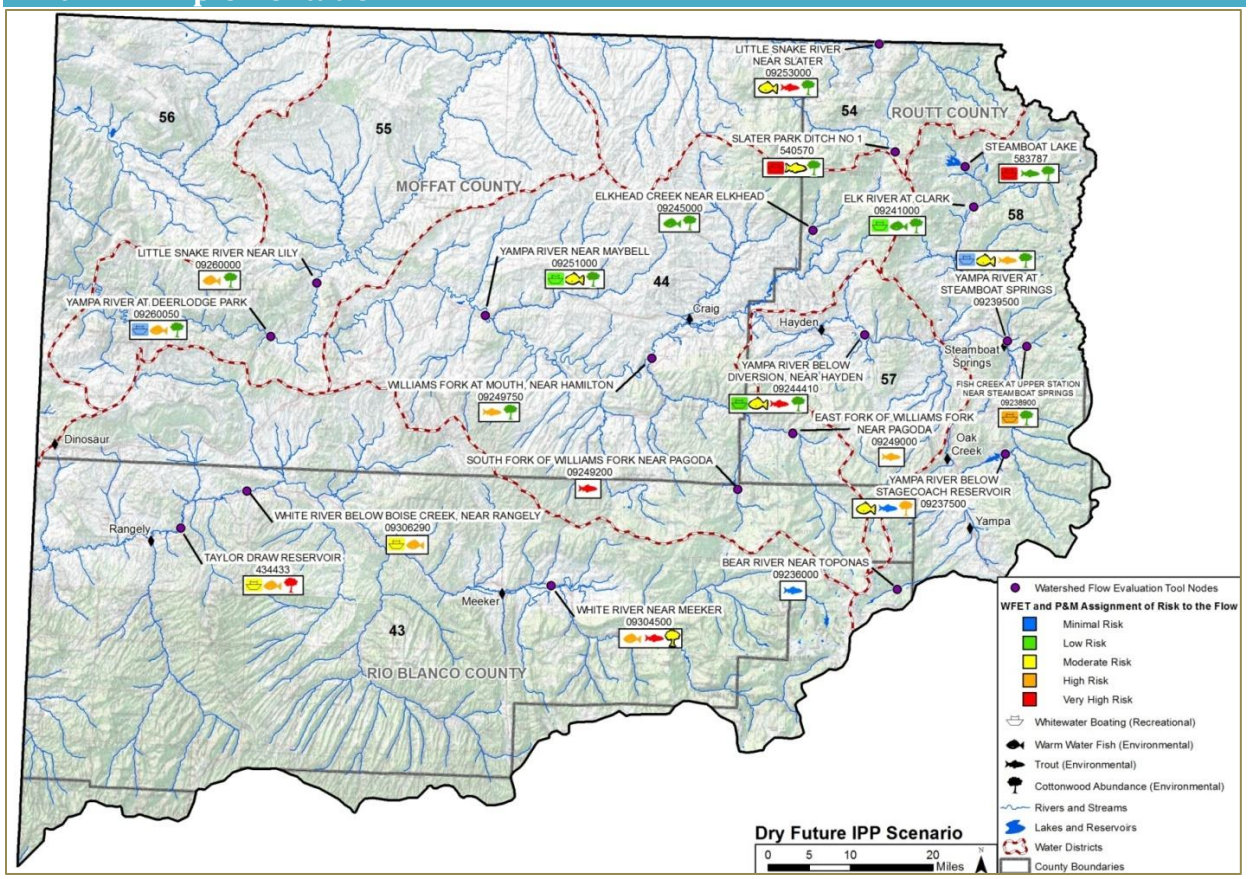
The purpose of this analysis is to provide a course examination of potential environmental and recreational "shortages." This is the most thorough technical analysis provided in any of the BIPs. In addition the BIP identifies 1617 environmental and recreational ~~IPPs. These IPPs are further supported by five multi-purpose projects and seven consumptive~~ projects that include a measurable, one of which is an agricultural project with some indentified~~could provide secondary benefits to~~ environmental/recreation benefits. The projects identify a total of 371 new stream miles. ~~and recreational values.~~ As stated in the BIP, "the basin roundtable~~Basin Roundtable~~ will continue to explore additional multi-purpose opportunities where they may exist through future planning efforts."[150]

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

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 9.5, 7.1, and 7.3, respectively.

Figure 6.2-5: Yampa/White/Green BIP- Associated Risk in Dry Future Scenario with IPP Implementation



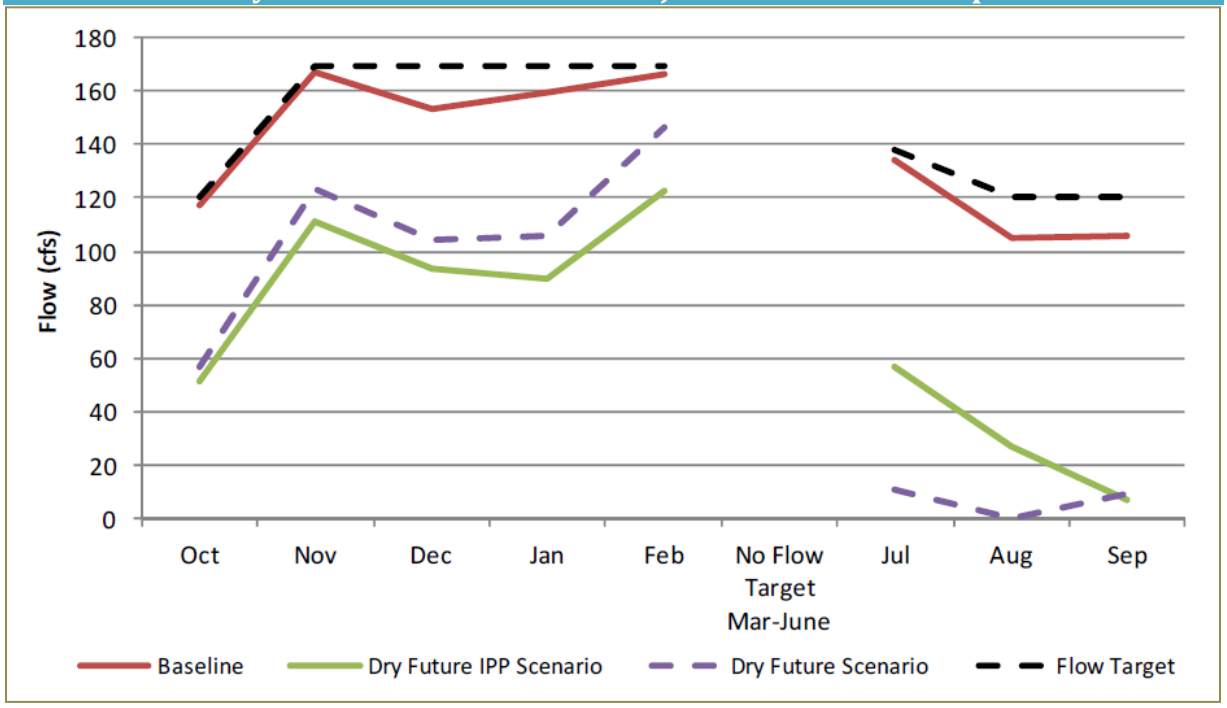
How other states have worked to meet their gaps

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 B.

Figure 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



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.

One of the primary purposes of Colorado's Water Plan is to address Colorado's water gaps~~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 ATMs.
- 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.

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

Colorado's water gaps must be identified and addressed. The CWCB will take the following steps to~~recommendations would help~~ accomplish this beginning in 2016:

- The CWCB will support the evaluation, feasibility, and completion of the BIPs through WSRA grants.
- The 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 information sheets and project tiering, similar to the Rio Grande, North Platte, and Gunnison BIPs.
    - Support the further quantification of costs associated with projects~~project~~ and methods~~ costs~~, new acre-feet developed, new irrigated acres developed, and new stream miles protected.
- The CWCB will incorporate the BIP information into the next version of SWSI~~ 2016~~ and will reassess the municipal, industrial, environmental, recreational, and agricultural gaps at that time.
- The CWCB will establish guidelines for basin roundtable WSRA grants that will enable the basin roundtables to facilitate implementation of their BIPs in their basin. The purpose of the grants would be to foster meeting municipal, industrial, agricultural, environmental, and recreational needs in a manner consistent with the BIPs.

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;
- Promote~~Instill a~~ water efficiency ethic throughout Colorado;
- Explore additional water reuse options;
- Further integrate land use and water planning;
- Seek creative options for improving agricultural irrigation conservation and efficiency

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, programs~~we encourage programmatic consistency~~ from the local level up to the state level will be strengthened. Much like trans-mountain diversions, agricultural water transfers, and storage,~~ While~~ conservation and reuse are not "silver-bullets", however they are critical components to address future needs. Conservation and reuse will be bolstered,~~" we can achieve benefits~~ by creating scalable technical resources, supporting~~bolstering~~ local initiatives through financial incentives, and sharing best-practices.

This section examines water conservation, reuse, land use, agricultural water conservation, self-supplied industrial (SSI) conservation, and state agency conservation. These various water management strategies will help Colorado close the water-supply gap, while at the same time minimizing trade-offs that could result from other solutions. Increased conservation, reuse, and better integration of land-use and water planning will help~~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."[151] 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:[152]

- 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 a~~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.

Conservation also acts as a management tool to buffer against drought 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, more storage may be required to maintain a drought reserve.[153]

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.

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 30 percent.[154] Most of the largest water providers in Colorado have CWCB approved water conservation plans and most~~the majority~~ of the 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 2,0002000 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 Rangefront range and eastern slope and 77 percent of western slope water providers have tiered rate structures that increasingly cost customers more if they use more than a base amount of water. These tiered rate structures are called inclining block rate structures.[155]

A successful[156] There are many great examples of water conservation strategy must build on past accomplishments and model examples already in place at a local level across the state. Below; 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 also 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. Additionally, they have been implementing a successful turf buy back and landscape design assistance program since 2007.
- **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. Specifically, the Town of Castle Rock is a leader in water conservation and is implementing best practices such as landscape/irrigation ordinances, landscaper certification requirements, landscapea variety of incentives , tiered rate structures (including a turf buy-back program, water budgets based on irrigated landscape area,), 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 eight8 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. Water budgets are rate structures that are derived from Using winter quarter average as a proxy for indoor use and allocated amounts ofGIS imagery to define water per square foot based on plant requirements and local climate data. Because rates climb steeply if a customer uses more than his or her water budgetuse outside, these communities use water budgetshave used this tool to manage their summer peak demands while maintaining healthy landscapesthrough 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 receive~~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 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 the 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. The legislation that authorized the pilot project study~~HB 09-1129~~ allowed for up to three pilot projects in each river basin and up to 10 pilot projects across the state.[157] 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.[158]

Social Norming/Behavioral Water Efficiency

Much of water ~~Water~~ conservation is based on human behavior. It requires constant communication and education~~practices across the United States~~

~~Texas~~

~~In 2013 Texas voters approved Proposition 6 which amended the state's constitution~~ to make~~create funds for cost effective water projects.[159] 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 a standard community practice (also known as social norming) and ~~and reuse projects under House Bill 4.[160] This equates~~ to directly influence behavior~~about $400 million which on a per capita basis would equate~~ to achieve~~approximately $75 million for Colorado focused on~~ water conservation results. ~~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.[161] 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.[162]~~

~~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.[163] 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.~~[164]

~~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 many~~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 several~~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.[165] 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 of 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.

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 CWCB's statewide water supply initiative and the IBCC 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."[166]

The fixtures bill became law~~(SB 14-103) was signed into law by the governor~~ in 2014.[167] 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. Future technology advances could make fixtures even more efficient.~~.~~ In addition, these fixtures do not cost more than their less-efficient counterparts. The bill's proponents estimate that long term replacement of indoor fixtures because of the fixtures bill~~it~~ will garner approximately 40,000 acre-feet of savings annually by 2050 and would increase the replacement rate of existing fixtures.[168] The bill is consistent with the IBCC's 2010 suggestion to require high efficiency fixtures~~explore legislative options to help increase indoor water efficiencies~~.

In 2015, Colorado enacted a law that provides incentives to encourage more participation in the state precipitation harvesting pilot program.[169] Incentives include a less burdensome substitute water supply planning process. The main incentive is that when calculating required replacements to the stream to account for captured precipitation, the proponent would not have to replace the amount of precipitation that would have been consumed through the historical depletion from natural vegetative cover that is replaced by impervious surfaces of the new development. The proponent may rely on regional factors established by the CWCB that specify the amount of precipitation consumed through evapotranspiration of preexisting natural vegetative cover.

Past Legislation

In 2010,~~Past~~ legislation passed

~~In 2010, the governor signed legislation~~ that requires most water providers to submit water use and conservation data to the CWCB.[170] 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 was signed into law 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.[171]

In 2009, ~~the governor authorized~~ a pilot program was authorized that allows 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.[172]

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.[173]

In 2005, the governor signed legislation that protected homeowners' property rights in regard to installation of xeriscape landscaping. This legislation amended the law regulating home owner associations~~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. [174]

IBCC No-and-Low-Regrets ~~IBCC no and low regrets actions~~

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.[175] 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.

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

In 2013, the IBCC developed the "No and Low Regrets Action Plan" for water conservation. 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 6.3.1-1). [176]

Table 6.3.1-1: IBCC Potential Future Actions Summary

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

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~~; the~~ 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.[177] Recently, ~~Many stakeholder-based efforts such as the 2010 Statewide Conservation "mini-summit," work of~~ the IBCC Conservation Subcommittee developed a stretch goal that goes beyond the no-and–low-regrets actions:

Reduce Colorado's 2050 municipal water demands by 400,000 acre feet statewide.

- **Benefits:** A stretch goal is in the state's best interest as part of a responsible and sustainable water plan.
- **Achieving the Stretch Goal:** High levels of customer participation will result from new regulatory mandates, technology innovations, incentives, and changing customer behaviors to reduce Colorado's 2050 water demands by 400,000 acre-feet statewide. This level of conservation includes an additional 60,000 acre-feet of demand reduction beyond the no and low regrets recommendations. Based on current conservation plans statewide, the committee believes this is achievable.
- **Implementation**
  - **Accountability:** For the goal to be successful, water providers will be encouraged to do comprehensive integrated water resource planning, geared toward implementing the best practices at the higher customer participation levels. This will be part~~work~~ of the necessary requirements to achieve state endorsement~~CWCB Water Conservation Technical Advisory Group, have helped to 1) determine the minimum levels~~ of projects, and financial assistance.
  - **Best Practice Based:** The goal can only be achieved through the implementation of best management practices at higher customer participation levels. The best management practices will continue to adapt and evolve over time, incorporating

innovative technologies, providing opportunities for contribution to these demand reductions

- **Maintain Local Control:** The goal recognizes the importance of local control and flexibility, while encouraging higher levels of conservation and adoption of innovative practices across the state.
- **Monitoring:** Tracking demand reductions as part of future SWSI updates will be necessary.
- **Adaptive Management:** The goal may need to be adapted based on future demand and other factors and incorporated into the portfolios and scenarios over time.

For the goal to be successful, water providers will be encouraged to do comprehensive integrated water-resource planning geared toward implementing the best practices at the higher customer participation levels. This will be part of the requirements~~conservation needed and 2) chart potential ways~~ to achieve ~~these levels of active conservation.~~ state endorsement of projects and financial assistance. ~~In these cases, greater storage is required to maintain a drought reserve.~~[178]

BIPs

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.

To illustrate progress to date, the Arkansas Basin highlighted many of the current water-efficiency activities such as the innovative regional water efficiency planning efforts being carried out by the Southeastern Colorado Water Conservancy District (SECWCD) and the Best Management Practices Toolkit for providers. The regional efficiency planning efforts brought 47 mostly small water providers under one efficiency plan while using the toolkit to create individual plans for each provider. The toolkit indentifies five components: water production and treatment, water distribution, water delivery to customers, customer demand management, and overall water system management as essential areas of water efficiency. As part of this regional effort, SECWCD will implement triennial system-wide water audits of all participants with annual data reporting back to SECWCD. As a solution for preventing future water supply gaps from increasing, attaining the basin goals and aligning with the ongoing regional efficiency plan implementation, the basin

listed several projects and recommendations related to water conservation. The projects focus on water loss metering and audits as identified by the CWCB as Foundational Water Efficiency Activities that every water utility should carry out. These include master meter improvements to aid in measuring water flow reliably and properly accounting for water loss using the internationally accepting the American Water Works Association M36 Water Loss Methodology. The BIP relates all of current water efficiency activities that are currently being carried out by water providers in the Arkansas Basin such as water loss management, re-evaluation of water rates, landscape water efficiency, adoption of advanced metering infrastructure, indoor fixture and appliance rebates, policies and regulations and customer education.[179]

Colorado Basin

The Colorado Basin mapped out Theme 4 as "Encourage ~~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.~~[180]

~~Colorado Basin~~

~~The Colorado Basin stated its desire to "encourage~~ a high level of basin-wide~~basinwide~~ conservation" with two goals specifically for M&I water conservation:

- Improve Colorado water law to encourage efficiency, conservation, and reuse; and
- Pursue continued M&I 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).[181]

Gunnison Basin

The Gunnison Basin BIP promotes high levels of water conservation. The BIP focused on identifying and addressing M&I 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."[182]

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, with the goal being high~~producing at least medium~~ levels of conservation savings as defined in SWSI 2010. The Gunnison Basin also identified statewide principles where water efficiency, ~~and employing relevant~~ conservation, and demand management were intertwined throughout several ~~strategies listed for both the low and medium levels~~ of them. The most salient principle is Principle 5:~~SWSI 2010.~~

Principle 5: ***Water conservation, demand management, and land-use planning that incorporates water supply factors should be equitably employed statewide.***

To achieve this principle the Gunnison Basin Roundtable believes that the best way to promote statewide water conservation is through incentives and not regulatory methods, and focusing demand management efforts on covered entities. Additionally, local land-use policies and regulations should discourage sprawl, link water supplies to development, and provide incentives for higher-density developments. Two implementation concepts focused on working with other roundtables to carry out this principle and to promote programs encouraging drought tolerant vegetation and discouraging lawn irrigation.[183]

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 M&I shortages in the future.[184]

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~~roundtable~~ 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 North Platte Basin Roundtable~~roundtable~~ supports a wide variety of water conservation methods including municipal conservation programs, strategic growth and development, and landscape limitations. The North Platte Basin Roundtable~~roundtable~~ believes that the best way to promote statewide water conservation is through incentive-based measures as opposed to regulatory methods."[185]

To maximize water savings and avoid an unnecessary burden on smaller rural water providers, the North Platte Basin Roundtable~~roundtable~~ 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 North Platte Basin Roundtable~~roundtable~~ 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 North Platte Basin Roundtable~~roundtable~~ 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.[186]

Rio Grande Basin

Much like the North Platte Basin, the Rio Grande Basin Roundtable~~roundtable~~ focuses on agricultural water and environmental needs. With that said, the Rio Grande Basin Roundtable~~roundtable~~ does have a goal "to meet new demands for water, to the extent practicable, without impacting existing water rights and compact obligations."[187]

For M&I water conservation the Rio Grande Basin Roundtable~~roundtable~~ 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.[188]

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."~~[189] 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 substantial~~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~~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~~roundtable~~ recommends conservation programs that would reduce per capita water use from a baseline of 188 in 2010 to 146 gpcd by 2050 (Table 6.3.1-2). The South Platte Basin Roundtable~~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.[190]

Table 6.3.1-2: South Platte and Metro Basin Conservation Goals

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."[191]

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."[192]

Finally, the South Platte/Metro Basin finished with thoughts on how more water efficiency could occur:

- Greater savings in outdoor water use would require major changes in landscaping that moves beyond just efficiency measures; this would involve lifestyle considerations about our urban environments. These decisions must be made and implemented at the broader community level, as well as at the water-planner level.
- Higher levels of indoor conservation will require broad political and public support.
- Land-use planning has the potential to promote densification, growth management, and comprehensive plans to include considerations for impact fees and firm yield.

The Metro and South Platte Basin Roundtables support ongoing statewide education to address these factors.[193]

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."[194] The Southwest Basin supports high conservation levels statewide. [195] ~~The Southwest Basin was a major supporter of the original language in SB14-017, which focused increasing levels of water conservation, especially for outdoor water use. 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 measurable outcomes ~~goals~~ for the goal of promoting wise and efficient water use through the implementation of municipal conservation strategies to reduce overall future water needs in their BIP:

- 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 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 were ~~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 and outdoor water use ratio and to incentivize the attainment of the 60/40 ratio ~~outdoor water conservation~~ 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.[196]

Another area where the Southwest Basin proposes water conservation action is in the basin public education and outreach plan. Short term goals "encourage education and conservation to reduce demand, implement information events on water conservation, land-use planning and reuse, and promote wise and efficient use through implementation of municipal conservation strategies to reduce overall future water needs".[197]

Yampa/White/Green Basin

The Yampa/White/Green Basin population is projected to nearly triple by the year 2050 and M&I water usage is also expected to nearly double, even with savings from passive conservation. The

basin roundtable has identified adequate storage, strong municipal conservation measures and drought plans to address the situation 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 M&I 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 M&I demands.
- Encourage municipal entities to meet some future municipal water needs through water conservation and efficiency.[198]

Measurable Outcomes
Reliably meet 100 percent of M&I 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 reduce projected use by 720 acre-feet by 2035 in Steamboat Springs by reducing per capita demand by 15 percent% in the Steamboat Springs municipal water system, through passive conservation and active conservation such as leak detection programs, fixture rebate programs, and reducing landscape irrigation needs.

Actions

The actions described below are based onoff the IBCCs No and Low Regrets Action Plan, the work of the Water Conservation Technical Advisory Group and, the basin roundtableswork of the Basin Roundtables, and utility water conservation plans.

1. **Adopt conservation incentives:** Over the next two years, the CWCB will adopt policies stating that in order to achieve a state endorsement and financial assistance for water management projects, water providers must conduct comprehensive integrated water resource planning geared toward implementing the water conservation best practices at the high customer participation levels.
2. **Support foundational activities for all water providers:**
   The CWCB will continue toState of Colorado should provide funding, technicalincentives and support, and training workshops to assist water providers with managing their water systems better through techniques 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.
3. **Better tracking and quantification**
4. 2. The CWCB should provide technical and financial assistance for the creation of savings tracking and tools, savings estimating tools, and improved data collection on customer water uses. For example, the CWCB will fund several regional training workshops and other technical resources for water providers in the next year on using the American Water Works Association M36 methodology for Water Audits and Loss Control. .
5. **Recommend WaterSense specifications for outdoor irrigation technology:** Through a stakeholder process, the Department of Natural Resources (DNR) will work with the General Assembly to

6.3. The State of Colorado should consider adoptingadoption of WaterSense specifications for outdoor technology at the retail level. These specifications would create a minimum standard that can be adapted easily to accommodate higher efficiency technologies as they are created and certified.

7. **Explore incentivesIncentives for outdoor water conservation measures:** As part of a broader funding strategy being developed over the next year, the CWCB will work with stakeholders to explore a tax credit program to incentivize

8.4. The CWCB should provide incentives for retrofitting higher water-use landscapes landscape with lower water-use landscapes and, more efficient irrigation systems. and selectively siting higher water use landscapes to create more appropriate use areas that would help garner higher levels of water savings.

9. **Adopt aStatewide no/low regrets target + stretch goal:** Reduce projected 2050 demands by 400**target discussion**

10.5. In addition to the 170,000 acre feet through -foot goal of active conservation savings. Based on stakeholder work, the CWCB will adopt a "that needs to be achieved regardless of which future scenario Colorado may face, a stretch goal" to encourage demand-side innovation that places Colorado at the conservation forefront in a thoughtful way that recognizes and addresses the impacts conservation carries. The 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 IBCC identified stretch goal, while giving appropriate credit for recent strides made in demand reduction.goal.

11. **Water conservation education and outreach:** The CWCB will develop an

12.6. The State of Colorado should implement far reaching education and outreach strategymeasures that includesinclude water conservation topics.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. More detail regarding specific education and outreach recommendations are detailed in Section 9.5. 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. These efforts willFor 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. ThisAs part of this work will include, 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.

13. **Support local water smart ordinances:** Over the next two years, the CWCB will provide trainings that

14.7. 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, education or certification of landscape professionals, green infrastructure ordinances, and more stringent green construction codes that include higher

efficiency fixtures and appliances and water-wisemore waterwise landscapes. This action is further explored in Section 6.3.3.

8. **Evaluation of barriers to green building and infrastructure**. CWCB and CDPHE will work together to determine which state agencies govern green infrastructure and buildings, identify barriers, and work with the appropriate agencies to adapt regulations to allow for graywater, green infrastructure, and other aspects of green developments.

15. **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.

16. **Strengthen Partnerships:**

17.9. The CWCB willshould create or renew partnerships between the CWCB and the following groups to reach our water conservation goals:

a. Local Water Providers and Local Governments- to implement - Probably our most important partners in that they carry out water conservation programs to benefit their water systems. system.

b. Intra-state government (Department of Local Affairs, (DOLA), DWR, Department of Regulatory Agencies (DORA), and state facilities) to coordinate and implement incentives.) and State Facilities).

c. Green Industry (GreenCO, Irrigation Association, Associated Landscape Contractors of Colorado) to implement efficient landscape installations and maintenance.).

d. Home Building/Construction (Home Builders Association, LEED, U.S. Green Building Council) to implement water-smart homes.).

e. Non-Governmental (Colorado WaterWise, Alliance for Water Efficiency, Western Resources Advocates, American Water Works Association, Water Research Foundation) to help educate Coloradans and further conservation innovations and research.).

f. Academia (Colorado State University, CU-Boulder, CU-Denver, One World One Water Center-Metropolitan State) Bring a consortium of businesses, academia, etc. to examine behavioral science and research conservation innovations.).

18. **ExploreFunding**

19.10. 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 funding:**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. , and should consistently total $2,000,000 per year. In addition, the CWCB's loaning ability

should be expanded to encompass conservation actions. The DNR will work with the General Assembly to institute these changes over the next two legislative cycles.

~~20.~~ **Market for conserved consumptive use water:** To use conserved consumptive use water to the greatest extent possible, the CWCB will~~water~~

~~The State of Colorado should~~ investigate ~~the following points:~~

~~21.~~11. ~~Identify and, where possible, resolve~~ legal and administrative barriers to the use or sharing of conserved consumptive use water through a stakeholder process. If barriers can be addressed through acceptable legislative modification, the DNR will work with the Water Resources Review Committee to propose legislative action~~of conserved water~~.

12. **Develop an alternative process for smaller entities to create water conservation plans and report water use data to the CWCB:** The CWCB will provide technical and financial support on this and will work to formalize this process into the CWCB Municipal Water Efficiency Guidance document.

~~a. 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.~~

~~22. **Changing threshold for covered entities**~~

~~The CWCB should revise C.R.S. 37-60-126, which defines a covered entity as delivering more than 2000 acre-feet annually, to reduce the threshold from 2000 acre-feet down to 1000 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.~~

~~23.~~13. **Continue implementation of state conservation programs**

a. ~~Conservation plan review and approval:~~ The CWCB will~~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.

b. ~~Water Efficiency Grant Fund:~~ The CWCB will~~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.

c. The CWCB will~~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 many~~a number of~~ small water providers that can create a regional water conservation plan. This will~~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 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 many~~a number of~~ innovative reuse projects already in existence and Colorado can also learn from several~~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. Nevertheless,~~However, widespread unintended or~~ "de facto" potable reuse occurs where one community discharges to receiving waters that are~~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) was~~), with no discharge to receiving waters or "environmental buffers," have recently been implemented in New Mexico and Texas, while Denver Water~~ pioneered through Denver Water's~~DPR~~ research with its potable reuse demonstration project in the 1980s. Nevertheless, there continues to be public health and environmental concerns related ~~Due~~ to brine disposal. While it~~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 to implement DPR today, it is not fully accepted by the public for reuse as drinking water. More~~but more~~ research and education will be needed to ~~assure regulators and to~~ gain public acceptance.[199] In Colorado, no utilities have seriously pursued DPR.

~~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 WateReuse Research Foundation, with WateReuse California, created the DPR 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.[200] 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.~~[201]

Widespread development of potable reuse will~~should~~ be an important facet of closing the future water supply-demand gap. The CWCB ~~has~~ funded research into zero liquid discharge (ZLD) 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 technologies to minimize or eliminate brine disposal in a manner~~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 environmentally~~user~~ friendly technology before widespread adoption can occur in Colorado.[202]

On a smaller scale, the Colorado Department of Public Health and Environment's (CDPHE)~~governor signed legislation that authorized the CDPHE's~~ Water Quality Control Division (WQCD) is authorized 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.[203] Following the promulgation of Regulation 86, and once the Plumbing Board adopts suitable changes, counties and municipalities may adopt local legislation to allow graywater use, subject to water rights restrictions. Graywater use is limited to the uses allowed under the well permit or water right of the original source or sources of the water. Once fully approved, graywater reuse should~~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.

In Colorado, reuse water that is used for non potable uses, such as landscape irrigation, is subject to the requirements of Regulation 84, which establishes standards to protect public health and the environment. Reuse water, which is also known as "reclaimed water" is defined in Regulation 84 as "domestic wastewater that has received secondary treatment by a domestic wastewater treatment works and such additional treatment as to enable the wastewater to meet the standards for the approved uses." 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. While reusing wastewater can help close the water supply gap, appropriate public health and environmental protections must remain in place. Therefore~~However~~, Regulation 84 is~~has~~ not ~~been interpreted to be~~ the only controlling regulation concerning reclaimed water depending on the use.~~. Instead,~~ CDPHE is committed to working with stakeholders~~has determined water providers using reclaimed domestic wastewater are also subject~~ to ensure that health~~numerous other regulations~~

~~applicable to surface and groundwater discharges, which create administrative~~ and the environment are protected while water reuse expands~~economic burdens. Reuse in Colorado lags far behind many other states, especially considering Colorado's semi-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 will~~should~~ be examined to identify potential change to foster permanent growth in the reuse of limited water supplies.

Currently, while there is not a specific regulatory pathway defined for DPR in Colorado, there are no regulations prohibiting or limiting a utility's pursuit of this option. At present, the Colorado should work through and approve a proposed DPR project. Despite momentum toward more reuse planning and implementation in Colorado, barriers such as public acceptance of DPR and costs of treatment for lower quality water sources are real issues that must be addressed. With this said, development of any new supplies will have implementation barriers as well. These include infrastructure capacities, losses, supply and demand timing, water quality, treatment costs and brine disposal, and regulatory requirements. Many, if not all, of these limitations must also be addressed for many of the new water supplies available to meet future demands, whether transmountain diversions, agricultural transfers, or other. They are not unique to reuse projects. Specifically, brine disposal is a challenge for trēating many lower-quality sources with reverse osmosis (RO) – as evidenced by several facilities in the state that use RO to treat groundwater supplies for potable use.

~~, 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. Reuse, like the development of other local supplies through full use of absolute rights or development of conditional water rights may reduce return flows that ~~Many~~ downstream users ~~are concerned that return flows they~~ have ~~relied upon~~ historically relied on. Nevertheless,~~will not be available~~ in combination with other water development, reuse can help mitigate impacts~~the future~~. Future research should be directed toward the possible effects~~impacts~~ on return flows from the reuse of water.

Recently, the CWCB funded a white paper, "Considering the Implementation of Direct Potable Reuse in Colorado", sponsored by the Water Environment Research Foundation and authored by HDR Engineering. The draft paper explored the technical, operational, regulatory, and public acceptance challenges of implementing DPR in Colorado. In line with Colorado's Water Plan's grassroots approach, Water Environment Research Foundation, the Water Research Foundation and WateReuse Colorado sponsored a workshop to get feedback on the white paper and discuss direct potable reuse as a new water supply. Reuse experts from across the country attended, including

first hand practitioners from Texas, California, and other states. Recommendations from the draft white paper and workshop are as follows:

- Convene a broad range of experts and interested parties to produce a roadmap to develop potable reuse in Colorado. This would include making policy, regulatory, technical, and operational recommendations.
- Sponsor a survey of Colorado utilities and water agencies to determine the extent to which DPR may be considered as a means to augment their water supply portfolios.
- Develop a program to educate the public, elected officials, and water utilities about the benefits and safety of DPR.
- Partner in research projects that advance the knowledge related to technical challenges associated with DPR including more cost-effective and environmentally acceptable RO concentrate management techniques and the evaluation of non-RO based treatment trains capable of producing water suitable for DPR.
- Investigate water quality of de facto reuse situations relative to potable reuse.
- Carry out a state funded potable reuse pilot project in Colorado to assess the impacts and benefits of potable reuse.[204]

Some of the results of this work are incorporated into the actions listed below.

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 more than~~over~~ 50 years in the form of direct reuse for irrigation and cooling. Irrigation consists of providing 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 employs~~is~~ IPR where Aurora's fully reusable water is extracted from the South Platte River near Brighton through river bank filtration (RBF) wells, into aquifer recharge and recovery (ARR) 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 Aurora's~~our~~ customers. The current capacity of the system is approximately10 million gallons per day (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.[205]

IBCC No-~~no~~ and-Low-Regrets Actions ~~low regrets actions~~

In 2013, the IBCC developed the "No and Low Regrets Action Plan" for water reuse. This strategy outlines what minimum level of water reuse should be carried out statewide (Table 6.3.2-1~~2~~).[206]

BIPs

Reuse of water has appeared in a few BIPs~~BIP 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.[207]

Table 6.3.2-1: 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) Use 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

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.[208]

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.[209]

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 beforeprior to further development of Colorado River System water."[210]

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 roleLeadership 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."[211]

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, environmental and recreational water uses is needed to assure that the State's plan has equal focus

on the other three previously identified strategies including: 1) developing IPPs, 2) municipal conservation and reuse, and 3) agricultural transfers~~, and 4) new supply~~."[212]

Table 6.3.2-2: South Platte and Metro Provider's Reuse IPPs

Basin	Providers	Project	Estimated Yield (acre-feet per year)	Estimated Completion Date
Metro	Aurora	Prairie Waters Project Expansion and Storage[4]	TBD	2050
Metro	Northglenn	Northglenn Reuse Plan	700	
Metro	Thornton	Thornton Reuse	2000	2030
Metro	Denver Water	Denver Water Reuse	17,500	2023
Metro	Westminster	Westminster Reclaimed Water		
Metro	Denver Water	Downstream Reservoir Exchanges	12,000	
Metro	Castle Rock	Alternative Northern Water Supply Project	2500	
Metro	Castle Rock	Plum Creek Diversion and Water Purification Facility Upgrades	4100	
Metro	Arapahoe County Water and Wastewater Authority	Reuse of ACWWA Flow Project Deliveries	3250	
Metro	City of Brighton	South Platte and Beebe Draw Well	3,200	
Metro	South Metro Water Supply Authority, Denver Water, Aurora	WISE	7225	2021
South Platte	Erie	Erie Reclaimed Water	5390	
		TOTAL:	58,135	

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."[213] In relation to non-consumptive needs they will ensure conservation, reuse and drought management plans consider environmental and recreational focus areas and attributes.[214]

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 uses~~utilizes~~ available reusable supplies from Aurora Water and Denver Water, diverted and delivered through Aurora's Prairie Waters collection and treatment system. Nevertheless~~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 raised~~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

[4] The 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.

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.~~[215] The ~~For many of the cities in the~~ South Platte~~/ and~~ Metro BIP does however advocate that the state should "direct the Colorado Water Quality Control Commission to look for ways to assist and facilitate reuse."[216] ~~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.~~[217]

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.[218]

Yampa/White/Green Basin

The Yampa/White/Green Basin considers reuse principally~~prinicipally~~ as a pre-condition for trans-mountain diversions, 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."[219]

Actions

1. **Explore regional reuse options:** Over the course of the next three years, the CWCB will conduct a technical review of regional reuse options and provide grants to support regional reuse plans and projects.

Improve quantification, planning and tracking for potential reuse projects: Over the next two years, the CWCB will

~~1.~~2. ~~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. As part of this work, the CWCB will work with partners to map all wastewater and potable infrastructure, water rights, needs, cost, and benefits to assess feasibility of potable reuse projects in Colorado. In addition, potential impacts to return flows will be examined.

Clarify~~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, IPR expansion, and DPR projects.~~

~~Improve~~ the regulatory environment: Over the next two years, the CWCB and the CDPHE will work with stakeholders to

~~2.~~3. ~~The State of Colorado should~~ examine the application of water quality regulations to reuse water to identify potential change that fosters~~to foster~~ permanent growth in the reuse of limited water supplies and that protects public health and the environment.~~ As Colorado~~

~~plans its reuse future, continued flexibility will be paramount to addressing water resource challenges.~~

Provide financial incentives for reuse innovation: As recommended in the DPR white paper, over the next year, the CWCB will proactively seek applicants to ~~**Explore incentives and funding**~~

4. ~~The CWCB should~~ use WSRA grant funds for expanded research and innovation related to the technical challenges and solutions of reuse. This includes exploring~~expand research into~~ areas such as ZLD~~zero liquid discharge~~, IPR, and DPR, examining regional opportunities, increasing the reliability of the technology, on site reuse of water, development of reuse water for food crop irrigation, and the ability to share reuse water. Such research also includes support for continued development of more cost-effective and environmentally acceptable RO concentrate management techniques and the evaluation of non-RO based treatments capable of producing water suitable for DPR.[220]

5. **Encourage the Examining Board of Plumbers to adopt the International Plumbing Code to allow for graywater.** The CWCB will encourage the Colorado Plumbing Board to adopt and incorporate the appropriate graywater provisions from the chapter or appendix of the International Plumbing Code to allow for graywater piping within structures.

~~3.~~6. **Expand loan programs:** The CWCB will explore expanding its loan~~The CWCB Loan~~ program to include loans for innovative or~~should be considered for expansion into these types of supply projects and could be used for developing~~ regional reuse projects. The DNR will work with the General Assembly to institute this modification during the 2016 legislative session. ~~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: As recommended in the DPR white paper, the CWCB will

~~4.~~7. ~~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. Specific recommendations are to sponsor a survey of Colorado utilities and water agencies to determine the extent to which DPR may be considered as a means to augment their legally reusable water supply portfolios and to develop a program to educate the public, elected officials and water utilities about the benefits and safety of DPR.[221] 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.[222]~~

Examine~~Consider~~ mechanisms to improve the ability to market, sell, and share reusable supplies: Through a stakeholder process, the CWCB will

~~5.~~8. ~~The State of Colorado should~~ investigate mechanisms to~~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. This topic is relevant today as illustrated by the fact that six boards of county commissioners (from eastern and western slopes), including Boulder, the city and county of Denver, Eagle, Grand , Pitkin, Summit, as well as elected officials from the city and county of Broomfield collaborated to craft comments for Colorado's Water Plan on land-use-water integration. The importance of water-sensitive land-use planning was stated as, "1. Decrease the water supply Gap. As Colorado's population continues to grow, well thought out, effective, sustainable, and predictable land-use planning is essential. 2. Provide low cost alternatives for meeting the Gap. Water sensitive land-use often results in less stress on water systems, indoor and outdoor water savings, and reduction in expensive long-term capital outlay. 3. Protect the values of Colorado, including vibrant economies, agriculture, open space, and recreation. Local land-use planning should be among the first points of consideration to protect and support all of Colorado's values and economic drivers. 4. Create more predictability and reliability as well as reduce risk in water supply planning, in turn creating more sustainability for current and future residents. 5. Encourage shared solutions including best management practices, collaborative physical projects and practical land-use models to address water quality and quantity challenges. 6. Result in benefits that reduce infrastructure and service costs, and enhance a community's quality of life". [223]

"Every community can do better on water conservation and efficiency via locally determined measures such as but not limited to reinvestment in aging infrastructure, community education, enhanced building codes and water sensitive land-use planning"
Guiding statement for County Commissioners [224]

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.[225] 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.[226]

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.[227] 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.[228]

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 M&I 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 in the fall of 2013. 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.[229] This collaboration is a model for integrating local planning efforts within a local government and into regional planning efforts. The latest LULA trainings took place in May 2015, with the training of five more Front Range municipalities, including Westminster, Lakewood, Commerce City, Broomfield, and Aurora. Additionally, representatives from South Adams Water and Sanitation, Denver Water, Bancroft-Clover Water, and Green Mountain Water and Sanitation attended. The LULA trainings will serves as a template for the trainings that the CWCB and the DOLA will carry out in 2016 as outlined in SB15-008.

Denver Regional Council of Governments MetroVision (DRCOG)

The 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.[230] 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.[231] This 10 percent increase willwould 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 annual 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.[232]

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 severala 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. To date, the project has produced a draft research report that examined strategies for implementing land-use patterns that reduce water demand. Four strategies were identified as having the most potential to reduce water demand: Smaller residential lots (cluster development), changing from Single Family to Multi-Family development (infill), increasing Multi-Family (moving –up) and turf/irrigation restrictions.[233] Additionally, Denver Water and Aurora Water are modeling water use patterns from their service areas on top of existing land-use patterns. The group will then use DRCOG's UrbanSim model to generate future land-use patterns with the overlay of water use patterns. As the project progresses, several different exploratory scenarios will be generated out to 2040 that could include effects of climate change, economics, market demand and political will for regulation. This water and growth project will create a report and roadmap in 2016This 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..[234]

Recent legislation

In 2008, the governor signed legislation passed requiringthat 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.[235] 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.[236]

In 2015, SB15-008 passed, which tasks the CWCB and the DOLA to carry out trainings for local water use, water demand, and land-use planners. The topic areas will cover best management practices for water demand management, water efficiency and water conservation. Additionally, the bill requires that best management practices for water demand management, water efficiency, and water conservation that may be implemented through land-use planning efforts must be evaluated in all covered entities' water efficiency plans.

BIPs

Each basin roundtable~~Basin Roundtable~~ is formulating their own implementation plan that will include land-~~-~~use goals and activities in addition to already planned projects and methods that~~which~~ are explored throughout Chapter 6.

Arkansas Basin

The Arkansas Basin did not address~~states that while each community should decide how the conversation between~~ land use in an extensive manner in the BIP. The Arkansas Basin did, however, create a policy calling for the integration of land-use and water-resource ~~supply~~ planning.

The Arkansas Basin came ~~should take place, it needs~~ to consensus on a policy statement regarding land-use and water-resource planning. ~~occur and be detailed and robust.~~[237]

- Policy Statement: The Arkansas Basin Roundtable supports the integration of land-use and water-resource planning.[238]

Creating a policy statement for this type of integration is an important first step in the future of demand management in the Arkansas Basin.

Colorado 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 BIP 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."[239]

Colorado Basin

The Colorado BIP created a theme and 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.

Theme 5 is "Develop local water conscious land use strategies" and the main~~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.[240]

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~~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.[241]

Additionally, the Grand County Region, Summit Region, Eagle River Region, Middle Colorado Region and the Roaring Fork Region all developed specific land-use themes and methods in their needs analysis.

The themes include:

- Develop local water conscious land-use strategies that focus on growth that affects water supplies and nonconsumptive/environmental needs.

The methods include:

- Limit development to within urban boundaries
- Promote water conscious growth development through improved land-use policies.
- Water providers should work with neighboring entities to provide and plan for growth between boundaries
- Implement water provider conservation projects
- Review local governments' land-use policies for water-quality and environmental protection standards.
- Assess county master plans and codes for improvements in smart growth land-use policies
- Ensure new development appropriately incorporates water-related values[242]

Gunnison Basin

As with other BIPs, the Gunnison BIP ties land use to water conservation and demand management. The Gunnison BIP set out goals related to land use and water conservation. Goal 9, which deals with public outreach and education around the role of citizens of the Gunnison Basin, identifies land use as a process to achieve this goal: "The GBRT Education Committee will prepare and present annual half-day State of the River seminars for local governments and planning staffs, with the objective of making sure that land-use decisions and new developments are made within the context of the Basin's probable water future"[243]

The Gunnison Basin also identified statewide principles where water efficiency, conservation and demand management were intertwined throughout several of them.

Principle 5: ***Water conservation, demand management, and land-use planning that incorporates water supply factors should be equitably employed statewide-***"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.".[244]

Additionally, the Gunnison Basin discusses land use in terms of Colorado River supplies. Under Principle 3: *Any new supply project from the Colorado River System must have specifically identified sponsor and beneficiaries and meet certain minimum criteria,* "entities must incorporate water supply factors into land-use planning and development"[245]

North Platte Basin

Because of~~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.[246]

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.[247]

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."[248]

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.[249]

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."[250]

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."[251]

The South Platte/Metro BIP ends with a land-use recommendation in the section *Recommendation for Additional SP-BIP Analysis and Refinements* to be:

Further Analysis of Planning Coordination— The South Platte and Metro Roundtables recommend further investigation into options for increased coordination between water utilities and land-use planners to better plan for water-efficient growth. [252]

Southwest Basin

Implement informational events about water conservation, land-use planning and water reuse efforts, tools and strategies."One strategy to achieve the short-term goals of conservation, land-use planning (which will include coverage and discussion of the 60/40 and 70/30 ratios referenced above), and water reuse is to implement a pilot conservation and land-use planning session in 2015. Initially it is anticipated that this would be a two to four hour workshop for local decision makers and water utility personnel." If successful, the session could move throughout the basin (e.g. Cortez, Telluride, Pagosa Springs, etc.) similar to the Water 101 Seminar.[253]

~~and~~ Yampa/White/Green Basin

The ~~Neither the Southwest nor the~~ Yampa/White/Green Basin did not describe~~Basins described~~ projects or plans for land use in their BIP. ~~BIPs~~.

Actions

To facilitate the use of local land-use tools to reduce water demands for municipalities and urbanization of agricultural lands, the following actions are needed.

Encourage the use of local development tools:

1. Through trainings established by Colorado's General Assembly~~technical and financial support~~, the CWCB~~,~~ in consultation~~partnership~~ with the DOLA~~other state agencies~~, will work with numerous partners to encourage local governments to incorporate best management practices for water demand management, water efficiency, and water conservation that may be implemented through land-use planning efforts. These trainings will begin in 2016. These include~~do the following~~:
   - Expediting~~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);
   - Inclusion of water supply and demand management in comprehensive plans
   - Installing climate~~Climate~~ appropriate plants~~plant lists~~;
   - Using appropriate amounts of soil~~Soil~~ amendments;
   - Incentivizing maximum~~Maximum~~ irrigable area or WaterSense certified landscapes;
   - Instituting tax~~Tax~~ incentives for developments that incorporate certain water efficiency measures or high levels density such as cluster developments;
   - Establishing structured~~Structured~~ impact (tap) fees designed to promote water-wise developments and in-fill; and
   - Developing water~~Water~~ budget rate structures to help maintain initial projected water budgets for a site
   - Introducing landscape and irrigation ordinances
   - Creating more stringent green construction codes that include higher efficiency fixtures and appliances and more waterwise landscapes
   - Exploring landscape professional education or certification programs
   - Examining opportunities to reduce agricultural urbanization and fragmentation.[~~254~~]

2. **Examine barriers in state law for implementing the above local development tools:** Over the next 18 months, examine barriers to local development tools that local jurisdictions may face while implementing the tools.

3. **Incorporation of Land-use Practices into Water Conservation Plans:** Over the next eighteen months, the CWCB will develop new guidance for water conservation plans to require the incorporation of land-use practices. This is an addition to C.R.S. 37-60-126.

Strengthen partnerships:

~~2.~~4. To be successful in integrating land-~~-~~use and water planning, the CWCB will need to partner with many different agencies and groups. The CWCB will set up meetings with the various agencies within the next year to map out how the CWCB and other agencies can work together on these issues.

- Local municipalities/local water providers/county governments ~~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.
- The DOLA is involved in the land-use and local government arena. Like the CWCB, the DOLA also has grant funding that could be leveraged for water and land-use planning initiatives, such as incentives for incorporating water supply into comprehensive land-use planning.
- The DORA regulates professionals in various industries and works to create a fair marketplace. The CWCB will work with the DORA to~~might~~ focus on the landscape and irrigation industry or the property management industry and to consider developing~~could develop~~ certifications for these industries to conserve water.
- Home Building/Construction (Home Builders Association, LEED, U.S. Greenbuilding Council). This industry will be building communities that will have a direct impact on water demand so must be involved in crafting the vision for future water sensitive developments.
- Non-Governmental (Keystone Center, Alliance for Water Efficiency, Western Resources Advocates, American Planning Association, economic development councils). These institutions can further land-use and water integration innovation and research.
- Academia (Colorado State University, University of Colorado Boulder, University of Colorado Denver, One World One Water Center-Metropolitan State, Rocky Mountain Land Use Institute). These academic institutions can further land-use and water-integration innovation and research.~~)~~.
- 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. The CWCB will work with LULA, or another local group, on creating a Colorado-specific training model for sustainable long term land-water planning integration.
- Councils of Governments- These entities make the connection between local and state level. Council of Governments can be strong allies in trainings and research into the land-water nexus.

Funding:

~~3.~~5. The CWCB should use Water Efficiency Grant Program (WEGP) funds and Water Supply Reserve Account grant funds to fund aspects of the land-use and water planning nexus. The CWCB will work with the basin roundtables to proactively seek applicants to use WSRA funds ~~could be used~~ for larger regional efforts tied more directly into the basin roundtables~~Basin Roundtables~~, while the WEGP funds will~~can~~ be used for smaller more localized efforts.

6.3.4 Agricultural Conservation, Efficiency, and Reuse

Introduction

This section seeks~~Recognizing the fact that agriculture uses between 80~~ to assist Colorado's ~~90 percent of water in Colorado, water managers and policy makers have long discussed the various opportunities for~~ agricultural industry to be more efficient and resilient~~conservation, efficiency,~~ and to reduce non-beneficial water consumption without impacting statewide agricultural productivity and the environment. Opportunities to stretch~~reuse to provide new~~ water supplies to help meet future needs are explored. The~~. 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, pursuant to HB91-1154, reported to the General Assembly on water salvage issues in Colorado, with a special emphasis on the Grand Valley area.[255] 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 Agricultural Water 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 an incomplete~~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~~.

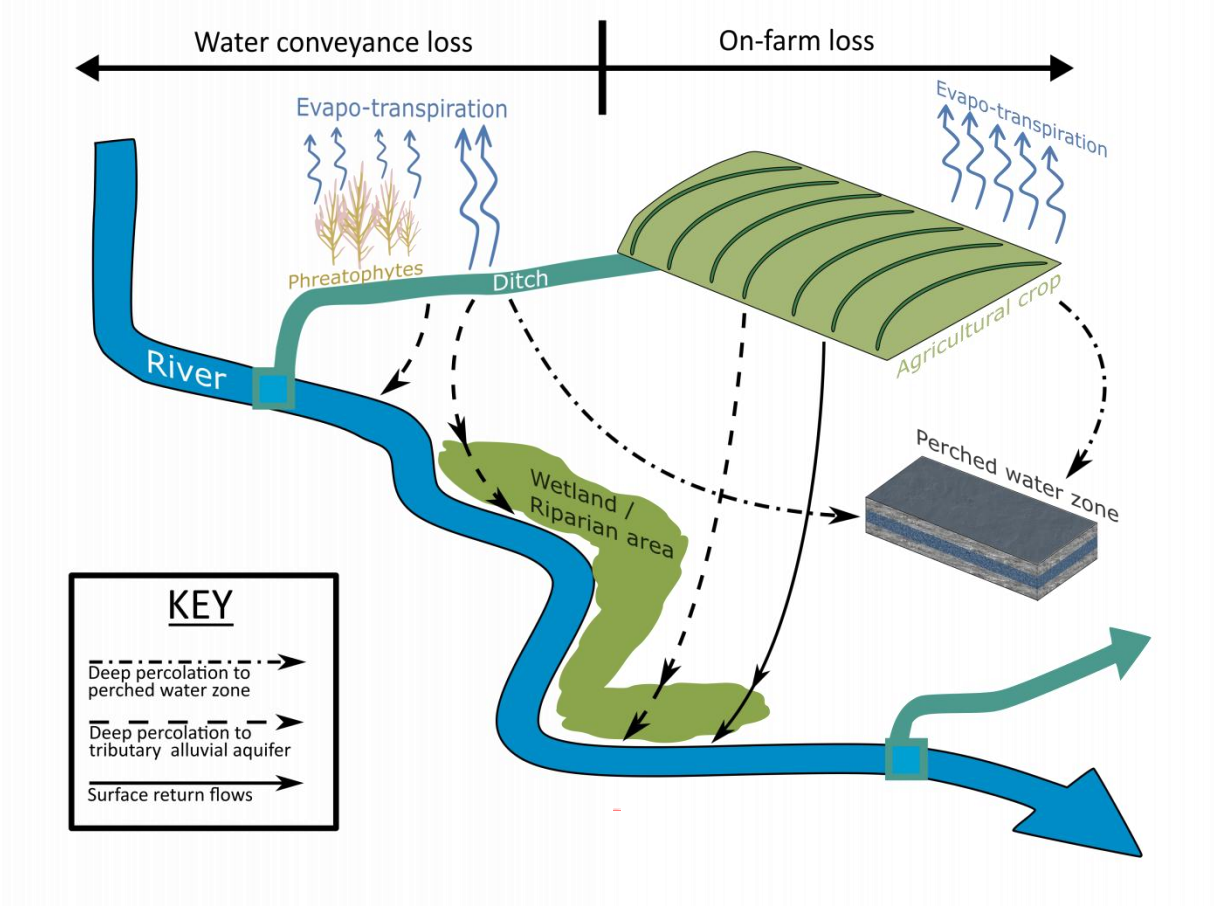
Background on Agricultural Water Use and Losses

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, crop irrigation is needed. The process of irrigation and the associated consumptive use (CU) and losses of water is illustrated in Figure 6.3.4-1. ~~.~~ In some cases, a deep rooted crop may withdraw water directly from shallow groundwater areas through a natural process known as subirrigation.

During the process of irrigation, water conveyance loss occurs when some of the water diverted via ditch or canal never reaches the crop. These losses can occur due to ditch or canal seepage where the water either returns to the stream via seepage into the local groundwater system through deep percolation, or via non-beneficial consumptive use by phreatophytes.[256] Ditch or canal seepage is considered nonconsumptive because the water returns as surface flows in the river system and is available for other users. Some conveyance loss is permanent, in which case it is frequently referred to as non-beneficial consumptive use. For example, this loss can include evaporation from exposed water or soil surfaces of ditches and canals and the unintentional growth of phreatophyte vegetation with no agricultural value. 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 use.[257] Nevertheless, some of these unintended uses provide environmental benefits by creating wetlands and enhancing riparian corridors.

Once the water reaches the field, it is either used by the plant as a CU or it becomes part of on-farm losses. Irrigation provides water to the crop's root zone to meet crop CU, which occurs through

Figure 6.3.4-1 Agricultural Water Use and Losses



transpiration from the growing plants and evaporation from adjacent soil surfaces. The combined effect of transpiration and evaporation is call evaportranspiration (ET). ~~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 evapotranspiration) 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. Water consumed~~Through ET water taken up~~ by ET~~the roots of a crop~~ is permanently removed from the local hydrologic system.[258] Because ~~Crop~~ ET is equivalent to the entirety of the water used by a plant,~~measure of~~ the beneficial use of an irrigation water right is therefore~~, however it cannot be readily~~ measured by the amount of crop ET. Crop ET is not easily measured~~directly~~. Rather, theoretical or potential ET (the maximum amount of water ~~ET is~~ a crop can consume) is calculated ~~amount~~ based on the factors that influence ET, such as~~:~~ crop type, growing season, and daily climatic conditions. Crop ET is measured at a specific location by adjusting for the amount of water applied to the crop.[259]

~~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 thea ~~given~~ soil ~~type~~ to retain the water resultingabsorb 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 percolation or surface runoff. Deep percolation into ~~percolate below the crop's root zone into the~~ underlying groundwater systems ~~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.[260] In locations where ~~When~~ the amount of deep percolation exceeds the ability of an aquifer to quickly transmit water back to the stream, groundwater storage occurs and produces lagged return flows. In some cases deep percolation collects in perched zones not connected to the regional groundwater system and is permanently lost to the river system as a type of non-beneficial CU. Surface runoff, on the other hand, occurs when. ~~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 majority of water diverted but not consumed creates return flows to the stream.[261] 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.[262]

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.[263] In over-appropriated basins an individual molecule of water will be diverted several times before it leaves the State or is finally consumed.[264]

Terminology Related to Irrigation Efficiency

There are several terms and phrases frequently raised in discussions related to irrigation efficiency~~agricultural water conservation~~. The following definitions, in conjunction with Table 6.3.4-2, are used ~~herein in an effort~~ to provide clarity to this complex topic.

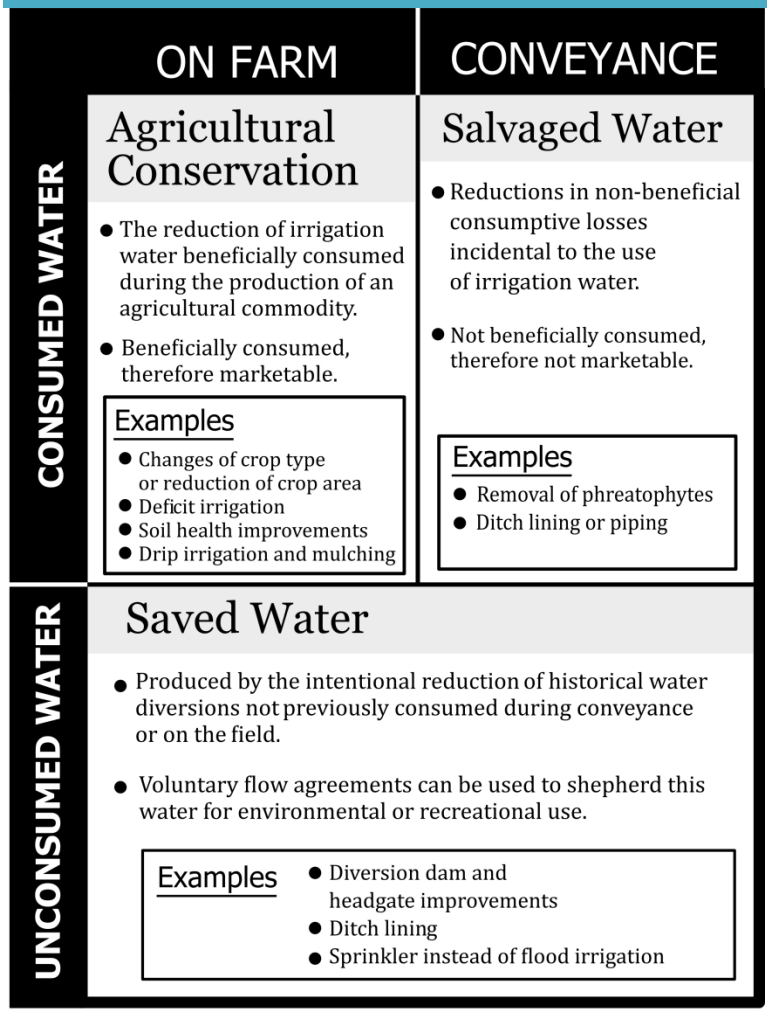
~~**Agricultural Water Conservation:** Agricultural water conservation is the water resulting from practices that reduce the amount of irrigation water beneficially or non-beneficially consumed during the production of an agricultural commodity. The amount of such water can be measured as a reduction 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 beneficially~~actually~~ consumed through ET~~evapo-transpiration~~ 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 consumed or diverted but not consumed. Because~~or increase the amount~~ of this, "~~crop ET. It is also important to note that the losses affecting~~ irrigation efficiency" is used as a general term to refer to agricultural conservation and efficiency practices on the farm and associated with conveyance. ~~may be either consumptive [non-beneficial consumptive use] or non-consumptive [resulting in return flows].~~

- **Water Conveyance (Delivery) Efficiency:** Delivery efficiency reflects seepage, ~~and~~ evaporation, and ET losses that occur in the canals, ditches, and laterals between the point of diversion and the turnout to the farm field.[265]
- **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.[266] 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~~)~~.[267] ~~.~~

- **Agricultural Water Conservation:** Agricultural water conservation is the water resulting from on-farm practices that reduce the amount of irrigation water beneficially consumed during the production of an agricultural commodity. The amount of such water can be measured as a reduction in historical consumptive use.[268] Examples of non-structural agricultural water conservation practices include changes in crop type, reduction of crop area, deficit irrigation, and soil-health improvements that reduce evaporative loss. Because agricultural water conservation is a reduction in historical consumptive use, it is the only irrigation-efficiency practice that can be marketed to other beneficial uses. However, there may be challenges associated with administering these water-rights transfers.

Figure 6.3.4-2 Irrigation Efficiency Outcomes



- **Salvaged Water:** Salvaged water is ~~defined to mean the~~ water lost~~resulting~~ from the ~~reductions in non-beneficial~~ consumptive use or permanent loss of water~~uses~~ that does not provide a beneficial use. These losses are~~occur~~ incidental to the use of irrigation water. For example, this can be ET from phreatophytes or deep percolation to a perched zone. In all cases the water is lost or consumed, although not beneficially. 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.[269] For example, removal of invasive phreatophytes and ditch lining or piping water could yield salvaged water.

- **Saved Water:** Saved water is produced by intentionally reducing the unconsumed portion of water diversions that otherwise provided a portion of historical return flows. Such saved water can come from either on-farm or conveyance efficiency practices that reduce losses that were ~~water diversions~~ not previously consumed.[270] Such water ~~either non-beneficially or by crops that~~ can be left in the stream, but it may not provide a benefit to environmental or recreational values without a voluntary flow agreement. Headgate ~~recovered through efficiency~~ improvements, ditch lining or piping ~~which eliminate or reduce losses due to seepage, deep percolation~~, and other efficiency improvements can produce saved water. ~~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:** Capturing~~Capture~~ and reusing~~reuse of~~ irrigation water for crop use on the same ground, when consistent with the underlying water right, is frequently done. Because~~Since~~ this water is also consumed it does not result in agricultural water conservation, although it may reduce the total amount of water diverted. Reuse~~,~~ when not consistent with the terms of a water right (~~,~~ such as reuse on acres not described in a decree) is considered an ~~results in~~ "expanded use,"~~"~~ which is prohibited.[271]

  ~~-~~On the other hand, reuse of treated M&I water for an agricultural purpose may have the potential to reduce irrigation diversions by allowing that~~providing the~~ M&I reuse water to be used as an additional~~alternate~~ source of agricultural supply. Reuse is more fully explored in Section~~subsection~~ 6.3.2.
- **Waste:** Waste is a ~~somewhat pejorative~~ term that is often used pejoratively to refer to water diverted but not beneficially consumed.[272] 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 made.[273]~~[274]~~ The state engineer~~State Engineer~~ has authority to curtail truly wasteful practices and ~~in fact~~ there is little waste occurring in agricultural water use.~~[275]~~ 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. Another example is when excess~~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. In areas with limited water storage availability and highly variable surface flows, some irrigators divert more water than can be used at that time by a crop in an effort to store the excess water in the soil profile. While it is a highly inefficient method of storage, for many irrigators it is the only option to mitigate future supply shortages. This practice is not considered wasteful or unreasonable under the circumstances.
- **"Use it or lose it":** The~~**"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 CU~~use~~, which in the case of an irrigation right is crop ET.[276] Thus there is no real incentive under law to divert more irrigation water than the crop will eventually~~can~~ consume. In addition, 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.[277] One ~~However, one~~ aspect of the "use it or lose it" perception does bear further consideration. ~~-~~ Under current law the determination of historical consumptive use is based on~~utilizes~~ the amount of water actually consumed by the crop, which is the lesser amount of the water actually applied to the crop or the maximum amount a given crop could potentially consume. ~~-~~ Thus, engaging in deficit irrigation for a period of time could reduce the transferable yield in a future change of water right case, which is a disincentive to adopting these new practices. ~~-~~ The legislature ~~has~~ provided partial relief to this problem in Western Colorado, via CRS 37-92-305(c), which allows for CU reductions without affecting historical CU calculations if the water user is under~~but consideration of~~ a conservation plan. ~~broader solution may be appropriate.~~

Benefits of Irrigation Efficiency

Irrigation efficiency can increase crop production, and enhance flows for environmental~~conservation/salvaged~~ and recreational needs, and increase opportunities for water marketing through water sharing practices. Water-sharing practices are discussed briefly in this section and in further detail in Section 6.4. ~~saved water~~

Increased crop production: A large segment~~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,[278] meaning that the available supply at some periods~~many points~~ during the growing season is less than the amount needed to fully satisfy~~meet~~ crop irrigation water requirements, (consumptive needs) at that time.~~point.~~ Thus, the primary incentive for a producer making efficiency improvements is to satisfy a crop's water consumption by eliminating conveyance and on-farm losses,~~has always been~~ to increase crop yields. The intention of this practice is to increase crop production through increased consumptive use, and it does not create new water supplies available for other users.

Enhanced flows for the environment & recreation: Refurbishing a headgate, diversion dam, or reducing diversions can increase flows below the water structure, potentially benefiting recreation and the environment. Even though this water cannot be transferred, local instream-flow benefits accrue from saved water left in the reach~~get more~~ of the stream between ~~diverted irrigation water to~~ the historic point of diversion and the downstream headgate. This is limited~~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 the location where return flows previously entered the stream. Environmental benefits of refurbished agricultural infrastructure present an opportunity for funding from state, federal, and foundation programs to contribute to the cost of ~~improve irrigation~~ efficiency changes. Environmental and recreational benefits can be enhanced and protected~~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 a voluntary flow management program or agreement negotiated with downstream water users.~~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.~~

Improved water quality: One~~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 the soil can retain for eventual crop consumption. This water migrates into the groundwater system, often dissolving natural salts~~[salt~~, uranium, and selenium~~]~~ and leaches 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.[279] Recognition of water-~~-~~quality benefits results~~has resulted~~ in substantial~~significant~~ amounts of federal funding for irrigation-~~-~~efficiency improvements, which over the past~~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). sharing: 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 that can be marketed to other users. ~~These methods rely on either reducing crop ET or soil moisture evaporation. Theysalvaging water through reduced non-beneficial use and~~ can be achieved by:

- Switching crop types to those with lower ET requirements.[280] 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.[281]
- Reducing soil evaporative losses through improved cultivation methods such as mulching, drip irrigation, and "soil health" practices.[282]
- Temporarily and entirely removing a crop from the ground through fallowing.[283]
- Permanently and entirely removing a crop from the ground through land retirement.[284]

Addressing Barriers to Irrigation Efficiency:

While these techniques have been used in Colorado to address ~~some fairly~~ specific situations, 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 Grande 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.[285]~~
- ~~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.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. These practices can reduce non-beneficial consumptive losses as well as making more available for crop consumptive use. One example that demonstrates the potential of these techniques is in the Rio Grande basin, where soil health techniques were used to both reduce water consumption and increase specialty potato crop quality. Rockey Farm replaced the rotation of a barley crop with a permanent cover crop, which uses less water, reduces soil moisture loss through evaporation, and adds organic matter to the soil. This in turn leads to increased soil moisture for the potato crop planted in the following year.[286]
- 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. The 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. Saved water cannot easily be used to reliably provide water to the environment or recreation. There is little direct advantage for irrigators and few legal mechanisms exist to shepherd this water downstream. Water generated from agricultural conservation practices, such as deficit irrigation, rotational fallowing, or a transition to cool season crops is the subject of ATMs and is further explored in Section 6.4 of Colorado's Water Plan.

Recent cases where

BIPs

~~For 2014, each basin roundtable is formulating their own implementation plan, and several include~~ agricultural producers in Colorado have improved efficiencies and overcome barriers provides context to the descriptions of the agricultural ~~water conservation and~~ efficiency concepts provided above:

- The Uncompahgre Valley Water Users Association converted portions of its open-ditch delivery system to pipelines through the Colorado River Basin Salinity Control Program,[287] thereby reducing seepage and delaying storage releases to better meet late season crop needs. This created the added benefit of reducing salt loading to ~~goals~~ and salinity of the Colorado River and improving downstream water quality. This is an example of a regional approach to addressing irrigation efficiency using state and federal funding to incentivize this work.~~activities.~~
- ~~Initial drafts of theArkansas 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.~~

~~IBCC actions~~

- Farmers in the Arkansas Basin converted thousands 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 U.S. Department of Agriculture'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, which expressly prohibits any improvements to irrigation systems that cause increased depletions at the state line. Because crops in Colorado typically do not receive the full amount of water that they can consume, most irrigation efficiency practices increase CU. Thus, producers who installed sprinklers and drip systems in the Arkansas basin are required to fully replace the increased depletions with augmentation water.
- The Grand Valley near Grand Junction is an area with adequate senior water rights where crops generally have a full supply throughout the growing season. Through federal programs, headgates and delivery systems were modernized thereby producing saved

water through reduced diversions, to provide enhanced flows in the Colorado River for endangered fish species while simultaneously reducing saline return flows.

- The Rio Grande and Republican River Basins use alternate crops and fallowing to maintain a sustainable agricultural community in the face of an imbalance between legally available groundwater supplies and current levels of water use.220
- The City of Aurora and the Rocky Ford Highline Canal have drought-driven temporary lease-fallow arrangements.
- The CWCB's Alternative Agricultural Water Transfer Methods Program supports pilot projects, such as the Colorado River Water Bank Working Group.288 This Water 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 Colorado River 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 (a crop planted to protect the soil) have improved the water holding capacity of the soil and reduced soil surface evaporation in many locations. These practices can reduce non-beneficial consumptive losses as well as making more available for crop CU. One example that demonstrates the potential of these techniques is in the Rio Grande Basin, where soil health techniques were used to both reduce water consumption and increase specialty potato crop quality and yield. Rocky Farm replaced the rotation of a barley crop with a permanent cover crop, which uses less water, reduces soil moisture loss through evaporation, and adds organic matter to the soil. This, in turn, leads to increased soil moisture for the potato crop planted the following year.[289] This work is showcased in the Rio Grande Basin's education and tour program to promote soil health and other irrigation efficiency practices.

Recent Legislative Actions Related to Irrigation Efficiency:
~~recommendations below.~~

~~Recent and past legislative actions~~

There are some existing legislative exceptions to the aforementioned limitations to agricultural conservation and efficiency, which are applicable in narrow instances, such as:

SB~~HB~~ 05-133 provides that a western slope water rights holder will~~stated that an owner would~~ not be deemed to have abandoned his or her~~their~~ water right if certain conditions are~~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 provide~~state~~ that an owner of a water right won't lose the right if non-use stems from water conservation activities.[290]

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.[291]

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 legislation seeks to mitigate for this disincentive.[292]

SB15-183 allows court discretion in determining the appropriate period of record to utilize in calculating historical consumptive use in change of water rights cases.[293]

HB 15-1006 establishes a two-year grant program for invasive phreatophyte control and provided $2 million each year for administration and distribution through the Colorado Water Conservation Board.[294]

Basin Implementation Plans and Irrigation Efficiency:

For 2015, each basin roundtable is formulating their own ~~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 statements related to the~~ implementation plan, and several include~~of~~ agricultural water-conservation and efficiency goals and activities.

The BIP goals for most of the roundtables indicate that they plan on increasing efficiencies and modernizing agricultural infrastructure. Several examples of these are below:

- Arkansas Basin Roundtable: Provide increased quantities of augmentation water to comply with Division 2 rules regulating increased farm efficiencies.[295]
- Colorado Basin Roundtable: Improve agricultural efficiency, preservation, and conservation.[296]
- Gunnison Basin Roundtable: Restore, maintain, and modernize critical water infrastructure, including hydropower.[297]
- North Platte Basin Roundtable: Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies.[298]
- Rio Grande Basin Roundtable: Operate, maintain, rehabilitate, and create necessary infrastructure to the Basin's long-term water needs, including storage.[299]
- South Platte/Metro Basin Roundtable: As measurable outcomes for the agriculture goal, this BIP intends to "support strategies that reduce traditional permanent dry-up of irrigated acreage through implementation of other solutions including conservation, reuse, successful implementation of local IPPs, successful implementation of ATMs, and development of new Colorado River supplies" and "support strategies to address agricultural water shortages through IPPs, new multi-purpose projects and innovative

measures to maximize use of available water supplies."[300]~~are presented as a starting point for further discussion.~~

- Southwest Basin Roundtable: Implement efficiency measures to maximize beneficial use and production.[301]
- Yampa/White/Green Basin Roundtable: Restore, maintain, and modernize water storage and distribution infrastructure.[302]

Interbasin Compact Committee No-and-Low-Regrets 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 actions below.

Actions

The following actions will support Colorado's agricultural industry to make it more efficient, resilient, and able to reduce water consumption without impacting agricultural productivity.

1. **Agricultural water incentive education program:** The CWCB will work in partnership with the basin roundtables, Colorado Energy Office, the Colorado Department of Agriculture, Natural Resources Conservation Service, and Colorado State University's extension program to develop a strategic education plan over the next two years. In addition to the topics discussed in the education and assistance program discussed in Section 6.5, the following topics will be covered:
    a. Agricultural water conservation: Outreach to the agricultural community about available agricultural water conservation techniques and ~~educate farmers on available~~ incentives; ~~for on-farm implementation of agricultural conservation measures.[303] 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).~~
    b. Soil health: Begin a soil health education and tour program to help growers examine ways to increase net revenues while decreasing water inputs, and in some cases water consumption;
2. **Continue to support the rehabilitation of diversions and ditches:** CWCB will continue to provide grants, loans, and technical support to refurbish diversions and ditches to generate saved water and reduce losses where there are benefits to recreation, the environment, and other consumptive water users.
3. **Voluntary flow agreements:** Over the next two years, the CWCB and the DWR will work with agricultural and environmental partners to develop model language for voluntary flow agreements paired with irrigation efficiency practices. CWCB will also provide funding, facilitation, and technical support to encourage these agreements.

2. **Removal of invasive phreatophytes:** The CWCB will ~~Many of the BIPs 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 mulching.[304]~~
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 benefits.[305]~~
4. ~~CWCB will continue to~~ support the management and removal of invasive phreatophytes through grants that use funding provided by HB 15-1006.
4. **Explore**~~its grant program and seek~~ **additional incentives:** Additional incentives will be explored ~~. 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 challenging.[306] Incentives for landowner control of phreatophytes, given savaged water legal limitations, could be still be developed.[307]~~
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 whole.[308] Additional incentives could be developed~~ to assist basins in implementing, where appropriate, irrigation~~agricultural~~ efficiency ~~and conservation~~ practices and changing crops type to a lower water use crop[309] These incentives should first be explored through ~~water~~ conservation demonstration and pilot projects.[310]
6. **New agricultural lands:** The CWCB will encourage newly developed agricultural lands (currently identified in the North Platte~~, and~~ Yampa, and Southwest Basins) ~~should be designed~~ to either be very efficient or provide direct and measurable benefits to the environment.~~use best management practices with regard to agricultural conservation and efficiency, or, alternately, be measurably and explicitly multi-purpose by meeting identified nonconsumptive needs.[311]~~
7. **Administrative tracking:** Over the next three years, the CWCB will work with the DWR to explore ~~The state will consider~~ the development of administrative means to track and administer agricultural ~~allocate~~ conserved water for the purposes~~and ensure compliance, although it is possible that the cost~~ of marketing these waters. ~~this administration if fully protective of all other users could exceed the value of the water at issue.[312]~~
8. ~~6Projects and Methods that support agricultural efficiency, modernization and conservation presented in BIP recommendations should be supported.~~

~~6~~.3.5 Self-Supplied Industrial Conservation & Reuse

Introduction

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 substantial~~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."[313]

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 slightly more than~~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).[314]

Thermoelectric Power

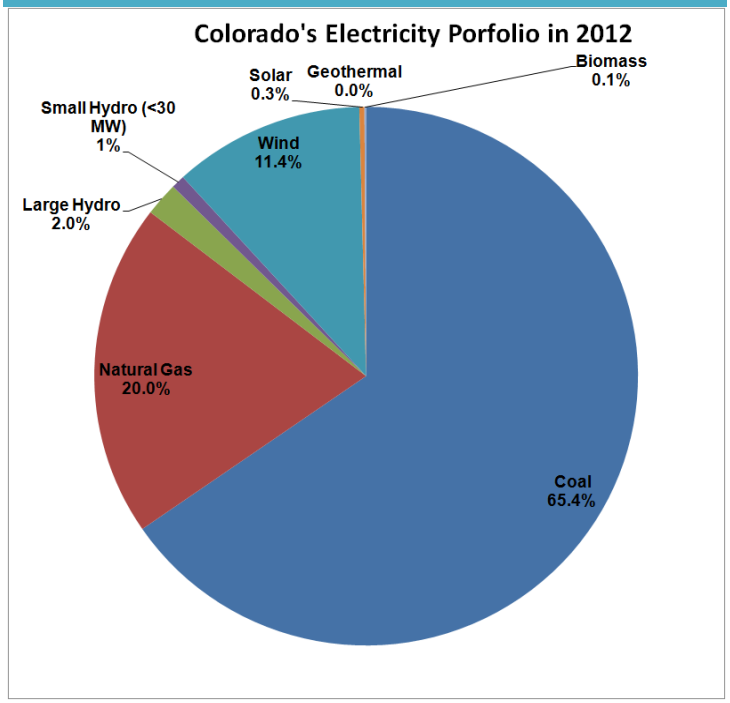
In 2012, thermoelectric facilities generated more than~~over~~ 85 percent of Colorado's electricity. Thermoelectric power generation heats water to produce steam that powers turbines to create electricity. While a variety of fuel types can be used to heat the water in thermoelectric power generation, 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.[315]

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 coolingtowers 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. [317] 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.

Figure 6.3.5-1: Colorado's 2012 Electricity Portfolio[316]



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 thatwhich increases the expense of this method. NeverthelessHowever, 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.

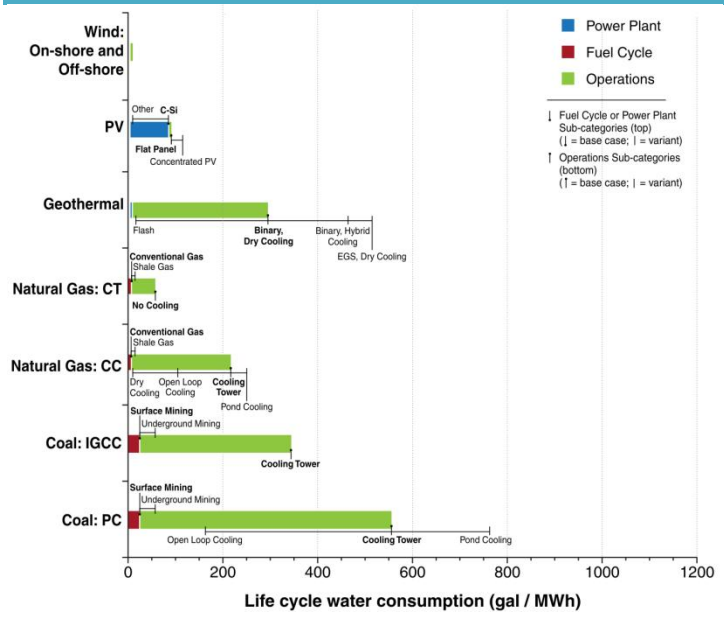
While coal and natural gas are the primary fuel sources for electricity generation in Colorado accounting for 65 percent and 20 percent in 2012, respectively (Figure 6.3.5-1), each requires different amounts of water for their process (Figure 6.3.5-2). Coal plants consume on average roughly 40 percent more water per MWh produced when compared to combined cycle natural gas plants when controlling for all cooling system types. [318] NeverthelessHowever, 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 substantiallysignificantly 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."[319] 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. Because of ~~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, more than~~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.

Figure 6.3.5-2: Life Cycle Water Consumption for Various Methods of Energy Production[320]



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.[321] Tri-State G&T provides water consumption data to the PUC as part of their public resource planning process.

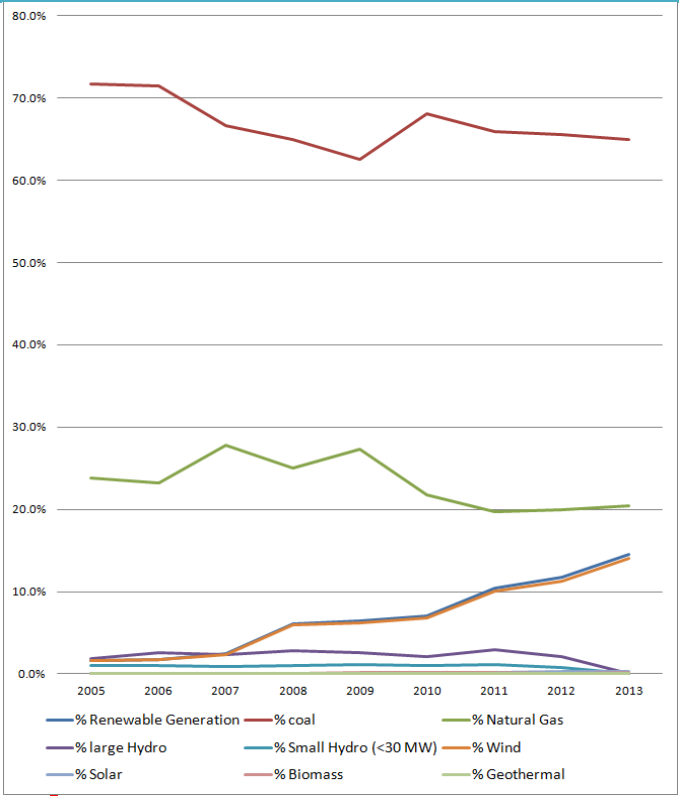
Hydroelectric Power Generation

Currently, hydropower provides around 4 percent of Colorado's electricity, generated from more than~~over~~ 60 hydropower facilities throughout Colorado. With a combined installed capacity of 1162 megwatts (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 affects~~affect~~ 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.

Figure 6.3.5-3: Colorado's Electricity Portfolio (Net Generation)



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 (CDA) 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.[322]

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.[323]

Various organizations, including federal agencies, have explored the hydropower potential of existing agricultural dams. There are more than~~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 (six~~6~~ projects).~~–~~ This leaves about 15 MW of untapped, economically feasible potential throughout the state.[324]

Opportunities for additional large hydro projects in Colorado are limited as most of the ideal sites have already been developed. Nevertheless ~~However~~, small hydro and agricultural hydro systems have better outlooks for future growth.~~–~~ According to the Bureau of Reclamation, Colorado currently has more than~~over~~ 30 potential hydropower sites at Reclamation facilities with the potential to produce more than~~over~~ 105,000 MWh annually.[325] A U.S. Department of Energy report estimates an additional 11 potential sites with the potential to produce more than~~over~~ 632,000 MWh annually.[326] Between these two studies, Colorado's estimated untapped hydropower energy potential is more than~~over~~ 737,975 MWh annually.~~-~~ If Colorado were to use this full potential, it could power more than~~over~~ 65,000 homes a year using new hydropower.

Oil and Gas Production

There are more than~~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 and 1,000,000 gallons of water, depending on the depth of the well. Horizontal wells typically use between 2,000,000 to~~-~~ 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 1609~~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.[327]

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 well site~~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 to ~~-~~320 acre-feet per year, with an average of 165 acre-feet (1,000,000 gallons = 3 acre-feet).[328] 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 water-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 6.3.5-4)."[329]

Concerning domestic water, the water-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.

Figure 6.3.5-4. Energy Is Used To Pump, Treat, Distribute, and Use Potable Water, and To Treat Wastewater[330]



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 SSI 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. They ~~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 CDA 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.[331] 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~~Water/Energy Nexus~~ programs that conserve both water and energy. Some concepts to further explore include:
    a. Joint water and energy home or commercial audits
    b. Joint rebate programs, which combine water and energy utility rebates to most effectively incentivize customers to purchase a specific energy/water efficient appliance
    c. 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~~energy office~~ will continue to support energy saving associated with on-farm agricultural practices that also reduce water use.
5. The 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. The 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,
    a. Through continued support of research into innovative ways to reuse produced water.
    b. 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 Greening Government Leadership Council recently generated a new draft goal for water demand reduction at state facilities. This goal will be achieved by 2020 with a baseline of 2015 and will be normalized for weather and other external factors.

> **Water goal:** *Collectively, all executive* ~~Executive Orders mandated~~ *State agencies and departments shall* ~~to~~ *reduce potable water consumption by a minimum of 1 percent annually (normalized for weather) and at least 7*~~10~~ *percent by FY 2020 relative to an* ~~2012 over the baseline usage of~~ *FY 2015 baseline.*

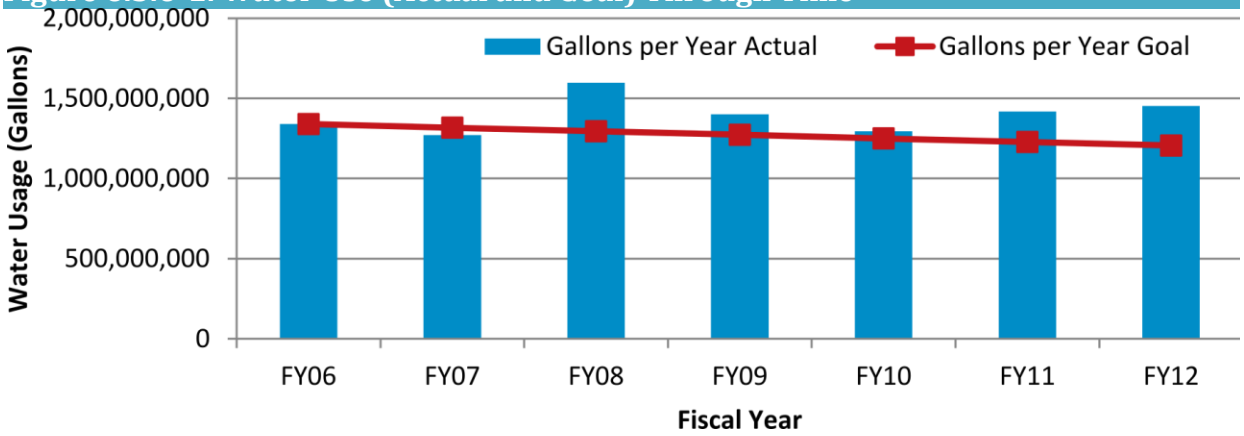
~~2006.[332]~~ State agencies reduce~~have reduced~~ their water consumption by various methods such as installation of efficient plumbing fixtures, advanced lawn irrigation controls, and taking advantage of re-use water.

The following is taken from the 2012 Greening Government Annual Report Card.[333] The state saw~~State has seen~~ an increase of 8.4 percent (112.5 million gallons of water) in water use. Each agency~~-~~ 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.[334]

Exemplary State Agency Projects

1. 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 more

Figure 6.3.6-1: Water Use (Actual and Goal) Through Time



thanover 2.5 million gallons per year. They also replaced high flushing urinals with 0.5 gallons per flush urinals and installed waterless urinals.

2. 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 water-energy nexus.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.

Actions

CWCB will provide grants and technical support to state agencies for the installation of high efficiency toilets and urinals, replacement of turf grass with plants that use less water, and improvement of cooling towers.

6.4: Alternative Agriculture Transfers

Colorado's Water Plan will respect property rights and the contributions of the agricultural industry by maximizing options for alternatives to permanent agriculturalfarmland 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. There are approximately 66.3 million acres of land in Colorado, of which 10.6 million acres are cropland.[335] 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.[336] 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.

Respect the contributions of the agricultural industry by maximizing options to permanent buy-and-dry. Achievement of a sharing goal of Potential ATM water needed:
50,000 acre-feet could
Could serve up to :
350,000 people annually.
Statewide

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.[337]

Agricultural interests are concerned about the possibility of drying up more agricultural lands in the future.[338] If Colorado continues down its current path, the South Platte River Basin could lose up to one-third of today's irrigated land by 2050.[339] The Arkansas River Basinbasin could lose another 17 percent of its total.[340] The main stem watershed area of the Colorado River Basin could also lose another 29 percent of its irrigated lands.[341] Reduction of irrigated lands can be measured as actual acres lost, but can also be measured in economic terms based on a reduction of crops being irrigated before the water transfer.[342]

The SWSI estimates that by 2050, Colorado may lose 500,000 to 700,000 acres of currently irrigated farmland to meet municipal growth demands. The IBCC and basin roundtables conclude that the current status quo path of 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, referred to as ATMs, do not limit the choice of private water right owners to permanently sell their water rights. ATMs offer voluntary, not mandatory, tools for both farmers and ~~urban~~ water users ~~providers~~ to ~~voluntarily~~ depart from the status quo. In addition, ATMs can be used to support the environment, recreation, industry, and groundwater sustainability and through the creation of~~used as~~ water banks to reduce demands on a water system. ATMs are flexible enough to focus on reducing net profit loss or, on the other hand, can help to protect higher value crops for economic benefits.

The Low to No regret scenario~~Scenario~~ planning, discussed in Section 6.1, indicates that the minimum goal of water needed from ATMs to meet the planning outlook is approximately 50,000 acre-feet, or enough water to serve as many as 350,000 people. This ~~, is the minimum~~ amount would reduce permanent transfer of agricultural water rights but would still result in agricultural dry up~~of water needed from ATMs~~. Currently, ATMs are more expensive and legally burdensome than traditional buy-and-dry approaches that permanently transfer water rights, making it difficult to obtain the estimated ~~this~~ amount of water from existing alternatives. There are many~~a number of~~ creative and cutting edge alternatives (as shown in Table 6.4-1) that~~. These alternatives~~ can help decrease permanent reductions in irrigated acreage.

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. Rather than a one-size-fits-all approach, we understand that a variety of alternatives will be needed to meet specific needs. 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 at this time can be difficult, or sometimes impractical, because of institutional, legal, financial, and court-related barriers, and the type of operation. For example, rotational

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 most the farming operation in production. It also works very well for drought supply, drought recovery, and conjunctive use. Revegetation protection, erosion control, and weed control of the fallowed plots are important considerations 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.[343] 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.[344] 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.[345] 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.

fallowing would not work on an established orchard since the trees would not survive without water for a growing season. 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.[346] 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.[347] Transaction costs tend to be relatively high, which can discourage potential water transfers. In addition, we need to assess fair and effective pricing for famers and water suppliers, and the ability for farmers to invest ATM revenues back into their operations. To avoid the problem of where and how to store ATM water, we need to better understand and define the infrastructure that may be needed. Infrastructure improvements, expanded reservoir operations, or reservoir re-

operations may bring needed utility and flexibility for storing ATM water. We believe that it would also be helpful to provide a means to support prioritization of research and investments into technology systems such as automated delivery techniques. ~~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. The strength of Colorado's agriculture is its diversity. A full mandate of ATMs across all sectors is not the answer, whereas creative options and solutions can be applied to feasible situations. Successes could be gained and barriers overcome based on creativity at the grass-roots level, which then could generate momentum at ditch and basin levels.~~Any suggestions for future legislation related to ATMs will be discussed in Chapter 10 of Colorado's Water Plan.~~

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.

Examples of ATMs

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.[348] 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 CWCB,~~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~~guage 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. Nevertheless~~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.[349] 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.[350]
- *The Lower Arkansas Valley Water Conservancy District and Super Ditch, LLC* submitted a pilot project proposal and then a full application to the CWCB in 2014, which was ultimately approved by the Board. The pilot began during the 2015 irrigation season and involves temporary transfers of water from certain agricultural lands on the Catlin Canal system to the communities of Fowler, Fountain, and Security. This project will assist in helping us to learn from an actual ATM being implemented in the basin.

ATMs 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 about $8000 ~~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.[351] The ATM grant program assists in developing and implementing creative alternatives to the traditional purchase and permanent transfer of agricultural water.

ATM related existing legislation

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. The key to the success of ATMs is to develop methods that meet the needs and respect the property rights of the agricultural water rights owners. ATMs can also provide long term security and financial practicality to urban water providers. 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.[352] 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.[353] 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.[354] 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.[355]

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 the CWCB's ~~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 sponors 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 (see also the Examples of ATMS section above). ~~.~~

More recently, SB 15-198 was signed into law by the governor, which expands upon the authorities in HB 13-1248. The pilot program may now include temporary transfers from agriculture to agriculture, agriculture to the environment, agriculture to industry, and agriculture to recreation.

BIPs

Final BIPs were submitted to the CWCB in April 2015 ~~July 2014~~ and provided valuable information regarding each basin's plans for agricultural needs, which are summarized below.

The Arkansas BIP 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.[356] 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.[357] Third, "Develop a viable rotationalworkable 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.[358]

The Arkansas Basin is working onbasin has completed some ATM projects and others are under developmentstill in progress. Future ATM projects will be identified using stakeholder input and current pilot project data.[359]

The Colorado BIP 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.[360]

The Gunnison BIP did not specifically identify ATMs as a method to meet its future needs. NeverthelessHowever, the Gunnison BIP does state that the roundtable is committed to the voluntary preservation of agriculture. The measurable outcome for this goal is to preservemaintain the current baseline of approximately 183existing 50,000 acres of protected agricultural land, and to expand participation in conservation easementsthis acreage by 5 percent by 2030.[361]

The North Platte BIP, 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.[362]

The Rio Grande BIP explores innovative soil health and CU reduction techniqueslisted ATMs as parta way to meet 8 of the goal to achieve groundwater sustainability. While specific water rights transfers may not be needed as part of these practices, 14 goals for the techniques are similar. As stated in the BIP:

> The amount of water available to irrigators is projected to decrease, as discussed extensively in this Plan. As such, some producers may want to explore opportunities to reduce pumping through alternative cropping rather than drying up productive farm ground. Incorporating alternative crops and farming methodsbasin and states that reduce consumptive water use are opportunities to maintain an economically stable future for agricultural producers but have challenges, as equipment needs and market conditions make switching to new crops complex.
>
> Valley producers may consider growing fewer acres of higher-value crops, such as organics. Demand for locally grown, organic food continues to rise. Assistance for growers wanted to diversify their operations, switch to organic farming altogether, or enter into grower cooperatives would be a great benefit to expanding this option. Local farmers' markets have

become a major source of local foods and are now a regular summer-into-fall feature in towns throughout the Valley.

Growers can also reduce water use by incorporating green manure into their crop rotation. Green manure is a mix of crops, such as mustards, radishes, and sorghum-sudan grass, which is specifically grown to be turned into the soil. Green manures improve soil health, as discussed in Section 5.2.6: Improving Soil Health, and require less water to go than other rotational crops. While the grower would not be selling a product in these years, the improvement to their operations has been shown to pay back the investment in green manure….

There are water savings through such methods as drip irrigation that~~more detailed accounts of ATM projects~~ will be realized through reduced evaporation losses. In addition to more efficient water use, the subsurface irrigation system may produce a higher quality of crop with less herbicides and pesticides required. , the widespread viability of subsurface irrigation has not yet been demonstrated in the Valley.~~included in future iterations of the BIP.~~[363]

Improved water management techniques, such as irrigation scheduling, can also boost efficiency without reducing crop yields. Finally, such practices as deficit irrigation — giving crops just enough water to produce a minimal profit — may be a noteworthy technique for water rights holders on the cusp of receiving deliveries.[364]

The South Platte/Metro BIP identifies successful implementation of ATMs as one of the measurable outcomes for their plan's agricultural goal.[365] The joint plan also lists minimizing traditional agricultural buy-and-dry and maximizing the use of ATMs to the extent practical as one of the eleven~~ten~~ key elements to their plan.~~, as the use~~ ATMs play~~plays~~ a key role in the South Platte/Metro's B and C portfolios for meeting approximately 35~~30~~,000 acre-feet of their future water demands.[366] ~~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.~~[367] Through the CWCB's Alternative Agricultural Water Transfer Methods Grant Program, the South Platte/Metro Basin has completed and is currently working on several ATM grants, and lists one of these projects as a new "IPP." The plan lists several recommendations to overcome ATM barriers associated with water court and transaction costs:~~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.~~[368]

- Development of special review procedures to facilitate ATM agreements
- Adoption of presumptive CU procedures
- Determination of historical CU for a canal or ditch system
- Develop specific methodologies for measuring, calculating, and monitoring CU water transferred through ATM projects (the Arkansas Basin is developing an "Administrative Tool" to calculate a farm's historic CU and return flow obligations)
- State funding of infrastructure cost
- Pursue transfer of a portion of a water right[369]

The Southwest BIP listed the implementation of ATMs as a means to preserve agriculture, while addressing other water use needs, as one of their measurable outcomes.[370]

The Yampa/White BIP 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."[371] The plan ~~currently~~ has not identified any specific ATMs to meet this goal.[372]

IBCC No-~~no~~-and-Low-Regrets Action Plan ~~low 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.[373]

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: No-and-Low-Regrets ATM Actions

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 (encourage maintaining or increasing highly productive lands) 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

Actions

The CWCB should consider the following list of options or action steps needed to help ensure that alternatives to permanent farmland dry-up are more attainable:

- Monitor current and future legislation necessary for the implementation of ATMs, including enhanced sharing opportunities and system flexibility.
- 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.
- Support appropriate fallowing-leasing pilot projects, such as the Catlin Canal pilot project, by responding to and processing applications in a timely manner under HB 13-1248 (C.R.S 37-60-115). These projects could be further supported through the ATM grant program. To proactively cultivate these projects, the CWCB will organize and conduct regional

workshops with partners or co-sponsors to share lessons learned on actual ATM projects, and to garner additional interest by discussing program benefits. ~~2013).~~

- The CWCB will encourage adaptive strategies that capture a "learning by doing" concept for pilot programs and other on-the-ground ATM applications.
- 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.
- Assess quantitative information related to agricultural dry-up in SWSI 2016 ~~the next version of the Statewide Water Supply Initiative~~, including lessons learned and monitoring the effects of ATMs in reducing permanent agricultural dry-up.
- Explore financial incentives through a stakeholder process as part of the funding Section~~section~~ in 9.2. These incentives or grants could include the new and ongoing revenue stream or tax incentives at the local or state level.
- The CWCB will work with the South Platte, Metro, and Arkansas Basin Roundtables to develop a WSRA or ATM grant to explore~~Explore~~ the formation of one or more pilot mutual management entities with municipal and agricultural stakeholders. The mission ~~in the South Platte Basin. This concept could allow farmers to retain ownership~~ of the mutual management entity is to facilitate water sharing arrangements. Part of the study will determine initial start up costs necessary to reach the goal, for instance by analyzing funding levels needed to reduce the barrier of high transaction costs associated with water right transfers, making a water right more flexible, and~~their~~ water rights accounting uncertainties under the current water courts, legal, and administrative system~~while ensuring supply for municipalities through contracts~~.
- The 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 Colorado water community and decision makers could ~~-~~consider the following options in support of ATM goals:
    - Continue to monitor basin level work to explore options to develop~~Provide legislative~~ flexibility for certain agricultural water rights to be used for multiple purposes.
    - Implement tools provided in SB 15-198 (C.R.S. 37-60-115) that ~~Use and~~ broaden pilot project end uses set forth in HB 13-1248 (C.R.S. 37-60-115). Such ~~to include additional objectives, such as~~ pilot projects could~~to~~ demonstrate agricultural transfers that meet environmental, recreational, industrial, or compact needs in addition to urban needs. The CWCB will encourage pilot projects to test the latest concepts or meet multiple benefits. ~~-~~
    - Reduce barriers, such as high transaction costs associated with water right transfers and water rights accounting uncertainties through continued exploration of pilot projects and other voluntary transactions to demonstrate streamlined approached or by providing financial support.
    - After a thorough outreach and stakeholder process, consider legislation to protect~~Protect~~ existing municipal owners of transferred water rights~~, through potential legislative action~~, if they choose to go through the court process to stipulate that their permanent agricultural transfers can be operated as ATMs. ~~-~~ This

concept could help ensure that a water rights owner could fall back to their previously adopted stipulations if the water court process for an ATM option yields an unfavorable outcome~~outcomes~~.

- Strengthen the recognition for new types of legal beneficial uses such as leased or flex use water.
- Identify and develop a request for a multi-basin WSRA grant through the basin roundtables. The goals of a potential grant would be to compile ATM data, identify areas that will encourage irrigators to enter agreements, analyze barriers, and increase awareness of the program.
- Research benefits and challenges of "buy and supply", which could preserve local irrigated agriculture and associated benefits. The concept is for M&I water users to purchase irrigated lands with associated water rights, establish a conservation easement for future farming, and then supply a full amount of water for a certain number of years out of a 10-year period. The water supply in the remaining non-farming years could then be delivered to the M&I user.
- Explore the possibility of third parties assisting with funding of ATMs to assure that farmers are appropriately compensated and that water suppliers are paying a reasonable incremental cost for firm yield. In this case, the third party would essentially assist in the effort to uphold the value of continued viable agriculture.
- Support research into the benefits and challenges of temporary rotational "idling" of crops, deficit irrigation, and split season irrigation.
- Incorporate improved water use data into decision making processes in a way that reduces uncertainty for water managers, and develop basin specific models for use in water court cases the help reduce transaction costs.

6.5 Municipal, Industrial, & Agricultural Infrastructure Projects & 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.
- Develop and implement policies and strategies that support meaningful agricultural viability statewide.

Many~~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. This section also includes a discussion of the IBCC's adopted "No and Low Regrets Action Plan" as it relates to the implementation of projects and methods and a summary of ongoing initiatives relating to the

viability of agriculture statewide. Agricultural viability was named as a priority in Colorado's water values, and Colorado's Water Plan includes specific policies and strategies to advance this concept.

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 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 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 more than~~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, M&I 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'~~BIPs~~ projects and methods aim to close the M&I gaps, reduce agricultural shortages, or both, and may 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 $85~~12~~ million to $486~~589~~ million per BIP, with a statewide preliminary total of approximately $902~~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 by BIP ranges from 603018 acre-feet per year of new supply to 321,31690,000 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.

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 nonot 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, also referred to as artificial recharge,Recharge is the process of infiltrating water to an aquifer through ponds, basins, canals, or wells.[374] Artificial recharge to the alluvial aquifer is most commonly used in Colorado for purpose of stream flow augmentation of stream depletions because of well pumping. Mostin Colorado. A majority of these alluvial recharge projects for augmentation occur in the South Platte Basinbasin, outside of the designated groundwater basins.Designated Basins.[375] 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.[376]

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.[377] 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 the use of alluvial aquifers: Aurora's Prairie Waters project in the South Platte basin; and Cherokee Metropolitan District's aquifer replacement plan in the Upper Black Squirrel basin~~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 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.

ATMs

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. ATMs are discussed in more detail in Section 6.4.

BIP Identified Municipal, Industrial, and Agricultural Infrastructure Projects and Methods

The types of projects and methods that~~, 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.

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 projects~~projects~~[378]

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
- ASR
- 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 also describes~~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 basin~~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 more defined. ~~clearer. Basins with less extensive project lists may further refine the available information or augment their lists before finalizing the draft.~~

~~Arkansas Basin~~

Arkansas Basin

Arkansas Basin at a Glance

120 projects identified on the IPP List which meet municipal, industrial, or agricultural needs

$84,700,000 in costs identified for **2** projects

166,500 acre-feet of development identified for **17** projects

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 ASR 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.[379]

Process: The roundtable reviewed the SWSI 2010 IPP list, and held 17 public outreach meetings where more than~~over~~ 100 Input Forms were submitted.[380] 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. As part of the roundtable's organization of basin needs, projects, and methods, they created a comprehensive database. The roundtable categorized projects that met a basin need as follows within the database: ~~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.~~

- All Input List: all identified needs from all sources.
- Preliminary Needs List: filtered to remove complete or obsolete needs.
- Master Needs List: The provider of each need on the Preliminary Needs List was asked to identify a Solution and a Plan of Action to implement a solution for the identified need. All needs with a defined Solution and Plan of Action carried forward onto the Master Needs List. Projects on the Master Needs List were located by latitude and longitude for later mapping.
- IPP List: Needs on the Master Needs List were compared to the criteria for an IPP per the SWSI 2016 draft glossary. Needs on the Master Needs List that met the SWSI 2016 IPP criteria are included in the IPP List.

While projects and methods included in the All Input List may include obsolete or completed projects, the IPP list is designed to meet SWSI criteria for an IPP.

Projects and methods summary: The roundtable identified a total of 120~~10~~ projects and methods on the IPP List that meet municipal, industrial, or agricultural needs.[381] 17[382] ~~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 identify acre-feet, totaling 166,500 acre-feet of development.~~were classified as potentially multi-purpose.~~

~~Three of the storage improvements & expansion projects provide for M&I 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~~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 regarding~~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

Colorado Basin at a Glance

28 projects identified as Top Projects which meet municipal, industrial, or agricultural needs

$135,000,000 in costs identified for **13** projects

21,472 acre-feet of development identified for **3** projects

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."[383] 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 many meetings, such as county commissions and city councils, to gather information. Roundtable members took a closer look at the list of projects and methods, and then identified representative projects in each subregion of the basin that met basin themes and subregion goals. These projects were designated "Top Projects" and represent important needs both at the basin-wide and subregion level.

~~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 five basin-wide Top Projects and methods.[384] Twenty-six Top Projects were ~~92 projects and methods meeting municipal, industrial, or agricultural needs, with associated acre-feet or costs.[385] The most commonly~~ identified by subregion. All 26 subregion~~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. Beyond the identified Top Projects, additional projects and methods submitted through the public input and targeted technical outreach are listed in the BIP Exhibits. ~~, while many others could have multiple benefits.~~

Basin Top Projects were evaluated by Basin Goals:

- 21 Top Projects were identified that meet the basin goal of "Sustain Agriculture."
- 23 Top Projects were identified that meet the basin goal of "Secure Safe Drinking Water."[386]

Future efforts of the basin will focus on implementation~~prioritization~~ of identified projects and methods, with ~~potential~~ modeling efforts underway~~,~~ to further understand potential constraints and opportunities within the river system.

Gunnison Basin

Gunnison Basin at a Glance

45 projects identified on the Tier 1 list which meet municipal, industrial, or agricultural needs

$478,107,269 in costs identified for **33** projects

139,406 acre-feet of development identified for **21** projects

Primary message: The primary goal of the Gunnison Basin is to "Protect existing uses in the Gunnison Basin."[387] 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. M&I 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 effects on~~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, irrigation decrees, agricultural effects~~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 2025~~2020~~; project does excellent job of meeting Basin Goals.
- **Tier 2:** implementation likely not feasible by 2025~~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 2025~~2020~~; project in preliminary stages of planning and/or may meet Basin Goals to lesser degree.[388]

Modeling analyses also informed the tiering process, identifying projects and methods with multi-purpose uses, as well as the selection of agricultural projects that~~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.[389] Future studies may also affect the prioritization, as supplies, demands, or processes are updated and refined.

Projects that~~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 meets~~may meet~~

basin goals. Projects thatwhich 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 45 Tier 185 projects and methods meeting municipal, industrial, or agricultural needs.[390] Tier 1.[391] The most commonly identified projects and methods were rated by their ability to meet Basin Goalsas follows:

- All 49 Tier 1 projects meet the overarching basin goal of "Protect existing water uses in the Gunnison Basin."
- 40 projects and methods seek to specifically "Improve agricultural water supplies to reduce shortages."
- 9 projects meet the basin goal of "Identify and address municipal and industrial water shortages."[392]

- 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, asto be expected in this largely agricultural area. Six projects were also identified proposing new storage.

North Platte Basin

Primary message: The Basin Goals established by the North Platte Basin Roundtableroundtable 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.[393] 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.

North Platte Basin at a Glance

52 total projects identified which meet municipal, industrial, or agricultural needs.

14 projects analyzed in summary sheets

12,197 acres of new irrigation for **9** projects

11,993 acre-feet of development identified for **5** projects

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 and, 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 conductedperformed to identify projects and methods thatwhich 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.[394]

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."[395] [396] ~~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 52~~27~~ projects and methods meeting municipal, industrial, or agricultural needs.[397] The 14~~most commonly identified~~ projects that received additional analysis~~and methods~~ were compared with the basin goals~~as follows~~:

- 13 projects met the basin goal to "Maintain and maximize the consumptive use of water permitted in the Equitable Apportionment Decree and the baseline depletion allowance of the Three State Agreement."
- 7 projects specifically addressed the basin goal to "Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies."
- 3 projects met the basin goal to "Increase economic development and diversification through strategic water use and development."[398]
- ~~10 identified Ditch & Diversion Improvements~~
- ~~5 New Storage projects~~
- ~~5 Monitoring, Assessment, or Planning Efforts~~

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 ~~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."[399] Additionally, the preservation of the

Rio Grande Basin at a Glance

61 projects identified which meet municipal, industrial, or agricultural needs

$129,754,895 in costs identified for **29** projects

6,030 acre-feet of development identified for **2** projects

agricultural economy, which represents 99 percent% of the basin's water use, is identified as an overarching goal. Through public outreach and the work of roundtable subcommittees, projects were identified thatwhich met Basin Goals. Projects and methods thatwhich 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 thatwhich meet Basin Goals.

Process: Through the subcommittee and stakeholder outreach process, 2918 projects were initially identified thatwhich the roundtable chose for a more in-depth analysis through project fact sheets.[400] 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 thatwhich displayed each project, the needs met by the project, and which basin goalsBasin Goals would be met through project implementation. 2516 of these projects were site-specific, and cost estimates were provided through the year 2020.[401]

2129 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 6147 projects and methods meeting municipal, industrial, or agricultural needs.[402] Projects [403] The most commonly identified projects and methods were evaluated by their ability to meet Basin Goals. Within the 29 projects evaluated by Fact Sheetsas follows:

- 14 projects meet the goal of "Operate, maintain, rehabilitate, and create necessary infrastructure to meet the Basin's long-term water needs, including storage."
- 14 projects and methods seek to "Manage water use to sustain optimal agricultural economy throughout the Basin's communities."
- 24 projects and methods are identified as multi-purpose, meeting the basin goal to "Support the development of projects and methods that have multiple benefits for agricultural, municipal and industrial, and environmental and recreational water needs."
- 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.

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."[404] 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."[405]

South Platte / Metro Basins at a Glance:

63 projects identified which meet municipal, industrial, or agricultural needs

191,980 acre-feet of development identified for **23** projects

This BIP specifically referenced the "Four Legs of the Stool", a result of the IBCC's~~IBCC~~ work that~~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.[406] The BIP examines both larger scale concepts, such as TMDs, 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, ASR, and TMDs.

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 that~~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. Additionally, the roundtables considered three conceptual projects, intended to demonstrate a collaborative approach to meeting basin needs moving forward.

Projects and methods summary: The basin roundtables identified a total of 63~~42~~ projects and methods meeting municipal, industrial, or agricultural needs.[407]

13 projects [408] ~~The most commonly~~ identified ~~projects and methods were~~ as ~~follows:~~

- ~~10 projects identified as Storage Improvements & Expansion~~
- ~~12~~ Reuse IPPs~~projects identified~~
- ~~8additional categories of projects such as~~ Agricultural Transfer IPPs~~Transfers, ASR, and TMDs~~
- 17 In-Basin IPPs
- 5 Transbasin IPPs

~~Future efforts of the basin will focus on identification of additional projects and refining of cost estimates.~~

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 3130 measurable outcomes were adopted by the roundtable in their BIP, with water supply needs as the focus.[409] 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, more than 8075 new projects were added to the list, totaling 164130 IPPs. Of these identified projects and methods, "agricultural IPPs make up about 19 percent50% of the total IPPs on the list to date. MunicipalIPPs are for needs such as agricultural, municipal, and industrial IPPs make up about 29 percent of the total IPPs on the list to date.""[410] 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 Glanceglance:

11797 projects identified which meet municipal, industrial, or agricultural needs

$60,000,000 in coststotal identified costs for **1** site-specific project

30,354245,687 total **acre-feet** of development identified for **8** projects

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 M&I Water Needs."[411] 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 thatwhich 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 11797 projects and methods meeting municipal, industrial, or agricultural needs.[412] The BIP highlights some specific IPPs that meet Basin Goals and Measurable Outcomes, and demonstrate the types ofmost commonly identified projects and methods planned within the basinwere as follows:

- 8 multi-purpose, cooperative, and regional19 projects and processes suchwere identified as renewable energy partnerships, water conservation and management plans, and optimization studies
- 5 potential IPPs related to hydropower
- 7 agricultural infrastructureditch and diversion improvements
- 13 projects involved collaborative management
- 10 monitoring, assessment, and planning efforts

The Southwest Basin Roundtableroundtable 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 BIP, 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."[413] Also identified was the need for implementation of projects and methods thatwhich are "appropriately located, sized, and operated…to protect important water uses and the environment."[414] 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

27 projects identified which meet municipal, industrial, or agricultural needs

$4,950,000 in costs identified for **3** projects

317,316 acre-feet of development identified for 12 projects

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. Twenty-one21 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 P&M Study.[415] 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 thatwhich were not included in SWSI or the P&M Study.

Projects and methods summary: The Draft BIP identified a total of 2721 projects and methods meeting municipal, industrial, or agricultural needs.[416] Some representative[417] The most commonly identified projects and methods presented in the BIP arewere as follows:

- 9 projects identifying potential new storage sitesNew Storage
- 2 irrigation improvement projects
- 2 reservoir improvements or expansion
- 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.

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~~no~~ and Low Regrets indicates that on average 80 percent~~%~~ 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 BIP 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 Collaborative Approach to Water Supply Permit Evaluation~~CAWS~~ group to improve communication among state and federal agencies about permitting issues • Support key IPPs (e.g., the Chatfield Reallocation Project; WISE; the CRCA) • Coordinate the DNR's~~DNR~~ responses to IPPs through the DNR Executive Director's Office • Provide technical and financial support to project proponents through 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 ~~D~~ata 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 effects~~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 the CWCB, the IBCC, and the basin roundtables~~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 ASR 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~~Basin Roundtables~~ in identifying feasible multi-purpose projects c) Prioritize implementation of multi-purpose projects that meet values of the Colorado Water Plan 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 M&I 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

Agricultural Viability

Governor Hickenlooper's executive order directed the CWCB to incorporate "a productive economy that supports vibrant and sustainable cities, viable and productive agriculture, and a robust skiing, recreation, and tourism industry" as the key values that Colorado's Water Plan is intended to

reflect.[418] In every BIP, the roundtables identified the importance of agriculture as an economic driver and overall community benefit to the basin landscapes. In discussing agricultural viability, the path forward is complicated; hydrology, commodity prices, and federal programming dictate to some extent the landscape for farmers and ranchers. The basin roundtables proposed solutions, stakeholders submitted comments to the CWCB, and the IBCC convened a subcommittee with the express purpose of exploring policies and concepts with the goal of maintaining viable agriculture in the face of future water supply and demand challenges. These initiatives are summarized, with the acknowledgement that this is an ongoing matter, with greater study, collaboration, and action items necessary moving forward.

Arkansas Basin

The Arkansas Basin Roundtable proposes an economic measure of agricultural benefit in their BIP. Members of the roundtable worked with a team from Colorado State University, establishing a baseline for agricultural production within the basin at $1.5 billion annually.[419] Given the constraints of water management within the Arkansas Basin, including the Arkansas River Compact, the roundtable seeks to maintain or increase this baseline through identifying and implementing sources of augmentation water, supporting the development of leasing/fallowing programming within the basin, and further exploring the nexus between agricultural and environmental and recreational uses.[420]

> "The preservation of irrigated agriculture in the Arkansas Basin shall be given a high priority in the state water plan. It is too important to tourism, the preservation of food production, recreation, the environment and the health and well-being of our citizens as well as the economy of the State of Colorado to be ignored"
>
> - *Arkansas BIP*

Colorado Basin

In assessing the future of agriculture in the Colorado Basin, the roundtable first articulates concern regarding development of a new transmountain diversion from the Colorado mainstem, citing existing diversions and the effect that further development could have on the agricultural economy.[421] The roundtable goes on to prioritize agriculture in one of six basin themes, established to be the guiding principles for the Colorado BIP: "Sustain, Protect, and Promote Agriculture." The BIP cites the importance of return flows to other economic drivers in the basin, such as recreation and tourism, and calls out the 100,000 acre-feet in shortages estimated by SWSI 2010.[422] The roundtable goes on to identify four goals to support this basin theme:

- Reduce agricultural water shortages
- Minimize potential for transfer of agricultural water rights to municipal uses (within private property rights)
- Develop incentives to support agricultural production
- Increase education among the agricultural community about Colorado River Basin water issues

The BIP articulates in greater detail measureable outcomes, short-term needs, long-term needs, and projects and methods in support of each goal.[423]

Gunnison Basin

Under the umbrella goal of "Protect existing water uses in the Gunnison Basin," the Gunnison roundtable also identified three basin goals centered on agricultural viability:

- Discourage the conversion of productive agricultural land to all other uses within the context of private property rights.
- Improve agricultural water rights to reduce shortages.
- Describe and encourage the beneficial relationship between agricultural and environmental recreational water uses.

> "Traditional agricultural water uses not only provide direct economic benefits but also help to drive the recreational economy by preserving the beautiful landscape enjoyed by the Basin's inhabitants and visitors."
>
> • *Gunnison BIP*

In the inventory of projects and methods, the Gunnison Roundtable identifies projects that seek to advance these three basin goals specifically.[424] The roundtable discusses each goal in detail, proposes a process to achieve each goal, and defines a measurable outcome that often includes a quantifiable target. For example, in discussion of the first bulleted basin goal, the roundtable hopes to achieve the following measurable outcome: "Preserve the current baseline of about 183,000 protected acres in the Gunnison Basin and expand the participation in conservation easements by five percent by 2030 through programs like the Gunnison Ranchland Conservation Legacy."[425] The roundtable also includes implementation goals, which may be a number of projects to be developed by a certain benchmark, or the completion of a study to assess infrastructural needs. Specific processes and measurable outcomes are explored further in the BIP.

North Platte Basin

The North Platte Basin Roundtable identifies agricultural shortages and issues with infrastructure as priority needs in the BIP, along with concerns regarding long-term implications of the Equitable Apportionment Decree.[426] Similar to the Gunnison BIP, one basin goal in the North Platte seeks to "describe and quantify the nonconsumptive benefits of agricultural use."[427] Moving forward, the roundtable hopes to complete further study of this relationship, quantifying these benefits and their overall effect on water management within the basin. Measurably, the roundtable seeks to complete at least two multi-purpose projects in the basin meeting multiple needs.[428] Four specific projects were identified in the BIP directly addressing this multi-purpose projects goal.

The roundtable also describes the shortages in the basin and the causes for these shortages, which fall into three categories: physical, legal, and irrigation practice related.[429] Other basin goals seek to resolve identified issues with water availability under the decree and address issues with aging or non-functional infrastructure. Detailed project information is available for projects that address agricultural needs or multi-purpose benefits.

Rio Grande Basin

The Rio Grande BIP begins by recognizing the importance of agriculture to the basin economy, where approximately 99 percent of water is used for agriculture.[430] The challenges inherent in compliance with the Rio Grande Compact and the Well Rules and Regulations for the basin make viability of agricultural production a major concern for basin stakeholders. Twelve of the 14 basin goals include an agricultural consideration, ranging from compliance with legal mechanisms to optimal management of agricultural and environmental water uses.[431]

The BIP discusses the role of innovations in agriculture, examining the future roles of strategic crop development and irrigation improvements as potential water-management strategies.[432] Additionally, the BIP includes a summary of current approaches within the basin to improve soil health as a component of improved water management as it relates to agricultural production.[433] The roundtable took a closer look at 29 projects and methods identified to meet future needs within the basin, 24 of which meet identified agricultural needs.[434] Beyond the projects and methods explored in further detail through project sheets, 18 additional projects and methods were identified with an agricultural nexus, ranging from specific improvements to agricultural infrastructure to an "Alternative Cropping Education and Promotion Program."[435]

South Platte Basin (including Metro)

In proposing strategies to meet the projected water supply gap in the South Platte and Metro Basins, the roundtables set guidelines recognizing the importance of agriculture to the basin economy, and encouraging multipurpose projects with a minimal impact on agricultural uses.[436] In planning for the future of water within the basin, the roundtable set a basin goal to "Minimize traditional agricultural "buy and dry" and maximize use of ATMs to extent practical and reliable."[437] Specific recommendations for achieving this goal include further support of water sharing methods and improvements to the water court process, with an acknowledgement of the importance of vested rights to water rights holder.

"The importance of agricultural production in the South Platte and Republican River Basins should not be overlooked. It is a major factor in the State's economy and includes processing of food and livestock from the entire state.

- *South Platte BIP*

The BIP discusses the benefits and challenges associated with the implementation of ATM projects, and it identifies some of the lessons learned from previous and ongoing ATM projects within the basin. The roundtables also provide some strategies at the local level to minimize agricultural dry-up, such as switching to cool weather crops, deficit irrigation, and dry year leasing. The BIP emphasizes continuation of state pilot programs for water sharing, as well as collaborative solutions such as coupling agricultural easements with municipal lease options.[438]

Southwest Basin

Similar to other western slope basins, the Southwest Basin expresses concern about the Colorado River Compact, and the impact that future development of Colorado River supplies may have on basin agriculture, given downstream obligations. To that end, the roundtable proposes that proponents of a new transmountain diversion, or water providers utilizing agricultural dry-up to meet demands, should meet a 70:30 ratio of inside to outside use of municipal water by 2030.[439] In assembling the BIP, the roundtable identified 21 goals, three of which specifically address the theme of "Meet Agricultural Needs."[440] In addition to the proposed municipal use ratio, the roundtable recommends implementation of ATM and efficiency projects, strategies to discourage permanent dry-up, and the implementation of at least 10 agricultural water efficiency projects identified as IPPs by 2050.[441]

The Southwest BIP also surveys the challenges inherent in achieving these measurable outcomes, such as the potential opposition to a statewide conservation ratio, and the difficulties in ATM

implementation under water rights administration within the basin.[442] In compiling the Southwest BIP, extensive outreach was conducted to update the roundtable's IPP list. Of the total IPPs listed, agricultural projects and methods total about 19 percent of the list, while 17 percent are multipurpose and may have an agricultural component.[443]

Yampa/White/Green Basin

The Yampa/White/Green Basin Roundtable identified eight goals, two of which specifically mention agricultural uses of water:

- Protect and encourage agricultural uses of water in the Yampa/White/Green Basin within the context of private property rights.
- Improve agricultural water supplies to increase irrigated land and reduce shortages.[444]

In looking to the future of the basin, the roundtable undertook a modeling exercise, which demonstrated agricultural shortages under a Baseline Scenario, as well as substantial shortages under a Dry Future Scenario.[445] The roundtable projects the addition of up to 14,805 irrigated acres within the basin, so identifying the timing and location of shortages is a priority for roundtable members. In the context of private property rights, the BIP proposes potential cooperative programs to reduce shortages, while encouraging multi-purpose projects with a benefit to agricultural uses.[446] With this closer study of shortages, and the encouragement of policies and programming to benefit agriculture, the roundtable has identified some quantifiable outcomes:

- Preserve the current baseline of approximately 119,000 irrigated acres and expand by 12 percent by 2030.
- Reduce agricultural shortages basin-wide by 10 percent by the year 2030.[447]

Additionally, the roundtable identifies several processes related to improving agricultural infrastructure, through collaborative processes and more in-depth analysis of potential for improvements given effects on other water uses.

BIPs & Agriculture Summary

The BIPs represent the best accounting of projects and methods with the goal of agricultural viability, established and inventoried at the grassroots level, with policy suggestions coming from the stakeholders who are actively involved at their local basin levels. These local stakeholders, water managers, and water users know what sorts of practices are actionable and that will work in their area. Moving beyond an acknowledgement of the importance of agriculture to the economy and communities, the BIPs make a series of bold steps towards actionable and measurable strategies that seek to maintain the viability of agriculture in the various basins. The next section summarizes the work going on at the IBCC level, in an effort to identify policies and strategies that have statewide applicability. These action items also strive to measurably and meaningfully encourage the viability of agriculture around the state, but take a broader approach, seeking actions that may provide a benefit in all basins.

Interbasin Compact Committee Agricultural Viability Actions and Strategies

To inform the ongoing statewide discussion on agricultural viability, the IBCC assembled a subcommittee in 2015 to propose specific concepts and strategies for the IBCC's support and potential short-term implementation. The committee presented draft concepts for discussion to the IBCC, which approved the action items for further work and implementation. Moving forward, the CWCB's members and staff will work with stakeholders and interested parties to implement these concepts, while recognizing the challenges and opportunities presented by each. The following summary describes briefly each of the IBCC concepts.

Agricultural Viability Long-Term Goal: The IBCC asked the task group to craft a long-term goal closely tied to continued long-term viability for agricultural uses, and to reflect the broad need to educate Coloradans on the importance of agriculture. Ideally, the goal should be measurable.

Program to Facilitate Agricultural Opportunities: Additional education and assistance to farmers and ranchers is needed to help realize more transactions that allow for water sharing and for new Colorado farmers to own land. The program should include education on and assistance with the following:

- Deals, contracts, and other options for sharing agricultural water,
- ATMs that allow for the farmer to continue owning the land,
- Opportunities to overcome entry barriers for young growers (in collaboration with such entities as Land Link, Farm Bureau's Young Farmer Group, and Colorado State University Extension),
- Perpetual agricultural agreements, such as conservation easements (such as those demonstrated by entities like the Lower Arkansas Valley Water Conservancy District),
- Other similar contractual agreements that allow for more long term flexibility (an example is the purchase of water rights in the Arkansas Basin by Aurora Water).
- Funding opportunities for agricultural producers.

The scope of work, goals, geographic range, and responsibilities of this program need to be created, along with measurements for success. Because many of the aspects of the program relate to agreements between municipalities and agricultural producers, both sectors should be involved in the development of the program and provide continued input.

Enforcing minimum standard for water rights applications: The court should be diligent in enforcing the minimum water rights application requirements, which are already in existence. This should be standardized statewide. Better guidance for applicants who do not have legal counsel or engineering consultants should be provided and advertised.

Incentives to reduce urbanization and fragmentation of agricultural lands: Colorado's Water Plan should indicate that the current land use incentives described in the plan would also help keep agricultural lands in production. These incentives should be reviewed to determine if more are needed to further encourage local governments and land owners to reduce fragmentation and

urbanization of agricultural lands. The incentives are meant to provide additional options, but not infringe upon private property rights.

Addressing barriers to keeping agricultural land and water ownership when water sharing: Members of the IBCC will work with BRTs to apply for a multi-basin WSRA grant to compile ATM data, identify areas that will encourage irrigators to enter agreements, analyze barriers (not just law review), and bring in municipalities' perspectives to understand both buyer and seller standpoints. We can develop next steps once this data has been compiled and reviewed.

Framework for evaluations of agricultural transfers: More transparency is needed with agriculture transfer transactions, so that agriculture producers and the general public understand the effect of agriculture transfers to agriculture, the local community, and the environment. An evaluation of agricultural transfers could help, but there are several concerns and details that would need to be determined. An evaluation of agricultural transfers could encroach on private property rights, stall operations, and become a permitting hurdle functioning like an Environmental Impact Statement. Other remaining details include: determination of the party responsible for conducting the evaluation, the end goal of such an evaluation, the effect on agricultural viability, and timing of such an evaluation in the water rights transaction process. A framework for an evaluation of agricultural transfers should be developed from a technical and legal perspective before the consideration of requiring such an evaluation. Stakeholders should be relied upon to help produce such a framework, and include local government, agricultural producers, municipalities, and environmental interests.

Agricultural to agriculture, environment, or industrial sharing pilot: Senate Bill 198 was signed in 2015, which allows for pilot projects to share water between agricultural entities, as well as industrial or nonconsumptive uses. To implement this program, the CWCB should encourage a pilot project to test the concept. In addition, ditch companies should be educated on this opportunity. Some ditch companies may need to change their bylaws to allow for this.

Update and improve Colorado's aging infrastructure: Building new storage and other infrastructure and updating aging infrastructure is too expensive and difficult for many agriculture producers (regulations, permits, costs). Storage benefits and supports all uses and all sectors. Therefore, other work on improving the permitting, system, review of water administration, court system, and law, as well as increased funding for aging infrastructure and identified agricultural projects is encouraged.

Regulations that increase costs for growers and how these might be modified: The agricultural community needs relief from increasing government regulations across sectors, which must be addressed as one of agriculture's top priority issues for the future, especially when encouraging young agriculturalists to continue farming.

Additional recommendations: In addition, the IBCC discussed the need for two additional points focused on funding agricultural infrastructure and agricultural IPPs. The latter recommendation will support agricultural and municipal IPPs that reduce reliance on agricultural dry-up.

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 9.2~~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 10~~ten~~ projects that~~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.[448] The Gunnison Basin Roundtable identified 22 projects classified as storage improvements and expansion: either maintaining existing reservoirs or planning for more storage.[449] The Colorado Basin similarly listed many projects associated with storage expansion, and also plans for improving or updating existing municipal infrastructure.[450] In this manner, the basins are preparing for new projects and methods, while maintaining the existing supply systems.

Actions

To support projects and methods that meet future municipal, industrial, and agricultural needs, several next steps are necessary.

1. **BIP project support:** The CWCB will continue~~Continue~~ to support and assist the basin~~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. **Climate change incorporation:** The CWCB will work with the basin roundtables and, upon request, work with project proponents, to incorporate~~Incorporate~~ the potential effect of climate change on municipal, industrial, and agricultural projects and methods.
3. **Expanding projects to be multi-purpose:** The CWCB will prioritize funding to the basin roundtables to support~~Support~~ an integrated approach to understanding how environmental and recreational projects and methods may interact with municipal, agricultural, and industrial projects and methods. As part of this task, basin roundtables will ~~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. **Project tracking:** In partnership with the basin roundtables, the CWCB will continue~~Continue~~ to track municipal, industrial, and agricultural projects and methods.

5. **Project support:** The CWCB will continue~~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. **Project funding:** As discussed in Section 9.2, the CWCB will work with partners to 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. **Storage opportunity assessment:** As part of the next version of SWSI, the CWCB will work with the DWR and local partners to assess~~Assess~~ storage opportunities to determine where existing storage can and should be expanded, where it is needed to prepare for climate change, where it can be used to better improve sharing and use of conserved water, and where it can help meet Colorado's compact obligations. Furthermore, the CWCB will provide financial support to technical and practical innovations in the use of aquifer storage and recharge where it is practicable.
8. **Multi-purpose project funding:** The CWCB will prioritize~~Consider prioritizing~~ support for~~to focus on~~ multi-purpose projects and those that modernize, ~~and~~ make more efficient, or build new critical infrastructure for agriculture, M&I uses, and hydropower production through programs explored in Section 9.2.
9. **Permitting:** As discussed in Section 9.4, refine the permitting process to make it more effective and efficient.
10. **Program to facilitate agricultural opportunities:** The CWCB and the CDA will establish an education and assistance program for farmers and ranchers to help realize more transactions that allow for water sharing and for new Colorado farmers to own land. The scope of work, goals, geographic range, and responsibilities of this program need to be created along with measurements for success. Because many of the aspects of the program relate to agreements between municipalities and agricultural producers, both sectors should be involved in the development of the program and provide continued input.
11. **Enforcing minimum standard for water rights applications:** The court should be diligent in enforcing the minimum water rights application requirements, which are already in existence. This should be standardized statewide. Better guidance for applicants who do not have legal counsel or engineering consultants should be provided and advertised.
12. **Framework for evaluations of agricultural transfers:** A framework for an evaluation of agricultural transfers will be developed from a technical and legal perspective before the consideration of requiring such an evaluation. The CWCB will host a stakeholder group to help produce such a framework, which will include local government, agricultural producers, municipalities, and environmental interests.
13. **Update and improve Colorado's aging agricultural infrastructure:** Over the next five years, the CWCB will work with the basin roundtables and agricultural partners to further identify and prioritize aging infrastructure projects, especially where there can be a large

effect on or benefits to other sectors. The CWCB will coordinate funding opportunities to address these needs.

14. **Encourage ditch-wide and regional planning:** Over the next two years, the CWCB will work with agricultural partners to explore opportunities to conduct ditch-wide and regional planning, such as that occurring in the Uncompahgre. These plans will explore system-wide conservation and efficiency opportunities, as well as explore the potential for water sharing, and develop a long-term infrastructure maintenance and upgrade plan

66.6 Environmental and Recreational Projects & Methods

The policy of the state of Colorado is to identify and implement environmental and recreational projects and methods to achieve the following statewide long-term goals:

- Promote restoration, recovery, ~~and~~ sustainability, and resiliency 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 and resiliency
- 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 BIPs.

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 SSI uses (e.g., irrigation of parks and golf courses, snowmaking).

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. A~~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.[451]

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 [TMD] 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.[452]

Projects and methods that maintain or improve Colorado's environmental and recreational values and achieve long-term sustainability and environmental resiliency are an important part of Colorado's water future. Resilience of a stream or watershed can be measured as an ecosystem's ability to recover function after a disturbance, whether acute or chronic.[5] The resilience of an ecosystem is a measure of its ability to absorb changes and still exist.[6] Resilient river systems provide complex and connected aquatic and riparian habitats, and support diverse, abundant, and reproducing populations of aquatic and riparian species. To determine levels of resiliency, it is necessary to identify the baseline status of these characteristics and to monitor streams and watersheds on an ongoing basis.[453] To promote environmental~~matter of ecological~~ resiliency, planned projects and methods should incorporate the potential stressors of drought and 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 scarce~~minimal~~ when compared with existing programs for municipal, industrial, or agricultural uses.[454] 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

[5] See Principle 7 of the IBCC Draft Conceptual Agreement.
[6] See http://torrensresilience.org/ecological-resilience (citing Holling, C.S. 1973. "Resilience and stability of ecological systems" in: *Annual Review of Ecology and Systematics*. Vol 4 :1-23).

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 from~~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. Another example is including a project component focused on habitat or flow restoration to address environmental and recreational needs. Water quality and habitat degradation effects resulting from traditional consumptive uses of water could be addressed with restoration projects and methods and coordinated water uses among water users. Such a balanced approach to meeting future water needs could accomplish multiple objectives.

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.[455] 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 and methods 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.

Existing Environmental and Recreational Projects & Methods

~~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
~~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.[456] This program, one of the nation's first ~~of its kind~~, vested the 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.[457] 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.[458]

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 (CPW), ~~,~~ the U.S. Department~~Deptartment~~ of Agriculture, and the U.S. Department~~Deptartment~~ of the Interior.[459] The CWCB uses a public notice and comment procedure in determining whether to appropriate instream flow water rights.[460] 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.[461] 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 CPW, the CWCB's~~Colorado Parks and Wildlife, CWCB~~ consideration of several factors related to the transaction, and opportunity for public input.[7]~~462~~

Since 1973, Colorado has appropriated instream flow water rights covering more than 9,200~~over 9200~~ miles of stream and natural lake level water rights on 486 natural lakes.[463] 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

[7] C.R.S. § 37-92-102(3), § 37-83-105(2), and Rule 6 of the CWCB's Rules Concerning the Colorado Instream Flow and Natural Lake Level Program govern the CWCB's acquisition of water for instream flow use. The Rules are located at: http://cwcb.state.co.us/legal/Documents/Rules/Final%20Adopted%20ISF%20Rules%201-27-2009.pdf.

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 improve[8]~~improve.[464]~~ 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 near~~in~~ Crested Butte, Colorado.[9]~~.[465]~~ See Appendix C for some specific examples of water acquisitions for instream flow use.

Recreational In-Channel Diversions (RICDs)

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 RICDs.[10]~~[466]~~ These water rights allow water to be called for recreational boating purposes when in priority. The size and magnitude of river flows called by some RICD water rights, depending on their location, 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.[467] Only a local governmental entity may apply for a RICD.[468] 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. Not impair~~Impair~~ Colorado's ability to fully develop and use its compact entitlements; and
3. Not cause~~Cause~~ material injury to the CWCB's~~CWCB~~ instream flow water rights.[469]

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.

[8] In 2002, the General Assembly passed Senate Bill 156, authorizing the CWCB to use acquired water to improve the natural environment to a reasonable degree (C.R.S. § 37-92-102(3)).

[9] Information on CWCB's instream flow water acquisitions is located at: http://cwcb.state.co.us/environment/instream-flow-program/Pages/CompletedTransactions.aspx.

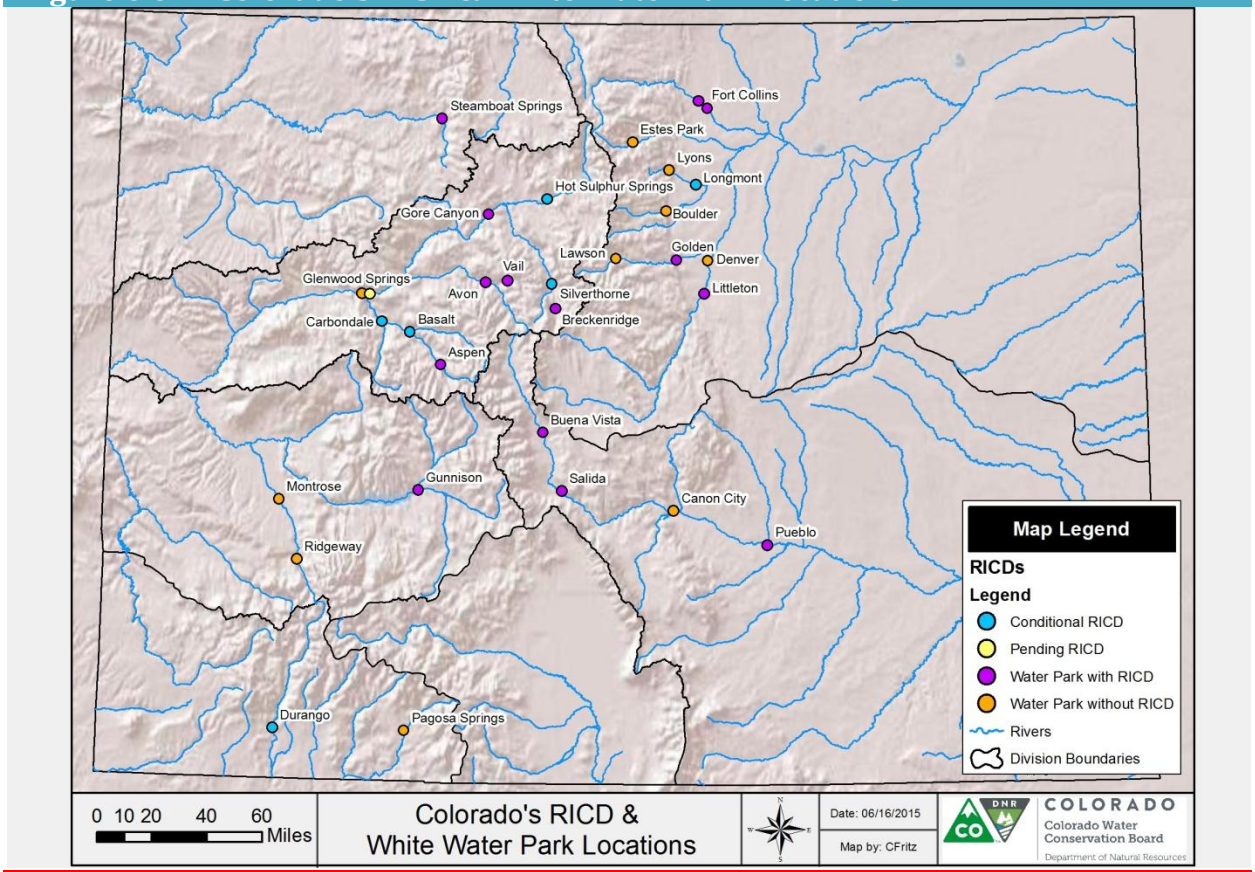
[10] C.R.S. § 37-92-102 (5, 6), § 37-92-103(10.1, 10.3), § 37-92-305(13),and the CWCB's Recreational In-Channel Diversion Rules govern RICD appropriations. The rules are located at: http://cwcb.state.co.us/legal/Documents/Rules/RICDrules2006Novhearing.pdf.

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.[470]

In Colorado, there are 15~~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). ndangered Species

Figure 6.6-1: Colorado's RICD & White Water Park Locations



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.[471] 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 amongbetween 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 Endangered Fish Recovery Program

The Upper Colorado River Endangered Fish Recovery 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 Endangered Fish River Recovery Program provides Endangered Species Act compliance for more than 2,050over 2050 water projects with more than 2.5 million acre-feet of existing water use and more thanover 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.[11][1172]

San Juan River Basin Recovery Implementation Program

[11] Information on the UCCRIP is located at: http://www.coloradoriverrecovery.org/index.html.

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 Basin Recovery Implementation Program provides Endangered Species Act compliance for more than~~over~~ 340 water projects using more than~~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.[12]~~[473]~~

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.[13]~~[474]~~

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 Colorado 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.

[12] Information on the SJRIP is located at: http://www.fws.gov/southwest/sjrip/. Also, detailed summaries of the UCRIP and SJRIP programs can be found at: www.coloradoriverrecovery.org/general-information/general-publications/briefingbook/2014HighlightsDig.pdf.

[13] Information on the PRRIP is located at: https://www.platteriverprogram.org/Pages/Default.aspx.

Through 2019, South Platte water users will pay more than $13 million and the State of Colorado will pay $24 million (according 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

CPW~~Colorado Parks and Wildlife~~, five other Colorado River Basin state wildlife agencies, the U.S. Forest Service (USFS), the~~,~~ Bureau of Land Management (BLM), the~~,~~ 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 range.[475] Noting rangewide declines of these species, the Three Species Agreement addresses the species' potential for listing by the U.~~–~~S. Fish and Wildlife Service (USFWS) as threatened or endangered under the Endangered Species Act of 1973, as amended. The USFWS~~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. CPW and the BLM~~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.

Colorado River Cutthroat Trout Conservation Strategy

Colorado River cutthroat trout (CRCT) is a state-listed species of special concern in Colorado, Wyoming, and Utah and also is characterized as a sensitive species by federal land management

agencies (the BLM and the USFS) who manage habitats where CRCT occurs. CPW works closely with Utah, Wyoming, and federal land managers to manage for the recovery and persistence of CRCT throughout their historic range, guided by the Conservation Strategy for Colorado River Cutthroat Trout, a multi-pronged strategy that articulates the steps that if implemented, would be most likely to preserve CRCT in perpetuity.[476] Implementation of the CRCT Conservation Strategy and showing progress on measurable benchmarks has allowed the USFWS to maintain its opinion that CRCT is "not warranted" for listing under the Endangered Species Act of 1973, as amended.[477] This finding has been beneficial to state wildlife management agencies to maintain state management authority for this species, and also is critically important to water managers so that consultation with the USFWS under Section 7 of the Endangered Species Act is not required for projects in CRCT-occupied waters.

In general, the CRCT Conservation Strategy focuses on the following objectives:

- Identify populations of CRCT and characterize the level of genetic introgression;
- Secure "conservation" and "core conservation" populations from further genetic dilution (from non-CRCT salmonids) or inter-specific competition (e.g., barrier construction, reclamation, stocking restrictions);
- Maintain and enhance watershed conditions, including streamflow protection, riparian buffers, and habitat projects;
- Public outreach and education;
- Monitoring and data exchange among state fish managers and federal land management agencies; and
- Coordination of all CRCT activities among the same agencies and non-governmental organization partners.[478]

As outlined in the CRCT Conservation Strategy, maps, regulations, and CRCT conservation waters are continually being updated as new monitoring data and research unfolds. Of current interest is the further delineation of historic native cutthroat trout into two distinct lineages reflecting pre-settlement occupation endemic to the Yampa-White river basins ("blue" lineage) or the Colorado-Gunnison-Dolores river basins ("green" lineage).[479] Regardless of the nomenclature for particular genotypes of native cutthroat trout, the CRCT Conservation Strategy partners will continue to evolve management strategies to address new challenges (e.g., climate change) and research findings.

Wild and Scenic Rivers

The National Wild and Scenic Rivers Act requires federal land agencies (including the BLM, the~~Bureau of Land Management,~~ National Park Service, the USFS, and the USFWS~~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.[480]

To be eligible, a river, stream, or segment must be free-flowing and must possess at least one Outstanding Remarkable Value (ORV)~~,~~ 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.[481] Many factors are considered in the suitability evaluation, including whether there is a demonstrated commitment to protect the river and its ORVs~~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. Currently, there are many river segments in Colorado that the USFS or the BLM have determined to be suitable for designation since the passage of the original Wild and Scenic Rivers Act in 1968.

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 ORVs for which a river is designated. However, it is up to the managing agency whether to quantify, adjudicate, or request enforcement of the federal water right. In this context, Colorado can work with local managing agencies to protect flows that can support ORVs using Colorado's Instream Flow Program. Additionally, federal land management agencies may protect the free flowing nature, water quality, and classification associated with ORVs for candidate (eligible and suitable) Wild and Scenic rivers by imposing conditions on permits or other federal land management decisions. Federal land management agencies review proposed projects in, above, or below a designated reach to determine if "they would invade the area or unreasonably diminish the Outstandingly Remarkable~~Remakable~~ Values."[482] If so, the agency may request project proponents to modify the project to avoid adverse effects. If the proposed project~~projet~~ cannot be modified, the permitting agency may deny the request for a federal permit or assistance. While federal agencies have determined that several rivers in Colorado are suitable for designation (e.g., Dolores~~Dolorado~~ and Arkansas rivers) and manage~~managed~~ them as suitable in the absence of Congressional designation, water development and management have proceeded.

In 2009, Colorado's General Assembly established the CWCB Wild and Scenic Rivers Act Alternatives Fund to support cooperative and collaborative processes that are committed to exploring alternative avenues for resource protection.[483] 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~~La~~ Poudre River is the only river in Colorado currently designated as a wild and scenic river.[484] However, several river segments in Colorado are currently being evaluated for wild and scenic eligibility and suitability by the BLM~~Bureau of Land Management~~ and the USFS~~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 discuss the merits of suitability findings and in most cases, 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 (working in southwest Colorado), 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.[485]

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.

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.[486] 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. the CWCB's~~CWCB~~ instream flow water rights, eligible Wild and Scenic rivers).[487] 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.[488] 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.[489] 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 (WFET)

The CWCB partnered with The Nature Conservancy and CDM Smith to pilot a tool known as the 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/Green Basin Roundtables~~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.[490]

Stream Management Plans

Stream management plans can play an important role in identifying both the needs of environmental attributes, and projects and methods that will benefit those attributes. For example, the Grand County Stream Management Plan examined approximately 30 stream reaches in the Upper Colorado River Basin to "provide a framework for maintaining a healthy stream system in Grand County, Colorado, through the protection and enhancement of aquatic habitat while at the same time protecting local water uses, and retaining flexibility for future water operations."[491] For each stream reach, the plan includes reach descriptions, study methodology and results, recommendations of environmental target flows, review of existing temperature and water quality data, monitoring guidelines, unique features and issues, and supporting data.[492] Action items identified in the plan include restoration opportunities and monitoring recommendations by stream reach, and the "Learning by Doing" (similar to adaptive management) process, which includes monitoring, evaluation and adjustment of restoration opportunities, including flow enhancements, for the purpose of meeting pre-established goals.[493]

Well-developed stream management plans should be grounded in the complex interplay of hydrology, channel morphology, and alternative water use and management strategies, and should include the flow dynamics needed to support both recreational uses and ecosystem function. A stream management plan should: (1) involve stakeholders to ensure their acceptance of the plan; (2) assess existing geomorphic conditions at a reach scale; (3) identify flow needs for environmental and recreational water uses given appropriate geomorphic conditions; (4) incorporate environmental and recreational values and goals identified in a basin roundtable's BIP; and (5) identify actions to maintain or improve flow regimes. Such plans can provide a framework

for decision-making and project implementation related to environmental and recreational water needs for basin roundtables, local stakeholder groups and decision makers.[14]

The steps necessary to develop a stream management plan include: (1) gathering stakeholders to participate in plan development; (2) identifying the plan's objectives; (3) identifying and prioritizing ecological and recreational values; (4) establishing flow and protection goals for streams and rivers within a given watershed; (5) collecting and synthesizing existing data describing flows for river ecosystems, boating, or other needs in the watershed; (6) assessing existing physical conditions of stream reaches, including geomorphic and riparian condition; (7) developing quantitative flow targets to meet articulated goals; (8) determining what new information is needed and the best methods for obtaining that information; (9) quantifying specific numeric flow recommendations (or ranges of flow) and assessing the potential for channel reconfiguration to support environmental and recreational values; (10) identifying temporal, geographical, legal, or administrative constraints and opportunities that may limit or assist the ability to meet environmental and recreational goals; and (11) identifying and prioritizing environmental and recreational projects and methods. Stream management plans should provide data-driven flow recommendations that have a high probability of protecting environmental and recreational values on streams and rivers.[15]

Section 7.1's recommendation of a collaborative approach to watershed planning that includes stakeholder involvement and management actions supported by sound science equally applies to stream management plans. An inclusive stakeholder approach expedites cooperative and integrated project planning, which leads to successful implementation of measures that will meet the needs identified in the stream management plan.

Additionally, while stream management plans can be developed independently of watershed master plans, a stronger stream management plan will result if conducted as part of, or in conjunction with, watershed master plans. Numerous watershed master plans incorporate important components of stream management plans. Future stream management plans should build off existing watershed plans and other available studies.

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 targeted in~~of~~ the ~~identified~~ projects and processes~~process~~.

[14] This summary of the elements of a stream management plan is based upon public comments that incorporated information compiled by the Colorado River basin roundtable.

[15] This description of the steps to develop a stream management plan is based upon public comments that incorporated information from the Grand County Stream Management Plan.

Based upon the above-described information and on information being developed by basin roundtables, stakeholder groups, and others, Colorado can work on developing a strategic approach to meeting its nonconsumptive needs to provide meaningful protection to environmental and recreational attributes.

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."[494] 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."[495] 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 the CWCB to use acquired water rights to improve the natural environment to a reasonable degree.[496] 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.[497] In 2007 and 2008, the General Assembly established protection for water rights owners who lease water to the CWCB for instream flow use by providing that a lease to the 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.[498]

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.[499] 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.[500] 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.[501]

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 RICDs.~~recreational in-channel diversions.~~[502] 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.[503]

BIP Environmental & Recreational Projects & Methods~~BIP identified environmental & recreational projects & methods~~

As part of the 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.[504]

Arkansas River Basin

The Arkansas Basin Roundtable~~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 IPPs from SWSI 2010, as well as focus areas or areas of concern identified by the Nonconsumptive Needs Committee.[505]

The roundtable has gathered project lists from several sources, including SWSI 2010, The Nature Conservancy, CPW~~Colorado Parks and Wildlife~~, and others. The ~~draft~~ BIP also identifies projects funded by the roundtable through the Water Supply Reserve Account program, and projects or methods identified through the public input process undertaken by the roundtable.~~.~~ 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's goals and measurable outcomes.[506]~~basin~~

Environmental ~~goals~~ and recreational~~measurable outcomes.~~[507]

~~The roundtable's Nonconsumptive Needs Committee has identified 25~~ projects are included in the BIP Project Database, classified into the database definitions of Master Needs, Preliminary Needs, and IPPs.~~.~~[508] These projects line up with the basin's environmental and recreational goals of maintaining and improving key attributes. Many~~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.

Arkansas Basin at a Glance

135~~25~~ projects identified on the IPP List that meet environmental or recreational needs

$65,030,000 in costs identified for **2** projects

382~~3~~ stream miles identified for protection by **15**~~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~~

Moving forward, the Arkansas Basin Roundtable~~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 goals may lead to a proponent being invited to a round~~-~~table 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 roundtable~~basin~~, supporting the BIP efforts and identifying areas of concern. This path forward is planned to complement the pending revised edition of the~~update to~~ SWSI, with projects and methods that meet the definition of an IPP specifically identified.

Colorado River Basin

The Colorado Basin Roundtable~~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. Roundtable members took a closer look at the list of projects and methods, then identified representative projects in each sub-region of the basin meeting basin themes and sub-region goals. These projects were designated "Top Projects" and represent important needs both at the basin-wide and sub-region levels.

The Colorado Basin Roundtable~~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."[509] In its identification~~inventory~~ of Top Projects~~projects~~, the roundtable identified several~~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.

The roundtable's identification~~inventory~~ of Top Projects~~projects~~ and methods includes many with an environmental or recreational focus. Many~~Keeping with the basinwide theme, most~~ of the identified projects include the~~and methods were related to watershed health. 79 projects and methods with an environmental purpose were identified, and 11 were specifically recreational.[510] 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.~~

Colorado Basin at a Glance

27 projects identified on the Top Projects list meeting environmental or recreational needs

$132,500,000 in costs identified for **13** projects

21,472 acre-feet of development for environmental or recreational needs identified by **3** projects

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 CRCA, or projects funded by the roundtable that contemplate multiple phases.[511]

Gunnison River Basin

The Gunnison Basin Roundtable~~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.[512] 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.[513]

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~~roundtable~~ defined Tier 1 projects and methods as those whose implementation is likely feasible by 2025~~2020~~ and do an excellent job of meeting basin goals.[514] 18[515] ~~11~~ of the 49~~30~~ projects classified as Tier 1 are associated with Basin Goal #5:~~the basin goal~~ "quantify and protect environmental and recreational water uses."[516] 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 22~~13~~ projects as meeting Basin Goal #7~~another basin goal~~: "Describe and encourage the beneficial relationship between agricultural and environmental and recreational water uses."[517] 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~~glance~~

30 projects identified meeting environmental or recreational needs

$427,848,100~~79 million~~ in costs~~total~~ identified ~~costs~~ for **23~~16~~** projects

21,472 acre-feet of development for environmental or recreational needs identified by **10** 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~~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.[518]

-North Platte River Basin

The North Platte Basin also had two primary goals related to environmental and recreational uses and needs.[519] 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

North Platte Basin at a Glance

55 projects identified meeting environmental or recreational needs

6,226 acre-feet of development for environmental or recreational needs identified by **3** projects

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."[520]

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.[521] 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.[522]

In its inventory of recommended solutions, the roundtable identifies 50 environmental and recreational projects. Of~~37 of~~ these projects, 37 are classified as restoration of wetlands, riparian or stream projects.[523] 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~~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.[524] ~~M~~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

Rio Grande Basin at a Glance

58 projects identified meeting environmental or recreational needs

$129,674,531 in costs identified for **24** projects

4 stream miles of protection for environmental or recreational needs identified by **3** projects

~~-~~The Rio Grande Basin Roundtable~~roundtable~~, like others around the state established a set of basin goals, and then examined potential projects and methods with these goals in mind. The roundtable compared its basin goals with basin needs and came up with a multi-purpose focus, as all basin~~13 out of 14~~ goals had a nexus with environmental and recreational needs.[525] 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 29~~eighteen~~ projects and methods to date, described in detail in "Project Fact Sheets," which were preliminarily evaluated by basin goals.[526]

The roundtable assessed the projects and methods identified in the ~~draft~~ BIP as multi-purpose projects, with 28~~all eighteen~~ identifying some nexus with environmental and recreational needs.[527] 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 BIP because of time constraints. This

additional section identified 19~~seven~~ projects and methods that would meet an environmental or recreational need, often as part of a multi-purpose project.[528]

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 and methods 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 25~~16~~ of the 29~~18~~ projects that were examined in Project Fact Sheets. These 25~~16~~ projects total an estimated financial need of more than $218~~over $54~~ million through the year 2020.[529] 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 against~~the~~ basin goals, may prioritize some of them. Similar to the Colorado Basin Roundtable~~roundtable~~, the Rio Grande Roundtable~~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.[530]

South Platte River Basin (Including Metro)

South Platte/Metro Basin at a Glance

75 projects identified meeting environmental or recreational needs

The joint BIP prepared by the South Platte Basin and Metro Roundtables~~area water roundtables~~ required a large amount of outreach throughout the basin, as the most populous area in Colorado. The roundtables chose "Protect and enhance environmental and recreation attributes," as an area of focus when looking to future water needs in the basin. Additionally the roundtable identified a series of measurable outcomes to meet the basin Environmental and Recreational Goal: "Fully recognize the importance of, and support the development of environmental and recreational projects and multipurpose projects that support water availability for ecologically and economically important habitats and focus areas."[531] ~~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.[532]~~

The South Platte/Metro BIP highlights example projects throughout the basin that are consistent with the above environmental and recreational Goal. These example projects are listed by basin sub-region, with mapping and analysis provided that demonstrates key attributes in those areas. 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, many of which have been completed. Beyond these identified projects, the roundtables also created an inventory of "Additional Identified Environmental and Recreational Projects."[533] 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.[534] 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.

Southwest River Basin

The Southwest Basin Roundtable 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. [535] The Southwest Basin Roundtable roundtable, similar to the Rio Grande, evaluates any project or method for potential multiple uses and benefits, so about 50 percent of the IPPs are primarily meeting many projects identified have a potential environmental and recreational needs.[536] nexus.

Southwest Basin at a Glance

72 projects identified meeting environmental or recreational needs

$30,000 in costs identified for **1** project

202 stream miles of protection for environmental or recreational needs identified by **9** projects

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.[537] 24 of these projects and methods are related to wetland, stream, or

~~riparian restoration.~~[538] 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 representative~~some storage projects that would have an~~ environmental and~~or~~ recreational IPPs within the text of the BIP. These example projects ~~nexus, providing a cost estimate for one-off-stream water storage facility, and identifying another reservoir that could potentially~~ provide a look at the type of implementation of environmental project and method implementation that is planned or ongoing within the multiple subbasins of the Southwest~~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.[539] 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 availability~~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.[540] The Southwest Basin Roundtable~~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 ~~i~~n 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.

Yampa/White/Green River Basin

The Yampa/White/Green Basin Roundtable~~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.[541]

Yampa/White/Green Basin at a Glance~~glance~~

22~~21~~ projects identified meeting environmental or recreational needs

$5,050,000~~.3 million~~ in costs~~total~~ identified ~~costs~~ for **4** projects

371 stream miles of protection for environmental~~**9 water right acquisitions** or **flow-related protections**~~

~~**3 water quality projects**~~

~~**4 watershed health projects**~~

~~**12**~~ recreational needs identified by **16** projects

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.[542] 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 18~~21~~ projects and methods. Several of these projects have a completion date before 2020, with others classified as ongoing through 2020.[543]

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 additional 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.

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.

Table 6.6-1: Completed, Ongoing and Potential Future Actions

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 the CWCB Instream Flow~~ISF~~ Program • Implement Colorado Watershed Restoration Program • Implement Species Conservation	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 BIPs a) Develop basinwide goals b) Develop measurable outcomes

Trust Fund • Implement CPW~~Colorado Parks and Wildlife~~ Management Plans	c) Identify needs and opportunities d) Use~~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~~DevelopIncentives~~, 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) Manage and improve storage, infrastructure, and reservoir operations to benefit environmental and recreational values *[see section 6.5]*

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:

1. **Technical work:** As part of the next version of SWSI, the~~The~~ CWCB, in consultation with the ~~technical team and~~ basin roundtables, will conduct~~work in partnership on conducting~~ additional technical work associated with the environmental and recreational focus areas to better determine the levels of existing protections, and where additional projects and methods should be focused.

~~1.~~2. **Near-term projects and methods to address high priority needs:** The CWCB will~~Based upon this~~ work with CPW, the basin roundtables, and other 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 water-based recreational uses by developing a plan within the next three years that compiles and develops near-term projects and methods that address these high priority needs, including projects identified in the BIPs. This work will build on the work of the basin roundtables and the SWSI, including the work done in Action 1 above. At the same time, the CWCB will continue to support the strategic implementation of currently identified projects with technical and financial assistance~~recreational uses~~.

3. **Common metrics:** In coordination with other state agencies, basin roundtables, and other stakeholders, the CWCB will develop common metrics for assessing the health and resiliency of watersheds, rivers, and streams.

~~2.~~4. **Watershed master plans:** As indicated in Section 7.1, to~~To~~ maintain watershed health, the CWCB will work with watershed and other stakeholder 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.

5. **Stream management plans:** To promote healthy watersheds, rivers, streams, and wildlife, the CWCB encourages and will work with basin roundtables and other stakeholder groups to

develop stream management plans for priority streams identified in a BIP or otherwise as having environmental or recreational value. As part of this work, the CWCB will provide guidelines and templates for developing stream management plans, and will conduct ongoing analyses through the SWSI. To ensure continued planning and implementation in this context, the CWCB will explore additional funding sources, in addition to that provided in the 2015 CWCB Projects Bill.

3. **Incorporation of drought & climate change:** 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.

4.6. The basin roundtables and the CWCB will incorporate the potential effect of drought and climate change on environmental and recreational attributes into the BIPs and the next update of the SWSI.

5. **Multi-purpose projects:** 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.

6.7. 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. Working with the basin roundtables and BIPs, the CWCB will also 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.

7. **Proactive implementation of existing programs:** 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.

8. 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 CPW's Wetlands for Wildlife Program. The DNR and its agencies will institute policies, criteria, and programmatic approaches to proactively developing projects and methods that strategically address important aquatic, riparian, and wetland habitats.Colorado Parks and Wildlife's Wetlands for Wildlife Program.

9. **Continued support of Endangered Species Act activities:** The CWCB, CPWColorado 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.

10. **RICDs:** The CWCB will continue to support local governments on recreational in-channel diversions through technical consultation and funding where appropriate.
11. **Funding:** As discussed in Section 9.2, 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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[1] Colorado Water Conservation Board, *SWSI 2016 Initial Draft Chapter 7: Scenario Planning & Adaptive Management* (CWCB, 2014).

[2] CWCB, "SWSI 2016 Initial Draft Chapter 7: Scenario Planning & Adaptive Mangement," CWCB, Denver, 2014.

[3] Colorado Water Conservation Board, CWCB, "*SWSI 2016 Initial Draft Chapter 7*.: Scenario Planning & Adaptive Mangement," CWCB, Denver, 2014.

[4] Colorado Water Conservation BoardCWCB & CDM Smith, "*Technical Memorandum: Basin Roundtable Portfolio and Trade-off Analysis* (," CWCB, Denver 2012).

[5] Colorado Water Conservation BoardCWCB & CDM Smith, "*SWSI 2010 Section 4 – Consumptive Needs Assessment* (Assessmnet," CWCB, Denver, 2011), Pg 4-19.

[6] K.v.d. Heijden, "*Scenarios: The Art of Strategic Conversation, 2nd ed.* (New York:," John Wiley & Sons, New York, 2005); e.g., Denver Water, San Diego.; [List major water providers that have adopted scenario planning in the West]

[7] P. Schwartz, "*The Art of the Long View* (New York:," Doubleday, New York, 1991), Pg 3.

[8] R. Marra, ""Scenario Planning: An Approach to Managing Uncertainty" (workshop at the, Workshop presentation," in Colorado Water Congress Annual Convention, Denver, Colorado, January 30-February 1, 2013).

[9] R. Marra and T. Thomure, "Scenario Planning: Making Strategic Decisions in Uncertain Times," *Southwest Hydrology*, no. May/June (, p. 22, 2009), 22.

[10] K.v.d. Heijden, "*Scenarios: The Art of Strategic Conversation*, Pg 12nd ed.," John Wiley & Sons, New York, 2005.

[11] Colorado Water Conservation Board, *IBCC Annual Report* (CWCB, 2012), Pg 2.11 K.v.d. Heijden, "Scenarios: The Art of Strategic Conversation, 2nd ed.," John Wiley & Sons, New York, 2005.

[12] Colorado Water Conservation Board, *IBCC Annual Report* (CWCB, 2012), Pg 4.

[13] CWCB, "IBCC Annual Report," CWCB, Denver, 2012.

[14] Colorado Water Conservation Board, *IBCC Annual Report*, Pp 7-8.

[15] CWCB, "Interbasin Compact Committee Annual Report," CWCB, Denver, 2012.

[16] Colorado Water Conservation Board, CWCB, "*SWSI 2016 Initial Draft Chapter 7*: Scenario Planning & Adaptive Mangement," CWCB, Denver, 2014.

[17] Colorado Water Conservation Board, *Draft Supplemental BIP Guidance - Goals and Measurable Outcomes* (Denver: 2013), 4.

[18] Colorado Water Conservation Board, *Draft Supplemental Basin Implementation Plan Guidance – Goals and Measurable Outcomes*, 11.

[19] Colorado Water Conservation Board, ~~Draft~~ *Supplemental Basin Implementation Plan Guidance* ~~– Goals and Measurable Outcomes~~, 5-11.
[20] CDM Smith, *SWSI 2010 Appendix J - 2050 Municipal and Industrial Gap Analysis* (Denver: CWCB, 2011), 19.
[21] CDM Smith, *SWSI 2010 Appendix J* ~~– 2050 Municipal and Industrial Gap Analysis~~, 19.
[22] West Water, CDM Smith, Shively, CH2MHILL, and Peak Facilitation, *Arkansas Basin Implementation Plan.*
~~[23] West Water, CDM Smith, Mark Shively, CH2MHILL, and Peak Facilitation, *Draft Arkansas Basin Implementation Plan* (Pueblo: Arkansas Basin Rountable, 2014).~~
[24] SGM, ~~Draft~~ *Colorado Basin Implmentation Plan* (Glewood Springs: Colorado Basin Roundtable, 2014).
[25] Gunnison Basin Roundtable, ~~Draft~~ *Gunnison Basin Implementation Plan* (Gunnison: 2014).
[26] North Platte Basin Roundtable, ~~Draft~~ *North Platte Basin Implementation Plan* (Walden: 2014).
[27] DiNatali Water Consultants, *Rio Grande Basin Implementation Plan* (Alamosa: Rio Grande Basin Roundtable, 2014).
~~[28] DiNatali Water Consultants, *Draft Rio Grande Basin Implementation Plan* (Alamosa: Rio Grande Basin Roundtable, 2014).~~
[29] HDR, West Sage Water Consultants, *South Platte Basin Implementation Plan* (Denver and Longmont: South Platte Basin Roundtable, 2014).
[30] HDR, West Sage Water Consultants, ~~Draft~~ *South Platte Basin Implementation Plan.* ~~(Denver and Longmonet: South Platte Basin Roundtable, 2014).~~
[31] A. Oliver and C. Lile, *Southwest Basin Implementation Plan* (Durango: Southwest Basin Roundtable, 2014).
~~[32] A. Oliver and C. Lile, *Draft Southwest Basin Implementation Plan* (Durango: Southwest Basin Roundtable, 2014).~~
[33] AMEC, ~~Draft~~ *Yampa/White/Green Basin Implementation Plan* (Craig: Yampa/White/Green Basin Roundtable, 2014).
[34] West Water, CDM Smith, Shively, CH2MHILL, and Peak Facilitation, ~~Draft~~ *Arkansas Basin Implementation Plan*.
[35] CDM Smith, *SWSI 2010 Appendix J - 2050 Municipal and Industrial Gap Analysis.*
[36] West Water, CDM Smith, Shively, CH2MHILL, and Peak Facilitation, ~~Draft~~ *Arkansas Basin Implementation Plan*.
[37] CDM Smith, *SWSI 2010 Executive Summary.*
~~[38] West Water, CDM Smith, Shively, CH2MHILL, and Peak Facilitation, *Draft Arkansas Basin Implementation Plan.*~~
~~[39] West Water, CDM Smith, Shively, CH2MHILL, and Peak Facilitation, *Draft Arkansas Basin Implementation Plan.*~~
[40] *Final Arkansas Basin Implementation Plan.*
~~[41] West Water, CDM Smith, Shively, CH2MHILL, and Peak Facilitation, *Draft Arkansas Basin Implementation Plan.*~~
[42] CDM Smith, *Basin M&I Gap Analysis* (Denver: CWCB, 2011).
[43] CDM Smith, *SWSI 2010 Appendix J* ~~– 2050 Municipal and Industrial Gap Analysis~~.
[44] SGM, ~~Draft~~ *Colorado Basin Implmentation Plan*.
[45] CDM Smith, *SWSI 2010 Appendix J.*
[46] SGM, ~~Draft~~ *Colorado Basin Implmentation Plan*.
[47] CDM Smith, *SWSI 2010 Appendix J - 2050 Municipal and Industrial Gap Analysis.*
~~[48] CDM Smith, *SWSI 2010 Appendix J - 2050 Municipal and Industrial Gap Analysis.*~~
[49] SGM, ~~Draft~~ *Colorado Basin Implmentation Plan*.
[50] CDM Smith, *Basin M&I Gap Analysis*.
[51] CDM Smith, *SWSI 2010 Appendix J.* ~~– 2050 Municipal and Industrial Gap Analysis~~.
[52] West Water, CDM Smith, Shively, CH2MHILL, and Peak Facilitation, ~~Draft~~ *Arkansas Basin Implementation Plan*.
[53] Gunnison Basin Roundtable, ~~Draft~~ *Gunnison Basin Implementation Plan*.
[54] Gunnison Basin Roundtable, ~~Draft~~ *Gunnison Basin Implementation Plan*.
[55] Gunnison Basin Roundtable, *Gunnison Basin Implementation Plan.*
~~[56] Gunnison Basin Roundtable, *Draft Gunnison Basin Implementation Plan.*~~

[57] Gunnison Basin Roundtable, ~~Draft~~ *Gunnison Basin Implementation Plan*.
[58] North Platte Basin Roundtable, ~~Draft~~ *North Platte Basin Implementation Plan*.
[59] CDM Smith, *Basin M&I Gap Analysis*.
[60] CDM Smith, *Basin M&I Gap Analysis*
[61] CDM Smith, *SWSI 2010 Appendix J*, ~~– 2050 Municipal and Industrial Gap Analysis.~~
[62] DiNatali Water Consultants, ~~Draft~~ *Rio Grande Basin Implementation Plan*.
[63] DiNatali Water Consultants, ~~Draft~~ *Rio Grande Basin Implementation Plan*.
[64] CDM Smith, *Basin M&I Gap Analysis*.
[65] CDM Smith, *SWSI 2010 Appendix J* ~~– 2050 Municipal and Industrial Gap Analysis~~.
[66] HDR, West Sage Water Consultants, ~~Draft~~ *South Platte Basin Implementation Plan*.
[67] HDR, West Sage Water Consultants, ~~Draft~~ *South Platte Basin Implementation Plan*.
[68] HDR, West Sage Water Consultants, ~~Draft~~ *South Platte Basin Implementation Plan*.
[69] CDM Smith, *Basin M&I Gap Analysis*.
[70] CDM Smith, *SWSI 2010 Appendix J* ~~– 2050 Municipal and Industrial Gap Analysis~~.
[71] DiNatali Water Consultants, ~~Draft~~ *Rio Grande Basin Implementation Plan*.
[72] Oliver and Lile, ~~Draft~~ *Southwest Basin Implementation Plan*.
[73] Oliver and Lile, ~~Draft~~ *Southwest Basin Implementation Plan*.
[74] CDM Smith, *Basin M&I Gap Analysis*.
[75] AMEC, ~~Draft~~ *Yampa/White/Green Basin Implementation Plan*.
[76] CDM Smith, *SWSI 2010 Appendix J*, ~~– 2050 Municipal and Industrial Gap Analysis.~~
[77]DiNatali Water Consultants, ~~Draft~~ *Rio Grande Basin Implementation Plan*.
[78] AMEC, ~~Draft~~ *Yampa/White/Green Basin Implementation Plan*.
[79] AMEC, ~~Draft~~ *Yampa/White/Green Basin Implementation Plan*.
[80] ~~AMEC, Draft Yampa/White/Green Basin Implementation Plan.~~
[81] Colorado Water Conservation Board, ~~Draft~~ *Statewide Water Supply Initiative 2016 Glossary* (Denver: 2014).
[82] Colorado Water Conservation Board, ~~Draft~~ *Supplemental Basin Implementation Plan Guidance - Goals and Measurable Outcomes* (Denver: 2013), 12.
[83] CDM, *SWSI 2010* (Denver: CWCB, 2011), 4-22.
[84] Colorado Water Conservation Board, *SWSI 2010 Appendix H - State of Colorado 2050 Municipal and Industrial Water Use Projections* (Denver: 2011), 156.
[85] CDM, *SWSI 2010*.
[86] Gunnison Basin Roundtable, ~~Draft~~ *Gunnison Basin Implementation Plan*.
[87] CDM, *SWSI 2010*.
[88] CDM, *SWSI 2010*.
[89] Gunnison Basin Roundtable, ~~Draft~~ *Gunnison Basin Implementation Plan*.
[90] CDM, *SWSI 2010*.
[91] CDM, *SWSI 2010*.
[92] West Water, CDM Smith, Shively, CH2MHILL, and Peak Facilitation, ~~Draft~~ *Arkansas Basin Implementation Plan*.
[93] West Water, CDM Smith, Shively, CH2MHILL, and Peak Facilitation, ~~Draft~~ *Arkansas Basin Implementation Plan*.
[94] West Water, CDM Smith, Shively, CH2MHILL, and Peak Facilitation, ~~Draft~~ *Arkansas Basin Implementation Plan*.
[95] CDM, *SWSI 2010*.
[96] CDM, *SWSI 2010*.
[97] CDM, *SWSI 2010*.
[98] SGM, ~~Draft~~ *Colorado Basin Implmentation Plan*.
[99] CDM, *SWSI 2010*.
[100] CDM, *SWSI 2010*.
[101] CDM, *SWSI 2010*.
[102] Gunnison Basin Roundtable, ~~Draft~~ *Gunnison Basin Implementation Plan*.
[103] ~~CDM, SWSI 2010.~~

[104] ~~CDM, *SWSI 2010.*~~
[105] ~~HDR, West Sage Water Consultants, *Draft South Platte Basin Implementation Plan.*~~
[106] ~~CDM, *SWSI 2010*.~~
[107] North Platte Basin Roundtable, ~~*Draft*~~ *North Platte Basin Implementation Plan*.
[108] North Platte Basin Roundtable, ~~*Draft*~~ *North Platte Basin Implementation Plan*.
[109] CDM, *SWSI 2010*.
[110] CDM, *SWSI 2010*; DiNatali Water Consultants, ~~*Draft*~~ *Rio Grande Basin Implementation Plan*.
[111] Rio Grande Water Conservancy District, *Proposed Plan of Water Management: Special Improvements District No. 1 of the Rio Grande Water Conservation District* (Alamosa: 2009).
[112] DiNatali Water Consultants, ~~*Draft*~~ *Rio Grande Basin Implementation Plan*.
[113] CDM, *SWSI 2010.*
[114] CDM, *SWSI 2010.*
[115] HDR, West Sage Water Consultants, *South Platte Basin Implementation Plan.*
[116] CDM, *SWSI 2010.*
[117] Gunnison Basin Roundtable, *Draft Gunnison Basin Implementation Plan.*
[118] CDM, *SWSI 2010*.
[119] CDM, *SWSI 2010*.
[120] CDM, *SWSI 2010*.
[121] Oliver and Lile, ~~*Draft*~~ *Southwest Basin Implementation Plan*.
[122] CDM, *SWSI 2010*.
[123] CDM, *SWSI 2010*.
[124] CDM, *SWSI 2010*.
[125] Oliver and Lile, ~~*Draft*~~ *Southwest Basin Implementation Plan*.
[126] Colorado Water Conservation Board, *Draft Statewide Water Supply Initiative 2016 Glossary*, 3.
[127] Colorado Water Conservation Board, CDM Smith, and The Nature Conservancy, *Nonconsumptive Toolbox* (Denver: CWCB, 2013), 53-63.
[128] Colorado Water Conservation Board, ~~*Draft*~~ *Supplemental Basin Implementation Plan Guidance - Goals and Measurable Outcomes*.
[129] West Water, CDM Smith, Shively, CH2MHILL, and Peak Facilitation, ~~*Draft*~~ *Arkansas Basin Implementation Plan*.
[130] Colorado Water Conservation Board, *July 2010 Nonconsumptive Needs Assessment Focus Mapping.*
[131] Colorado Water Conservation Board, April 2014 *Gap Analysis Framework, Appendix 4.7-A.*
[132] West Water, CDM Smith, Shively, CH2MHILL, and Peak Facilitation, *Arkansas Basin Implementation Plan.*
[133] SGM, ~~*Draft*~~ *Colorado Basin Implmentation Plan*.
[134] SGM, ~~*Draft*~~ *Colorado Basin Implmentation Plan*.
[135] SGM, ~~*Draft*~~ *Colorado Basin Implmentation Plan*.
[136] Gunnison Basin Roundtable, ~~*Draft*~~ *Gunnison Basin Implementation Plan*.
[137] 2010 *Gunnison Basin Nonconsumptive Needs Assessment*
[138] Gunnison Basin Roundtable, ~~*Draft*~~ *Gunnison Basin Implementation Plan*.
[139] Gunnison Basin Roundtable, ~~*Draft*~~ *Gunnison Basin Implementation Plan*.
[140] North Platte Basin Roundtable, ~~*Draft*~~ *North Platte Basin Implementation Plan*.
[141] North Platte Basin Roundtable, ~~*Draft*~~ *North Platte Basin Implementation Plan*.
[142] North Platte Basin Roundtable, ~~*Draft*~~ *North Platte Basin Implementation Plan*.
[143] DiNatali Water Consultants, ~~*Draft*~~ *Rio Grande Basin Implementation Plan*.
[144] HDR, West Sage Water Consultants, ~~*Draft*~~ *South Platte Basin Implementation Plan*.
[145] HDR, West Sage Water Consultants, ~~*Draft*~~ *South Platte Basin Implementation Plan*.
[146] DiNatali Water Consultants, ~~*Draft*~~ *Rio Grande Basin Implementation Plan*.
[147] Oliver and Lile, ~~*Draft*~~ *Southwest Basin Implementation Plan*.
[148] DiNatali Water Consultants, ~~*Draft*~~ *Rio Grande Basin Implementation Plan*.
[149] AMEC, ~~*Draft*~~ *Yampa/White/Green Basin Implementation Plan*.
[150] AMEC, ~~*Draft*~~ *Yampa/White/Green Basin Implementation Plan*.

[151]Coyote Gulch, "AWWA Annual Conference: 'Every conversation about water should begin with conservation' — Governor Hickenlooper", June 11th, 2013. https://coyotegulch.wordpress.com/2013/06/11/awwa-annual-conference-every-conversation-about-water-should-begin-with-conservation-governor-hickenlooper/

[152] Colorado Water Conservation Board, *Municipal Water Efficiency Plan Guidance Document* (2012), 39-40. http://www.http://cwcb.state.co.us/technical-resources/water-conservation-plan-development-guide/Pages/main.aspx.

[153] P. Mayer, D. Little, and A. Ward, *System Reliability and Demand Hardening* (Colorado Statewide Water Supply Initiative, Conservation and Efficiency Technical Roundtable, 2006), 2-3.

[154] Colorado Water Conservation Board, *Appendix L~~Appendix L~~: SWSI 2010 Municipal and Industrial Water Conservation Strategies*, 25.

[155] Colorado Water Conservation Board, *CWCB Water Conservation Levels Analysis II* (2011), 25.

~~[156] Colorado Water Conservation Board, *CWCB Water Conservation Levels Analysis II* (2011), 25.~~

[157] C.R.S. 37-60-115 (6)

[158] I. Leondard Rice Engineers, "Sterling Ranch Precipitation Harvesting Annual Report," July 2014. http://cwcb.state.co.us/water-management/waterEfficiency/Pages/main.aspx.

~~[159]Texas Water Development Board, http://www.twdb.texas.gov/newsmedia/press_releases/2013/11/prop_6.asp~~

~~[160] Texas Water Development Board, http://www.twdb.texas.gov/swift/hb4/index.asp~~

~~[161] Tennessee Comptroller of the Treasury Water and Wastewater Financing Board, "New Water Loss Information", http://www.comptroller.tn.gov/WWFB/~~

~~[162] Tennessee Comptroller of the Treasury Water and Wastewater Financing Board, "New Water Loss Information", http://www.comptroller.tn.gov/WWFB/~~

~~[163] Bennett, D.B., 2011, SNWA's Conservation Program: Presentation to the Office of the Nevada Sate Engineer: Southern Nevada Water Authority, Las Vegas, Nevada, 5-1.~~

~~[164] Los Angeles Department of Water and Power, accessed 2014, https://www.ladwp.com/ladwp/faces/ladwp/aboutus/a-water/a-w-factandfigures?_adf.ctrl-state=tz9j82bo0_4&_afrLoop=387610830934180~~

[165] Gomez, Dominique, personal communication, Sept.2014.

[166] C.R.S. 37-98-103 (5)~~[166] General Assembly of the State of Colorado, "Senate Bill 14-017," 11 April 2014. http://www.leg.state.co.us/Clics/CLICS2014A/csl.nsf/fsbillcont3/4A3CD48EAA0C6B9987257C30000648102?Open&file=017_enr.pdf.~~

[167] C.R.S. 6-7.5-101-103~~[167] General Assembly of the State of Colorado, "Senate Bill 14-103," 6 June 2014. http://www.leg.state.co.us/Clics/CLICS2014A/csl.nsf/fsbillcont3/88AB3C8473D0BB5F87257C43006368E72?Open&file=103_enr.pdf.~~

[168] D. Water, *SB14-103 Fact Sheet, Unpublished,* 2014.

[169] C.R.S. 37-60-115; C.R.S. 37-92-308

[170] C.R.S. 37-60-126 (4.5) ~~[170] General Assembly of the State of Colorado, "House Bill 10-1051," 7 June 2010. http://www.leg.state.co.us/CLICS/CLICS2010A/csl.nsf/fsbillcont3/68D1C9003815AB67872576A8002A2E45?Open&file=1051_enr.pdf.~~

[171] C.R.S. 38-35.7-107~~[171] General Assembly of the State of Colorado, "House Bill 10-1358," 09 June 2010. http://www.leg.state.co.us/CLICS/CLICS2010A/csl.nsf/fsbillcont3/7F972C539E9610D6872576BE0079EE23?Open&file=1358_enr.pdf.~~

[172] C.R.S. 37-60-115 (6)~~[172] General Assembly of the State of Colorado, "House Bill 09-1129," 2 June 2009. http://www.leg.state.co.us/CLICS/CLICS2009A/csl.nsf/fsbillcont3/7EBE1FD8BEB4A0088725753C0061EF02?Open&file=1129_enr.pdf.~~

[173] C.R.S. 37-92-103(2)~~[173] General Assembly of the State of Colorado, "House Bill 05-133," 14 April 2005. http://www.leg.state.co.us/CLICS2005A/csl.nsf/fsbillcont3/FBB0C9C9D434B64487256F890076CA49?Open&file=133_enr.pdf.~~

[174] C.R.S. 37-60-126 (11)~~[174] General Assembly of the State of Colorado, "Senate Bill 05-100," 2005.~~

[175] Interbasin Compact Committee, *IBCC Report to the Governor Ritter and Governor-Elect Hickenlooper* (2010), 20-22. http://cwcb.state.co.us/about-us/about-the-ibcc-brts/Pages/main.aspx.
[176]Interbasin Compact Committee, *Draft No & Low Regrets Action Plan* (2013), 20., http://cwcb.state.co.us/water-management/basin-roundtables/Pages/main.aspx.
[177] Interbasin Compact Committee, *Draft No & Low Regrets Action Plan*, ~~(2013),~~ 19. http://cwcb.state.co.us/water-management/basin-roundtables/Pages/main.aspx.
~~[178] P. Mayer, D. Little, and A. Ward, *System Reliability and Demand Hardening* (Colorado Statewide Water Supply Initiative, Conservation and Efficiency Technical Roundtable, 2006), 2-3.~~
[179] W.Research, CDM Smith, CH2M Hill, Sustainable Practices, B. Bourquard, *Arkansas Basin Implementation Plan* (2015), Section 4.3.
~~[180] W. Research, *Draft Arkansas Basin Implementation Plan* (2014), Section 4.3,14.~~
[181] SGM, ~~*Draft*~~ *Colorado Basin Implementation Plan* (2015), Section 2,63~~2014), 37~~.
[182] W. W. Group, ~~*Draft*~~ *Gunnison Basin Implementation Plan* (2015), 33~~2014), 34~~.
[183] W. W. Group, *Gunnison Basin Implementation Plan*, 43.
[184] W. W. Group, ~~*Draft*~~ *Gunnison Basin Implementation Plan, Table 7,* 8~~6~~.
[185] W. W. Group, ~~*Draft*~~ *North Platte Basin Implementation Plan* (2014), 25.
[186] W. W. Group, ~~*Draft*~~ *North Platte Basin Implementation Plan*, 25.
[187] D. W. Consultants, ~~*Draft*~~ *Rio Grande Basin Implementation Plan* (2014), 122.
[188]D. W. Consultants, ~~*Draft*~~ *Rio Grande Basin Implementation Plan*, 129.
[189] H. &. W. S. W. Consultants, ~~*Draft*~~ *South Platte/Metro Basin Implementation Plan* (2015), 5~~2014), 6~~-2.
[190] H. &. W. S. W. Consultants, ~~*Draft*~~ *South Platte/Metro Basin Implementation Plan*, 4-20~~17~~.
[191] H. &. W. S. W. Consultants, ~~*Draft*~~ *South Platte/Metro Basin Implementation Plan~~, 3-3~~*.
[192] H. &. W. S. W. Consultants, ~~*Draft*~~ *South Platte/Metro Basin Implementation Plan~~, 5-21~~*.
[193] H. &. W. S. W. Consultants, *South Platte/Metro Basin Implementation Plan*,4-23.
[194] Ann Oliver and Carrie Lile, *Southwest Basin Implementation Plan* (2014), 15.
~~[195] Ann Oliver and Carrie Lile, *Draft Southwest Basin Implementation Plan* (2014), 15.~~
[196] Oliver and Lile, ~~*Draft*~~ *Southwest Basin Implementation Plan*, 14.
[197] Oliver and Lile, *Southwest Basin Implementation Plan*, 80.
[198] AMEC, ~~*Draft*~~ *Yampa/White/Green Basin Implementation Plan* (2015~~2014~~), 1-10~~9~~.
[199] G. Tchobanoglous, H. Leverenz, M. Nellor and J. Crook, *Direct Potable Reuse: A Path Forward* (Water Reuse Research Foundation and WateReuse California, 2011), 28.
~~[200] W. R. R. Foundation, *DPR Initiative* (Water Reuse Research Foundation, 2014),https://www.watereuse.org/foundation/research/DPR-Initiative.~~
~~[201] National Research Council, Water Reuse: Potential for Expanding the Nation's Water Supply Through Reuse of Municipal Wastewater, 194, National Academy of Sciences, 2012.~~
[202] P. Brandhuber, *Pilot Testing of Membrane Zero Liquid Discharge for Drinking Water Systems* (Water and Environment Reasearch Foundation, 2014), ES2-5.
[203] C.R.S. 25-8-103 (8.3-8.4); C.R.S. 25-8-205 (1)(g); C.R.S. 30-11-107 (1)(kk)~~[203] General Assembly of the State of Colorado, House Bill 13-1044, 2013.~~
[204] P. Brandhuber, S. Craig, T. Thomure, Considering the Implementation of Direct Potable Reuse in Colorado-Draft, WERF5T10b, 2015.
[205] H. &. W. S. W. Consultants, ~~*Draft*~~ *South Platte/Metro Basin Implementation Plan*, 4-19.
[206] IBCC, ~~"~~*Draft No & Low Regrets Action Plan*~~," 2013~~, 57~~.~~,~~ http://cwcb.state.co.us/water-management/basin-roundtables/Pages/main.aspx.
[207] W. Research, CDM Smith, CH2M Hill, Sustainable Practices, B. Bourquard,~~*Draft*~~ *Arkansas Basin Implementation Plan (2015)*,~~,~~ Section 1.6.2.1~~0~~,14.
[208] W. Research, CDM Smith, CH2M Hill, Sustainable Practices, B. Bourquard,~~*Draft*~~ *Arkansas Basin Implementation Plan*, Section 3.1.6, 108~~, 43~~.
[209] SGM, ~~*Draft*~~ *Colorado Basin Implementation Plan*, 37.
[210] W. W. Group, ~~*Draft*~~ *Gunnison Basin Implementation Plan,* 42.
[211] H. &. W. S. W. Consultants, ~~*Draft*~~ *South Platte/Metro Basin Implementation Plan*, 6~~5~~-2.
[212] H. &. W. S. W. Consultants, ~~*Draft*~~ *South Platte/Metro Basin Implementation Plan*, 6-2~~1-21~~.

[213] H. &. W. S. W. Consultants, ~~*Draft* *South Platte/Metro Basin Implementation Plan*~~, 1-27~~24~~.
[214] H. &. W. S. W. Consultants, ~~*Draft* *South Platte/Metro Basin Implementation Plan*~~,-1-27~~25~~.
[215] H. &. W. S. W. Consultants, ~~*Draft* *South Platte/Metro Basin Implementation Plan*~~, 4-29~~22~~.
[216] H. &. W. S. W. Consultants, *South Platte/Metro Basin Implementation Plan*, 5-30.
[217] ~~H. &. W. S. W. Consultants, *Draft South Platte/Metro Basin Implementation Plan*, 5-21.~~
[218] Oliver and Lile, ~~*Draft* *Southwest Basin Implementation Plan*~~, 14~~15~~.
[219] AMEC, ~~*Draft* *Yampa/White/Green Basin Implementation Plan*~~, 1-3.
[220] P. Brandhuber, S. Craig, T. Thomure, Considering the Implementation of Direct Potable Reuse in Colorado- Draft, WERF5T10b, 2015.
[221] P. Brandhuber, S. Craig, T. Thomure, Considering the Implementation of Direct Potable Reuse in Colorado- Draft, WERF5T10b, 2015.
[222] ~~L. Macpherson, S. Snyder, I. Law and S. Johnson, *Effect of Prior Knowledge of Unplanned Potable Reuse on the Acceptance of Planned Potable Reuse* (Water Reuse Research Foundation, 2012), 10.~~
[223] Boulder County, City and County of Denver, City and County of Broomfield, Eagle County, Grand County, Pitkin County and Summit County, *Comments on the Colorado Water Plan (March 5 - May 1, 2015)*, Item No. 67. May 1, 2015.
[224] Boulder County, City and County of Denver, City and County of Broomfield, Eagle County, Grand County, Pitkin County and Summit County, *Comments on the Colorado Water Plan (March 5 - May 1, 2015)*, Item No. 67. May 1, 2015.
[225] L. Kathlene, J. Lynn, A. Greenwade, W. Sullivan and Q. Lung, *Colorado Review: Water Management and Land Use Planning Integration* (Center for Systems Integration, 2010).; Colorado Water Conservation Board, *Calculating Per Capita Water Demand Savings from Density Increases to Residential Housing for Portfolio and Trade-off Tool* (2010), http://cwcb.state.co.us/public-information/publications/documents/reportsstudies/draftdensitytechnicalmemo.pdf.
[226] M. S. P. R. Arkansas, *East Slope Roundtable Joint Meeting Summary* (Aurora, 2013), 6.
[227] "Water Innovation Cluster," http://www.co-waterinnovation.com/2014/02/net-zero-water-initiative/.
[228] C. W. I. Cluster, *Water Resource Conservation Public Education and Outreach Grant Request: Net Zero Water,* (2014), 4.
[229] "Land Use Leadership Alliance Training Program," Pace University School of Law, accessed Septemer 2014., http://www.law.pace.edu/land-use-leadership-alliance-training-program.
[230] DRCOG, *Metro Vision 2035 Plan* (2011), 7. http://drcog.org/sites/drcog/files/resources/2011%20MV%202035%20Plan%20for%20Web5-12-11_0.pdf.
[231] DRCOG, *Regional Snapshot: MetroVision Goals* (2014), 2. http://drcog.org/sites/drcog/files/resources/Regional%20Snapshot%20-%20Metro%20Vision%202035%20Goals_0.pdf. [Accessed 2014].
[232] Colorado Water Conservation Board, *Calculating Per Capita Water Demand Savings from Density Increases to Residential Housing for Portfolio and Trade-off Tool,* 8.
[233] Clarion Associates, *Colorado Water and Growth Dialogue; Draft Research Report,* March, 2015, 51.
[234] "Colorado Water & Growth Dialogue," The Keystone Center, accessed September 2014. https://www.keystone.org/policy-initiatives-center-for-science-a-public-policy/environment/colorado-water-growth-dialogue.html.
[235] C.R.S. 29-20-103 (1); C.R.S. 29-20-301-306.~~[235] General Assembly of the State of Colorado, House Bill 08-1141, 29-5 (2008). http://www.leg.state.co.us/CLICS/CLICS2008A/csl.nsf/fsbillcont3/2657C547FB15832C8725739F0082A589?Open&file=1141_enr.pdf.~~
[236] C.R.S. 29-20-301 (1)(c)(d); C.R.S. 29-20-103 (1) ~~[236] General Assembly of the State of Colorado, Senate Bill 13-258, 23-5 (2013). http://www.leg.state.co.us/clics/clics2013a/csl.nsf/fsbillcont3/EEAA4DA5507105F487257B080065B8A3?Open&file=258_enr.pdf.~~
[237] ~~W. Research, *Draft Arkansas Basin Implementation Plan*, Section 4.3,7.~~

[238] W. Research, CDM Smith, CH2M Hill, Sustainable Practices, B. Bourquard, *Arkansas Basin Implementation Plan(2015)*, Section 4.1.6.2..
[239] W. Research, *Draft Arkansas Basin Implementation Plan*, Section 4.3,8.
[240] SGM, *Draft Colorado Basin Implementation Plan*, Section 2, 6537.
[241] SGM, *Draft Colorado Basin Implementation Plan*,Section 2, 67 33.
[242] SGM, *Colorado Basin Implementation Plan*, Section 3.2,86.
[243] W. W. Group, *Gunnison Basin Implementation Plan,* 38.
[244] W. W. Group, *Draft Gunnison Basin Implementation Plan,* 43.
[245] W. W. Group, *Gunnison Basin Implementation Plan,(2015),* 42.
[246] D. W. Consultants, *Draft Rio Grande Basin Implementation Plan*, 211.
[247] H. &. W. S. W. Consultants, *Draft South Platte/Metro Basin Implementation Plan*, 5-54.
[248] H. &. W. S. W. Consultants, *Draft South Platte/Metro Basin Implementation Plan*, 5-54.
[249] H. &. W. S. W. Consultants, *Draft South Platte/Metro Basin Implementation Plan*,-5-54.
[250] H. &. W. S. W. Consultants, *Draft South Platte/Metro Basin Implementation Plan*, 5-2421.
[251] H. &. W. S. W. Consultants, *Draft South Platte/Metro Basin Implementation Plan*, 5-5.
[252] H. &. W. S. W. Consultants, *South Platte/Metro Basin Implementation Plan*, 6-16.
[253] Oliver and Lile, *Southwest Basin Implementation Plan*,(2015) 80-81.
[254] L. Kathlene, J. Lynn, A. Greenwade, W. Sullivan and Q. Lung, *Colorado Review: Water Management and Land Use Planning Integration* (Center for Systems Integration, 2010), Table 5.2,119.
[255] CWCB, *An Analysis of Water Salvage Issues in Colorado and Supplement*, (prepared pursuant to HB91-1154), (1992)
[256] Colorado Water Conservation Board, *Water Salvage Issues*, 3.
[257] Colorado Agricultural Water Alliance, *Opportunities and Challenges*, 11.
[258] Colorado Water Conservation Board, *Water Salvage Issues*, 4.
[259] Colorado Agricultural Water Alliance, *Opportunities and Challenges*, 12.
[260] Colorado Water Conservation Board, *Water Salvage Issues*, 4.
[261] Colorado Water Conservation Board, *Water Salvage Issues*, 4.
[262] Andrew P. Jones and Thomas Cech, *Colorado Water Law for Non-Lawyers* (2009), 111.
[263] Colorado State University, *Irrigation Water Conservation*, 11.
[264] Colorado Water Conservation Board, *Water Salvage Issues*, 4.
[265] Lamm Rogers et al, *Irrigation Management Series: Efficiencies and Water Losses of Irrigation Systems* (KSU, 1997), 3.
[266] Colorado Water Conservation Board, *Water Salvage Issues*, 3.
[267] United State Bureau of Reclamation, *Phase 1 Moving Forward, Chapter 4 - Agricultural Water Conservation, Productivity and Transfers* (USBR, 2015), 4-19 – 4-20.
[268] Colorado Agricultural Water Alliance, *Opportunities and Challenges*, 15.
[269] Colorado State University, *Irrigation Water Conservation*, 14.
[270] Colorado State University, *Irrigation Water Conservation*, 14.
[271]Colorado State University, *Irrigation Water Conservation*, 14-15.
[272] Colorado Water Conservation Board, *An Analysis of Water Salvage Issues in Colorado and Supplement-Appendix C* (CWCB, 1992), 2.
[273] Colorado Water Conservation Board, *Water Salvage Issues-Appendix C*, 1.
[274] § 37-92-105(4), C.R.S.
[275] DWR Synopsis, 2011
[276] Colorado Foundation for Water Education, *Citizen's Guide to Colorado Water Law 3rd ed.* (CFWE, 2009), 14.
[277] Colorado Water Conservation Board, *Water Salvage Issues-Appendix C*, 1.
[278] United State Bureau of Reclamation, *Moving Forward-Chapter 4* , 4-14.
[279] Colorado Agricultural Water Alliance, *Opportunities and Challenges*, 12.
[280] Colorado Agricultural Water Alliance, *Opportunities and Challenges*, 15.
[281] Colorado Agricultural Water Alliance, *Opportunities and Challenges*, 15.
[282] Colorado Agricultural Water Alliance, *Opportunities and Challenges*, 15.
[283]Colorado Agricultural Water Alliance, *Opportunities and Challenges*, 15.

[284] Colorado Agricultural Water Alliance, *Opportunities and Challenges*, 15.
[285] D. W. Consultants, *Draft Rio Grande Basin Implementation Plan*, 139.
[286] National Young Farmers Coalition, *Sustaining farming in the Arid West: Stories of young farmers, water and resilience.* 2014, pp 12-13.
[287] United States Department of Agriculture, Environmental Protection Agency, U.S. Fish and Wildlife Service, U.S. Geological Survey, Bureau of Land Management, and Bureau of Reclamation: *Colorado River Basin Salinity Control Program - Federal Accomplishments Report for Fiscal Year 2011* (2011), 79. http://www.usbr.gov/uc/progact/salinity/pdfs/FedAccompRep-2011.pdf.
[288]Colorado Water Conservation Board, *Alternative Agricultural Water Transfer Methods Grant Program Summary and Status Update* (CWCB, 2012), 17.
[289] National Young Farmers Coalition, *Sustaining Farming in the Arid West: Stories of young farmers, water and resilience* (NYFC), 11-12.
[290] C.R.S. 37-92-103(1)
[291] C.R.S. 37-92-309(1)
[292] C.R.S. 37-92-305(c)
[293] C.R.S. 37-92-305
[294] C.R.S. 37-60-132(2)(s)(I)
[295] WestWater Research, CDM Smith, CH2MHILL, Peak Facilitation, *Arkansas Basin Implementation Plan,* 16.
[296] SGM, *Colorado Basin Implementation Plan* (2015), 52.
[297] Wilson Water Group, *Gunnison Basin Implementation Plan* (2015), 10.
[298] Wilson Water Group, *North Platte Basin Implementation Plan* (2015), 21.
[299] DiNatale Water Consultants, *Rio Grande Basin Implementation Plan* (2015), 58.
[300] HDR and West Sage Water Consultants, *South Platte Basin Implementation Plan* (2015), 1-26.
[301] Harris Water Engineering, *Southwest Basin Implementation Plan* (2015), 13.
[302] AMEC and Hydro Consulting, *Yampa/White/Green Basin Implementation Plan* (2015), 1-12.
[303] Colorado Agricultural Water Alliance, *Opportunities and Challenges Associated with Potential Agricultural Water Conservation Measure* (2008).
[304] Colorado Water Conservation Board (CWCB), *Draft IBCC Discussion Document for a Conceptual Agreement* (2014), 15.
[305] CWCB, *Draft IBCC Discussion Document for a Conceptual Agreement* (2014), 15.
[306] CWCB, *Draft IBCC Discussion Document for a Conceptual Agreement*, 15.
[307] Colorado Agricultural Water Alliance, *Opportunities and Challenges Associated with Potential Agricultural Water Conservation Measure*.
[308] Colorado Agricultural Water Alliance, *Opportunities and Challenges Associated with Potential Agricultural Water Conservation Measure*.
[309] CWCB, *Draft IBCC Discussion Document for a Conceptual Agreement*, 15.
[310] Colorado Agricultural Water Alliance, *Opportunities and Challenges Associated with Potential Agricultural Water Conservation Measure*.
[311] CWCB, *Draft IBCC Discussion Document for a Conceptual Agreement*, 15.
[312] Colorado Agricultural Water Alliance, *Opportunities and Challenges Associated with Potential Agricultural Water Conservation Measure* .
[313] Alliance for Water Efficiency/American Council for an Energy Efficient Economy, *Water-Energy Nexus Research: Recommendations for Future Opportunities* (2013), 5.
[314] U.S Energy Information Administration, *Annual Energy Outlook 2014, Market Trends: Electricity Demand* (2014). http://www.eia.gov/forecasts/aeo/MT_electric.cfm.
[315] Xcel Energy, *2013 Corporate Responsibility Report, Water Management* (2013). http://www.xcelenergy.com/staticfiles/xe/Corporate/CRR2013/environment/water-management.html.
[316] Colorado Electricity Portfolio in 2012 & Colorado Electricity Portfolio (Net Generation) were created by CEO.
[317] Xcel Energy, *2013 Corporate Responsibility Report, Water Management* (2013).; URS, *Energy Development Water Needs Assessment Phase 1 Report* (Glenwood Springs: Colorado, Yampa, and White River Basin Roundtables Energy Subcommittee, 2008).) pg 5-2.

[318] J. Macknick R. Newmark, G. Heath, and KC. Hallett. *A Review of Operational Water Consumption and Withdrawal Factors for Electricity Generating Technologies, NREL TechnicalNRELTechnical Report TP-6A20-50900* (2011). http://www.nrel.gov/docs/fy11osti/50900.pdf.
[319] 4 CCR 723-3 3651
[320] Meldrum, J., Nettles-Anderson, S., Heath, G., and Macknick, J. "Life cycle water use for electricity generation: a review and harmonization of literature estimates," *Environmental Research Letters 8* (2013). (http://iopscience.iop.org/1748-9326/8/1/015031/pdf/1748-9326_8_1_015031.pdf)
[321] 4 CCR 723-3 3651
[322] Colorado Department of Agriculture, *Recommendations for Developing Agricultural Hydropower in Colorado* (2013). http://www.colorado.gov/cs/Satellite?blobcol=urldata&blobheadername1=Content-Disposition&blobheadername2=Content-Type&blobheadervalue1=inline%3B+filename%3D%22Small+Hydro+Assessment.pdf%22&blobheadervalue2=application%2Fpdf&blobkey=id&blobtable=MungoBlobs&blobwhere=1252013282299&ssbinary=true.
[323] Colorado Department of Agriculture, *Recommendations for Developing Agricultural Hydropower in Colorado*.
[324] Colorado Department of Agriculture, *Recommendations for Developing Agricultural Hydropower in Colorado*.
[325] U.S. Department of the Interior, Bureau of Reclamation, *Site Inventory and Hydropower Energy Assessment of Reclamation Owned Conduits* (2012). http://www.usbr.gov/power/CanalReport/FinalReportMarch2012.pdf.
[326] U.S. Department of Energy, *Hydropower Resource Assessment and Characterization*. (2014). http://energy.gov/eere/water/hydropower-resource-assessment-and-characterization.
[327] Completed Interval Reports (Form 5A) from COGCC
[328] Annual Hydrology Reports (Rule 4.05.13.4) from DRMS
[329] Western Resource Advocates, *Water Conservation = Energy Conservation: A Report for the CWCB* (2009), 5.
[330] Cohen, R., B. Nelson, and G. Wolff, *Energy Down the Drain: The Hidden Costs of California's Water Supply* (Oakland: Natural Resources Defense Council and Pacific Institute, 2004), 2.
[331] Western Resource Advocates,. Water Conservation = Energy Conservation 2014 discussion with energy experts (Colorado Energy Office, Xcel Energy, Western Resource Advocates) 2009.
[332] Governor Bill Ritter, *Greening Government Executive Order D 0011 07* (2007). http://www.colorado.gov/. ; Governor Bill Ritter, *Greening Government Executive Order D 0012 07: Detailed Implementation* (2007). http://www.colorado.gov/.
[333] Colorado Energy Office, *2012 Colorado Greening Government Report* (2012), 12. http://www.colorado.gov/cs/Satellite/GovEnergyOffice/CBON/1251597774824.
[334] Colorado Energy Office, *2012 Colorado Greening Government Report*, 12.
[335] National Agricultural Statistics Service, Colorado Field Office, U.S. Department of Agriculture, *Colorado Agricultural Statistics* (2014), 2.
[336] Bureau of Economic Analysis, U.S. Department of Commerce, www.bea.gov (2014), 156.
[337] Bureau of Economic Analysis, U.S. Department of Commerce, www.bea.gov (2014), 156.
[338] Colorado Ag Water Alliance, *Agricultural Economics and Water Resources: Methods, Metrics and Models – A Specialty Workshop* (October 2013), *17.*
[339] Colorado Water Conservation Board, *Statewide Water Supply Initiative* (2010), 4-28.
[340] Colorado Water Conservation Board, *Statewide Water Supply Initiative*, 4-28.
[341] Colorado Water Conservation Board, *Statewide Water Supply Initiative*, 4-28.
[342] Colorado Water Conservation Board, *Statewide Water Supply Initiative*, 4-28..
[343] J. Yahn, North Sterling Irrigation District, *Lower South Platte Water Cooperative* (October 2011).
[344] Colorado River District, *Colorado River Water Bank Feasibility Study Presentation* (November 2013).
[345] Colorado Corn Growers, et. al., *Flex Market Model Project Completion Report* (June 2013), viii, 1-1, 1-2.
[346] R. McLane and J. Dingess, "The Role of Temporary Changes of Water Rights in Colorado," *University of Denver Law Review*, 17:2 (2014).
[347] McLane and Dingess, "The Role of Temporary Changes of Water Rights in Colorado."

[348] Lower Arkansas Valley Water Conservancy District, www.lavwcd.com (2011)
[349] Metropolitan Water District of Southern California, *Palo Verde Land Management, Crop Rotation, and Water Supply Program* (2013), 1-2.
[350] Metropolitan Water District of Southern California, *Palo Verde Land Management, Crop Rotation, and Water Supply Program* (2013), 1-2.
[351] Colorado Water Conservation Board, *Alternative Agricultural Water Transfer Methods, Grant Program Summary and Update*, (2012), 1-46.
[352] McLane and Dingess, "The Role of Temporary Changes of Water Rights in Colorado," 3.
[353] Colorado General Assembly, HB-13-1248, *A Bill for an Act Concerning Statewide Lease-Fallowing Pilot Projects* (2013).
[354] Colorado General Assembly, HB-13-1248, *A Bill for an Act Concerning Statewide Lease-Fallowing Pilot Projects* (2013).
[355] Colorado Water Conservation Board, *Criteria and Guidelines for Fallowing-Leasing Pilot Projects* (November 2013).
[356] W. Research, ~~*Draft*~~ *Arkansas Basin Implementation Plan* (2014), Section 1, 15. http://coloradowaterplan.com.
[357] W. Research, ~~*Draft*~~ *Arkansas Basin Implementation Plan*, Section 1, 16.
[358] W. Research, ~~*Draft*~~ *Arkansas Basin Implementation Plan*, Section 1, 16.
[359] W. Research, ~~*Draft*~~ *Arkansas Basin Implementation Plan*, Section 4.6, 4-9.
[360] SGM, ~~*Draft*~~ *Colorado Basin Implementation Plan* (2014), 49~~28~~. http://coloradowaterplan.com.
[361] W. W. Group, ~~*Draft*~~ *Gunnison Basin Implementation Plan* (2014), 32-33. http://coloradowaterplan.com/.
[362] W. W. Group, ~~*Draft*~~ *North Platte Basin Implementation Plan* (2014), 23-24. http://coloradowaterplan.com.
~~[363] D. W. Consultants, *Draft Rio Grande Basin Implementation Plan* (2014), 275. http://www.coloradowaterplan.com.~~
[364] D. W. Consultants, *Rio Grande Basin Implementation Plan* (2014), 275. http://www.coloradowaterplan.com.
[365] H. &. W. S. W. Consultants, ~~*Draft*~~ *South Platte/Metro ~~Basin~~ Basin Implementation Plan* (2014), Section 1, 26~~23~~. http://www.coloradowaterplan.com
~~[366] H. &. W. S. W. Consultants, *Draft South Platte/Metro Basin Implementation Plan*,Section 6, 3-10.~~
[367] H. &. W. S. W. Consultants, ~~*Draft*~~ *South Platte/Metro Basin Implementation Plan*, Section 6, 3-4~~12~~
~~[368] H. &. W. S. W. Consultants, *Draft South Platte/Metro Basin Implementation Plan*, Section 4, 25.~~
[369] H. &. W. S. W. Consultants, *South Platte/Metro Basin Implementation Plan*, Section 4, 32.
[370] Ann Oliver and Carrie Lile, ~~*Draft*~~ *Southwest Basin Implementation Plan* (2015), 13~~2014), 14~~. http://www.coloradowaterplan.com.
[371] AMEC, ~~*Draft*~~ *Yampa/White/Green Basin Implementation Plan* (2014), Section 1, 8-9. http://www.coloradowaterplan.com.
[372] AMEC, ~~*Draft*~~ *Yampa/White/Green Basin Implementation Plan* , Section 4, 13-14.
[373] Inter-Basin Compact Committee, *Draft Low and No Regrets Action Plan*~~,~~ (2013)~~,)~~ Section 1, 5.
[374] Colorado Water Conservation Board, *SB06-193 Underground Water Storage Study* (Denver: CWCB, 2007).
[375] Colorado Water Conservation Board, *SB06-193 Underground Water Storage Study*.
[376] Colorado Division of Water Resources, *Administration Protocol: Recharge, Division One – South Platte River.* Revised Feb. 1 2008. Retrieved at http://water.state.co.us/DWRIPub/Documents/div1protocol_recharge.pdf.
[377] Colorado Geological Survey, *Artificial Recharge of Ground Water in Colorado – A Statewide Assessment* (Denver: CGS, 2004).
[378] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010* (Denver: CWCB, 2011) 5-2.
[379] WestWater Research, CDM Smith, CH2MHILL, Peak Facilitation, ~~*Draft*~~ *Arkansas Basin Implementation Plan* (Colorado Springs: WestWater Research, 2014) Executive Summary.
[380] WestWater Research, CDM Smith, CH2MHILL, Peak Facilitation, ~~*Draft*~~ *Arkansas Basin Implementation Plan,* 4.1, 3-5.
[381] WestWater Research, CDM Smith, CH2MHILL, Peak Facilitation, *Arkansas Basin Implementation Plan,* Arkansas River Basin Project Database.

~~382 WestWater Research, CDM Smith, CH2MHILL, Peak Facilitation, *Draft Arkansas Basin Implementation Plan*, 5, 3-7.~~
383 SGM, ~~*Draft* *Colorado Basin Implementation Plan* (Glenwood Springs: SGM, 2014) 45.~~
384 SGM, *Colorado Basin Implementation Plan*, 125-134.
~~385 SGM, *Draft Colorado Basin Implementation Plan*, 50-118.~~
386 SGM, *Colorado Basin Implementation Plan*, 125-134.
387 Wilson Water Group, ~~*Draft* *Gunnison Basin Implementation Plan* (Denver: Wilson Water Group, 2014), 2.~~
388 Wilson Water Group, ~~*Draft* *Gunnison Basin Implementation Plan*, 75~~.
389 Wilson Water Group, ~~*Draft* *Gunnison Basin Implementation Plan*, 5.~~
390 Wilson Water Group, *Gunnison Basin Implementation Plan*, 88-94.
~~391 Wilson Water Group, *Draft Gunnison Basin Implementation Plan*, 88-94.~~
392 Wilson Water Group, *Gunnison Basin Implementation Plan*, 8.
393 Wilson Water Group, ~~*Draft* *North Platte Basin Implementation Plan* (Denver: Wilson Water Group, 2014) 2.~~
394 Wilson Water Group, ~~*Draft* *North Platte Basin Implementation Plan*, 61.~~
395 Wilson Water Group, *North Platte Basin Implementation Plan*, 71.
~~396 Wilson Water Group, *Draft North Platte Basin Implementation Plan*, 71.~~
397 Wilson Water Group, ~~*Draft* *North Platte Basin Implementation Plan*, 63-64.~~
398 Wilson Water Group, *North Platte Basin Implementation Plan*, 2-5.
399 DiNatale Water Consultants, ~~*Draft* *Rio Grande Basin* *Implementation* ~~*Water*~~ *Plan* (Boulder: DiNatale Water Consultants, 2014) 121.~~
400 DiNatale Water Consultants, ~~*Draft* *Rio Grande Basin* *Implementation*~~*Water* *Plan*, 116-151~~252-272~~.
401 DiNatale Water Consultants, ~~*Draft* *Rio Grande Basin* *Implementation* ~~*Water*~~ *Plan* (Boulder: DiNatale Water Consultants, 2014)~~ 154-155~~252-272~~.
402 DiNatale Water Consultants, *Rio Grande Basin Implementation Plan*, 150-155.
~~403 DiNatale Water Consultants, *Draft Rio Grande Basin Water Plan*, 252-278.~~
404 HDR, WestSage Water Consultants, ~~*Draft* *South Platte Basin Implementation Plan* (Denver: HDR, West Sage Water Consultants, 2014) 1-1.~~
405 HDR, WestSage Water Consultants, ~~*Draft* *South Platte Basin Implementation Plan*, 1-1-21~~.
406 HDR, WestSage Water Consultants, ~~*Draft* *South Platte Basin Implementation Plan*, 1-24~~21~~.
407 HDR, WestSage Water Consultants, *South Platte Basin Implementation Plan*, 4-15 – 4-35.
~~408 HDR, WestSage Water Consultants, *Draft South Platte Basin Implementation Plan*, 4-11 – 4-30.~~
409 Harris Water Engineering, ~~*Draft* *Southwest Basin Implementation Plan* (Durango: Harris Water Engineering, 2014) 11-20.~~
410 Harris Water Engineering, ~~*Draft* *Southwest Basin Implementation Plan*, 73~~3~~.
411 Harris Water Engineering, ~~*Draft* *Southwest Basin Implementation Plan*, 11.~~
412 Harris Water Engineering, ~~*Draft* *Southwest Basin Implementation Plan*, Appendix A.~~
413 AMEC, ~~*Draft* *Yampa/White/Green Basin Implementation Plan (*Denver: AMEC, 2014) i.~~
414 AMEC, ~~*Draft* *Yampa/White/Green Basin Implementation Plan*, i.~~
415 AMEC, ~~*Draft* *Yampa/White/Green Basin Implementation Plan*, 4-11 – 4-19.~~
416 AMEC, *Yampa/White/Green Basin Implementation Plan*, 4-11 – 4-19.
~~417 AMEC, *Draft Yampa/White/Green Basin Implementation Plan*, 4-11 – 4-19.~~
418 Executive Order D2013-005.
419 Jake Salcone and James Pritchett, *Value of Water Used in Agriculture for the Arkansas River Basin*, February 4, 2014.
420 WestWater Research, CDM Smith, CH2M, Peak Facilitation, *Arkansas Basin Implementation Plan*, 16.
421 SGM, *Colorado Basin Implementation Plan*, 12.
422 SGM, *Colorado Basin Implementation Plan*, 29.
423 SGM, *Colorado Basin Implementation Plan*, 52-53.
424 Wilson Water Group, *Gunnison Basin Implementation Plan*, 9-10.
425 Wilson Water Group, *Gunnison Basin Implementation Plan*, 32.
426 Wilson Water Group, *North Platte Basin Implementation Plan*, 3.
427 Wilson Water Group, *North Platte Basin Implementation Plan*, 18.

[428] Wilson Water Group, *North Platte Basin Implementation Plan*, 24.
[429] Wilson Water Group, *North Platte Basin Implementation Plan*, 30-31.
[430] DiNatale Water Consultants, *Rio Grande Basin Water Plan*, 8.
[431] DiNatale Water Consultants, *Rio Grande Basin Water Plan*, 14-15.
[432] DiNatale Water Consultants *Rio Grande Basin Implementation Plan* 106-107.
[433] DiNatale Water Consultants *Rio Grande Basin Implementation Plan* 108-109.
[434] DiNatale Water Consultants *Rio Grande Basin Implementation Plan* 150-151.
[435] DiNatale Water Consultants *Rio Grande Basin Implementation Plan* 156.
[436] HDR, WestSage Water Consultants, *South Platte Basin Implementation Plan*, S-10.
[437] HDR, WestSage Water Consultants, *South Platte Basin Implementation Plan*, S-13.
[438] HDR, WestSage Water Consultants, *South Platte Basin Implementation Plan*, 5-13.
[439] Harris Water Engineering, *Southwest Basin Implementation Plan*, 2.
[440] Harris Water Engineering, *Southwest Basin Implementation Plan*, 13.
[441] Harris Water Engineering, *Southwest Basin Implementation Plan*, 13.
[442] Harris Water Engineering, *Southwest Basin Implementation Plan*, 13.
[443] Harris Water Engineering, *Southwest Basin Implementation Plan*, 73.
[444] AMEC, *Yampa/White/Green Basin Implementation Plan*, 1-9.
[445] AMEC, *Yampa/White/Green Basin Implementation Plan*, E-1 – E2.
[446] AMEC, *Yampa/White/Green Basin Implementation Plan*, 1-9.
[447] AMEC, *Yampa/White/Green Basin Implementation Plan*, 1-9.
[448] Wilson Water Group, ~~*Draft*~~ *North Platte Basin Implementation Plan*, 61.
[449] Wilson Water Group, ~~*Draft*~~ *Gunnison Basin Implementation Plan*, 88-94.
[450] SGM, ~~*Draft*~~ *Colorado Basin Implementation Plan*, 50-118.
[451] Colorado Water Conservation Board, *Nonconsumptive Toolbox Report* (Denver: CWCB, 2013~~).~~ Appendix G.
[452] Interbasin Compact Committee. *Draft Conceptual Agreement* (2014). http://cwcbweblink.state.co.us/WebLink/ElectronicFile.aspx?docid=191531&searchid=0e0a416b-3b1d-4d97-92ec-c12350d56016&dbid=0.
[453] The Nature Conservancy, email message to CWCB with comments on *Colorado Water Plan*, June 25, 2015.
[454] Colorado Water Conservation Board, *Nonconsumptive Toolbox Report*~~, (Denver: CWCB, 2013)~~ Appendix E.
[455] Colorado Water Conservation Board, *Nonconsumptive Toolbox Report,* Appendix A.
[456] C.R.S. ~~Senate Bill 73-97 is codified at section~~ 37-92-102(3), ~~C.R.S.~~
[457] *Colorado River Water Conservation Dist. v. Colorado Water Conservation Bd.*, 594 P.2d 570, 594 (Colo. 1979).
[458] *Colorado River Water Conservation Dist. v. Colorado Water Conservation Bd.*, 594 P.2d 570, 594 (Colo. 1979).
[459] § 37-92-102(3), C.R.S. (2014).
[460] § 37-92-102(4)(a), C.R.S. (2014).
[461] § 37-92-102(3)(c), C.R.S. (2014).
~~[462] § 37-92-102(3) and § 37-83-105(2), C.R.S. and Rule 6 of the CWCB's Rules Concerning the Colorado Instream Flow and Natural Lake Level Program govern the CWCB's acquisition of water for instream flow use. The Rules are located at: http://cwcb.state.co.us/legal/Documents/Rules/Final%20Adopted%20ISF%20Rules%201-27-2009.pdf.~~
[463] Instream Flow and Natural Lake Level Database; http://cwcb.state.co.us/technical-resources/instream-flow-water-rights-database/Pages/main.aspx.
~~[464] In 2002, the General Assembly passed Senate Bill 156, authorizing the CWCB to use acquired water to improve the natural environment to a reasonable degree (codified at section 37-92-102(3), C.R.S.).~~
~~[465] Information on CWCB's instream flow water acquisitions is located at: http://cwcb.state.co.us/environment/instream-flow-program/Pages/CompletedTransactions.aspx.~~
~~[466] § 37-92-102(5) and (6), § 37-92-103(10.1) and (10.3), and § 37-92-305(13), C.R.S. and the CWCB's Recreational In-Channel Diversion Rules govern RICD appropriations. The Rules are located at: http://cwcb.state.co.us/legal/Documents/Rules/RICDrules2006Novhearing.pdf.~~
[467] § 37-92-103(10.3), C.R.S. (2014).

[468] § 37-92-103(10.3), C.R.S. (2014).
[469] § 37-92-102(6), C.R.S. (2014).
[470] § 37-92-102(6), C.R.S. (2014).
[471] 16 U.S.C. §1531, § 7 (1973)~~[471] 16 U.S.C. §1531, § 7 (1973). ESA documents at: http://www.fws.gov/endangered/esa-library/index.html#esa. ESA-related regulations and policies at: http://www.fws.gov/endangered/laws-policies/regulations-and-policies.html.~~

~~[472] Information on the UCCRIP is located at: http://www.coloradoriverrecovery.org/index.html.~~
~~[473] Information on the SJRIP is located at: http://www.fws.gov/southwest/sjrip/. Also, detailed summaries of the UCRIP and SJRIP programs can be found at: www.coloradoriverrecovery.org/general-information/general-publications/briefingbook/2014HighlightsDig.pdf.~~
~~[474] Information on the PRRIP is located at: https://www.platteriverprogram.org/Pages/Default.aspx.~~
[475] "Range-Wide Conservation Agreement and Strategy for Roundtail Chub *Gila Robusta*, Bluehead Sucker *Catostomus Discobolus*, and Flannelmouth Sucker *Catostomus Latipinnis,*" Utah Department of Natural Resources, Division of Wildlife Resources, Publication Number 06-18, 2006, 1. http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/RecoveryPlans/ChubSuckerRangewideConservationAgreementandStrategy01-04-07.pdf.~~ http://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/RecoveryPlans/ChubSuckerRangewideConservationAgreementandStrategy01-04-07.pdf.~~
[476] CRCT Coordination Team, Conservation strategy for Colorado River cutthroat trout (*Oncorhynchus clarkii pleuriticus*) in the States of Colorado, Utah, and Wyoming. Colorado Division of Wildlife, Fort Collins, CO. (2006):24. http://cpw.state.co.us/Documents/Research/Aquatic/pdf/CRCT_Conservation_Strategy_Jun06.pdf.
[477] See http://www.fws.gov/mountain-prairie/pressrel/07-38.htm.
[478] CRCT Coordination Team, *Conservation strategy for Colorado River cutthroat trout (Oncorhynchus clarkii pleuriticus) in the States of Colorado, Utah, and Wyoming* (Fort Collins: Colorado Division of Wildlife, 2006),13-14, 24.
[479] Kevin R. Bestgen, Kevin B. Rogers, and Robert Granger, *Phenotype Predicts Genotype for Lineages of Native Cutthroat Trout in the Southern Rocky Mountains* (November 2013). http://cpw.state.co.us/Documents/Research/Aquatic/CutthroatTrout/2013CutthroatTroutMeristics.pdf.
[480] 16 U.S.C. 1271-1287 (1968)~~). Information on the various federal agencies' roles is located at: http://www.rivers.gov/agencies.php.~~
[481] Interagency Wild and Scenic Rivers Coordinating Council, *The Wild & Scenic River Study Process* (1999), 2. http://www.rivers.gov/documents/study-process.pdf.~~ http://www.rivers.gov/documents/study-process.pdf.~~
[482] 16 USC 1271-1287 (1968).
C.R.S. ~~[483] Senate Bill 09-125, codified at~~ § 37-60-122.3, ~~C.R.S. (2014).~~
[484] National Wild and Scenic Rivers System, "Managing Agencies," ~~(~~accessed September ~~11/~~14, ~~/~~2014.~~),~~ http://www.rivers.gov/agencies.php.
[485] ~~"Information on the~~ South Platte Enhancement Board," ~~is located at:~~ http://southplatte.org/.
[486] CDM Smith, ~~The maps are available as part of the Statewide Water Supply Initiative (~~*SWSI*~~)~~ *2010* ~~report Section 2 and in more detail in~~ *Appendix C* (Denver: CWCB, 2010). ~~.~~
[487] CDM, *Nonconsumptive Needs Assessment Focus Map*~~Mapping~~ *Report,* (Denver: CWCB,~~Appendix C (July~~ 2010). ~~This report is located at:~~ http://cwcbweblink.state.co.us/WebLink/ElectronicFile.aspx?docid=143889&searchid=a05c7436-830c-490a-a93b-a24fe22bf46e&dbid=0 .
[488] CDM,~~*Colorado's* Nonconsumptive Needs *and* Projects and Methods Implementation,~~ (Denver: CWCB, ~~November~~ 2011~~, located at:~~ http://cwcb.state.co.us/environment/non-consumptive-needs/Documents/NonconsumptiveFactSheet.pdf.
[489] CDM Smith,~~The information and the maps are summarized in~~ *SWSI 2010 Appendix D*~~Section 3~~ – *Nonconsumptive Needs Toolbox,* (Denver: CWCB, 2010).; CDM Smith, *SWSI 2010*~~Projects and Methods. More detailed information is contained in SWSI~~ *Appendix F – Nonconsumptive Needs Assessment Survey Interview Projects,* (Denver: CWCB, 2010).; CDM Smith, ~~and~~ *SWSI 2010 Appendix G –Nonconsumptive Needs Assessment*

Project Analysis, (Denver: CWCB, 2010). ~~. The information and maps also are contained in the Nonconsumptive Needs Toolbox in the Needs and Opportunities section and in Appendix D.~~

[490] Camp, Dresser and McKee, Inc. et. al, ~~,~~"*Watershed Flow Evaluation Tool Pilot Studies for Roaring Fork and Fountain Creek Watersheds and Site-Specific Quantification Pilot Study for Roaring Fork Watershed* (~~,~~" June 2009)~~, at~~ 1-3, 1-4.

[491] Tetra Tech Inc., Habitech, Inc., Walsh Aquatic Consultants, Inc., *Draft Report Stream Management Plan Phase 3, Grand County, Colorado*, (Grand County, Colorado, 2010), ES-1. http://co.grand.co.us/412/Stream-Management-Plan-Phase-3.

[492] Tetra Tech Inc., Habitech, Inc., Walsh Aquatic Consultants, Inc., *Draft Report Stream Management Plan Phase 3, Grand County, Colorado*, (Grand County, Colorado, 2010), ES-1

[493] Tetra Tech Inc., Habitech, Inc., Walsh Aquatic Consultants, Inc., *Draft Report Stream Management Plan Phase 3, Grand County, Colorado*, (Grand County, Colorado, 2010), ES-22-25.

[494] C.R.S.~~Senate Bill 73-97, codified at~~ § 37-92-102(3), ~~C.R.S.~~

[495] C.R.S.~~Senate Bill 73-97, codified at~~ § 37-92-102(3), ~~C.R.S.~~

[496] C.R.S.~~Senate Bill 02-156, codified at~~ § 37-92-102(3), ~~C.R.S.~~

[497] C.R.S.~~HB 03-1320 and HB 05-1039, codified at~~ § 37-83-105(2)~~.), C.R.S.~~

[498] C.R.S.~~HB-1012 and HB-1280, codified at~~ § 37-92-102(3)~~.), C.R.S.~~

[499] C.R.S.~~HB 08-1046, codified at~~ § 37-60-123.7~~, C.R.S~~.

[500] C.R.S.~~SB 08-168, codified at~~ § 24-33-111(2)(a)(II)~~.), C.R.S.~~

[501] C.R.S.~~HB 09-1067, codified at~~ § 39-22-533~~, C.R.S~~.

[502] C.R.S.~~SB 01-216, codified at~~ § 37-92-102(5~~.) and (~~6), C.R.S.~~§~~§ 37-92-103(10.1~~,~~) and (~~10.3)~~,)~~ and C.R.S. § 37-92-305(13)~~.), C.R.S.~~

[503] C.R.S.~~SB 06-37, codified at~~ § 37-92-102(5~~.) and (~~6), C.R.S.~~§~~§ 37-92-103(10.1~~,~~) and (~~10.3)~~,)~~ and C.R.S. ~~§§n~~ 37-92-305(13)~~.), C.R.S.~~

[504] Colorado Water Conservation Board, *Nonconsumptive Toolbox Report*, 5.

[505] WestWater Research, CDM Smith, CH2MHILL, Peak Facilitation, ~~*Draft*~~ *Arkansas Basin Implementation Plan* (Colorado Springs: WestWater Research, 2014), Section 4-7.

[506] WestWater Research, CDM Smith, CH2MHILL, Peak Facilitation, *Arkansas Basin Implementation Plan,* Section 4-7.

[507] ~~WestWater Research, CDM Smith, CH2MHILL, Peak Facilitation, *Draft Arkansas Basin Implementation Plan,* Section 4-7.~~

[508] ~~WestWater Research, CDM Smith, CH2MHILL, Peak Facilitation, *Draft Arkansas Basin Implementation Plan,* Section 4-7.~~

[509] SGM, *Draft Colorado Basin Implementation Plan* (Glenwood Springs: SGM, 2014), 2.

[510] ~~SGM, *Draft Colorado Basin Implementation Plan,* 50-118.~~

[511] SGM, *Draft Colorado Basin Implementation Plan,* 50-118.

[512] Wilson Water Group, ~~*Draft*~~ *Gunnison Basin Implementation Plan* (Denver: Wilson Water Group, 2014), 2.

[513] Wilson Water Group, ~~*Draft*~~ *Gunnison Basin Implementation Plan*, 109.

[514] Wilson Water Group, *Gunnison Basin Implementation Plan*, 5.

[515] ~~Wilson Water Group, *Draft Gunnison Basin Implementation Plan*, 5.~~

[516] Wilson Water Group, ~~*Draft*~~ *Gunnison Basin Implementation Plan*, 8~~7~~.

[517] Wilson Water Group, ~~*Draft*~~ *Gunnison Basin Implementation Plan*, 8~~2~~.

[518] Wilson Water Group, ~~*Draft*~~ *Gunnison Basin Implementation Plan*, 35.

[519] Wilson Water Group, ~~*Draft*~~ *North Platte Basin Implementation Plan* (Denver: Wilson Water Group, 2014), 2.

[520] Wilson Water Group, ~~*Draft*~~ *North Platte Basin Implementation Plan*, 17.

[521] Wilson Water Group, ~~*Draft*~~ *North Platte Basin Implementation Plan*, 20.

[522] Wilson Water Group, ~~*Draft*~~ *North Platte Basin Implementation Plan*, 24.

[523] Wilson Water Group, ~~*Draft*~~ *North Platte Basin Implementation Plan*, 66-70.

[524] Wilson Water Group, ~~*Draft*~~ *North Platte Basin Implementation Plan*, 23.

[525] DiNatale Water Consultants, ~~*Draft*~~ *Rio Grande Basin Water Plan* (Boulder: DiNatale Water Consultants, 2014), Section 3.2.

[526] DiNatale Water Consultants, ~~*Draft*~~ *Rio Grande Basin Implementation*~~*Water*~~ *Plan*, 150-156~~Section 6.2~~.

[527] DiNatale Water Consultants, ~~*Draft*~~ *Rio Grande Basin* *Implementation*~~*Water*~~ *Plan*, 156-157~~252-272~~.
[528] DiNatale Water Consultants, ~~*Draft*~~ *Rio Grande Basin* *Implementation*~~*Water*~~ *Plan*, 150-156~~275-277~~.
[529] DiNatale Water Consultants, ~~*Draft*~~ *Rio Grande Basin* *Implementation*~~*Water*~~ *Plan*, 150-156~~273-274~~.
[530] DiNatale Water Consultants, ~~*Draft*~~ *Rio Grande Basin Water Plan*, 277.
[531] HDR, WestSage Water Consultants, *South Platte Basin Implementation Plan,* 1-28.
~~[532] HDR, WestSage Water Consultants, *Draft South Platte Basin Implementation Plan* (Denver: HDR, West Sage Water Consultants, 2014), 1-22 – 1-26.~~
~~[533] HDR, WestSage Water Consultants, *Draft South Platte Basin Implementation Plan,* Appendix D-39.~~
[534] HDR, WestSage Water Consultants, ~~*Draft*~~ *South Platte Basin Implementation Plan,* D-14.
[535] Harris Water Engineering, ~~*Draft*~~ *Southwest Basin Implementation Plan* (Durango: Harris Water Engineering, 2014), 74.
[536] Harris Water Engineering, *Southwest Basin Implementation Plan,* 3.
~~[537] Harris Water Engineering, *Draft Southwest Basin Implementation Plan*, Appendix.~~
[538] Harris Water Engineering, ~~*Draft*~~ *Southwest Basin Implementation Plan*, Appendix.
[539] Harris Water Engineering, ~~*Draft*~~ *Southwest Basin Implementation Plan,* 17.
[540] Harris Water Engineering, ~~*Draft*~~ *Southwest Basin Implementation Plan*, 89-102.
[541] AMEC, ~~*Draft*~~ *Yampa/White/Green Basin Implementation Plan* (Denver: AMEC, 2014), 1-10.
[542] AMEC, ~~*Draft*~~ *Yampa/White/Green Basin Implementation Plan*, 4-11 – 4-12.
[543] AMEC, ~~*Draft*~~ *Yampa/White/Green Basin Implementation Plan,* 4-20 – 4-26.

coloradowaterplan.com
cowaterplan@state.co.us
Direct: 303-866-3441

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 that~~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 watershed management about~~water~~ quality and quantity 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

Watersheds connect terrestrial, freshwater, and coastal ecosystems, and provide ecosystem services, such as carbon sequestration, water supply, filtration, and purification.[1] 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.[2] Watershed health management strategies developed to protect this domestic supply will also protect other uses in the watershed.

Colorado's mountain watersheds have a strong influence on the quality and quantity of water. Watershed geography includes physical aspects~~science~~, such as climate and geology, ecological aspects such as stream biology, as well as the relationship that humans have with the land and water. Healthy watersheds provide ecosystem services that benefit ecological processes, local and

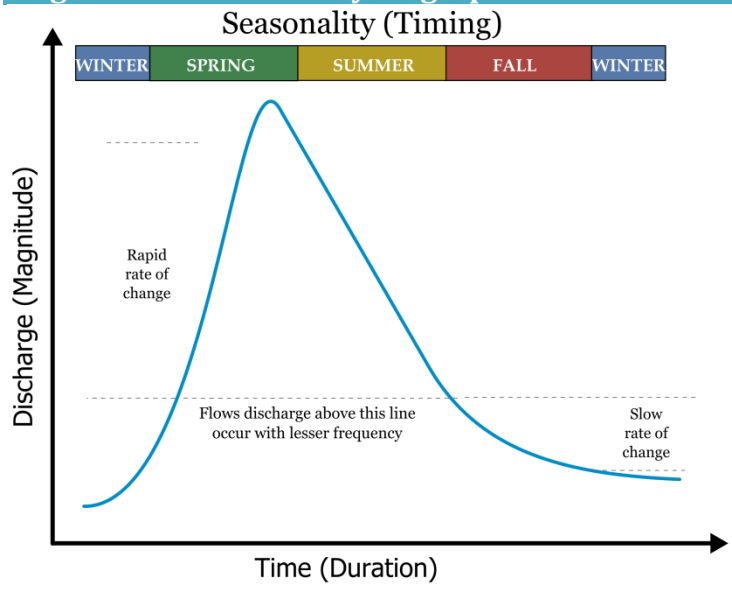
state economies, and social stability. Ecosystem services include flow regulation, flood attenuation, water purification, erosion control, and habitat protection.

This section begins by defining the physical processes that influence watershed health and then discussesconcludes with recommended strategies for successful stewardship of watersheds and water supply. It concludes with, and a summary of the watershed health strategies developed in the Basin Implementation Plans (BIPs).

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." Headwater areasForested watersheds are the natural forebays of Colorado's water supply. Headwater areas include forested watersheds, intermountain wetland complexes (parks), and the riparian corridors of stream valleys. 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 watersheda watershed's health.

Figure 7.1-1: Stream Hydrograph



Watershed health can be broadly defined as a measure of ecosystem structure and function. Structure refers to species Species richness (characterized by abundance and diversity), inorganic and organic resources, and physical attributes (including habitat complexity).of an area comprise structure. Function refers to ecosystem processes such as the hydrologic cycle, nutrient cycling, energy flowproductivity and successionhydrology. [3] A critical componentelement of the hydrologic cyclefunction 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. This figureIt 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.

Watersheds support dynamic ecosystems that are subject to natural perturbations, such as fire, flood, and drought.[4] Resilient ecosystems existfunction in a state of dynamic equilibrium, (e.g., the flow regime may deviate around a mean while still maintaining its function).. These watersheds experience natural disturbances with littleno substantial impact on function. Often, the impacts from fire, flood, and drought are exacerbated by anthropogenic, or human induced, impacts. perturbations. For example, watersheds that have historically been managed to suppressexclude fires have changed ecosystem structure and productivity. This results in fires that burn with greater intensity and leads to soil hydrophobicity that increases runoff and erosion. When natural ecosystem functionsfunction thresholds are alteredcrossed, a watershed no longer exists in equilibrium. The resultant changes to hydrologic function and water quality have direct effects on water supply and infrastructure.

Watersheds work to Sediment is the most concerning non-point source pollutant contributed from our forested lands.[5] An acceleratedunbalanced 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 and riparian corridors 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 bywith increasing temperatures, alteringaltered precipitation patterns, and causing earlier snowmelt. This results 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]

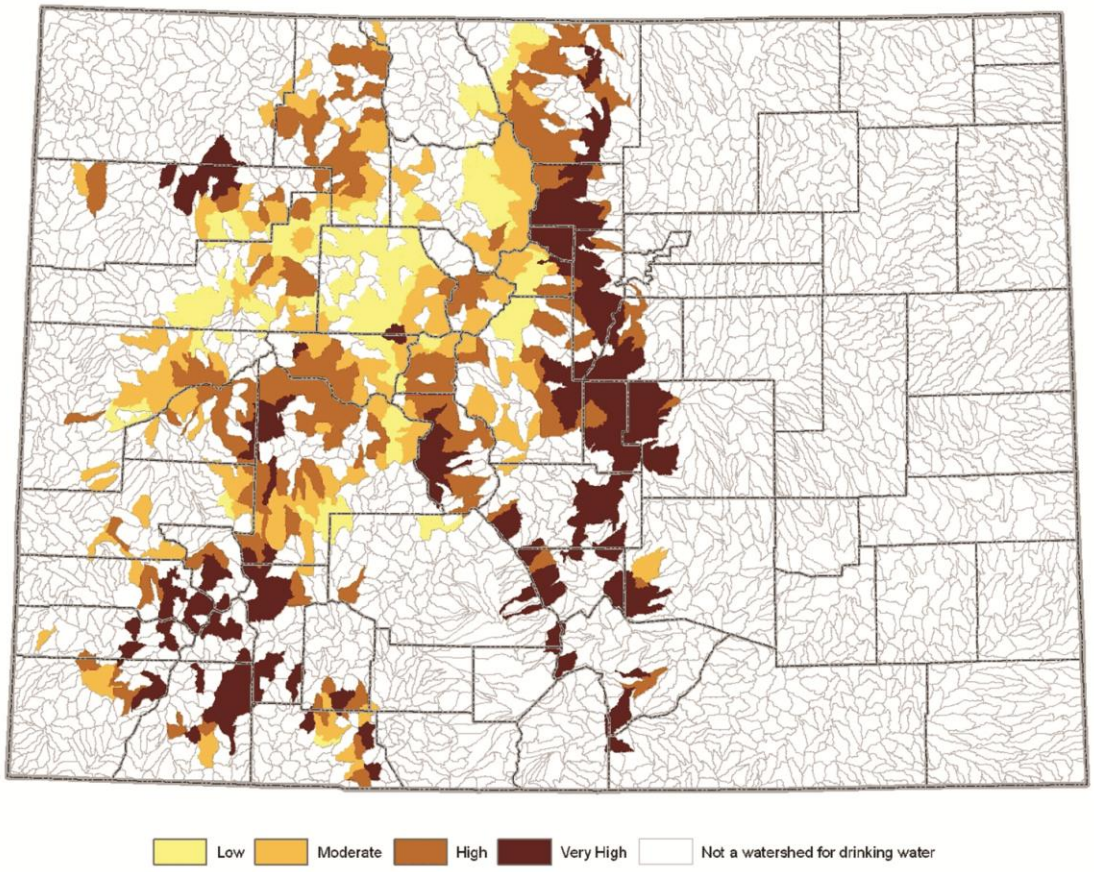
While forests are vital to overall watershed health, the physical extension of these lands are comprised of the lower elevation rangelands. Rangelands, wetlands and riparian corridors play have a substantialsignificant role in water storage, transport, sediment control, water quality, wildlife habitat, and streamflows. Lower elevation watershed health maycan be favorably influenced by the presence of wetland complexes and optimal agricultural practices.

Watershed Partnerships

~~Managing partnerships for healthy watersheds~~

Managing watersheds for healthy ecosystem structure and function can provide~~is~~ a unique opportunity for watershed~~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 span~~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.

Figure 7.1-2: Colorado State Forest Service Risk of Post-fire Erosion in Watersheds That are Important Sources of Drinking Water



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).[10] 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, aquatic and riparian habitat enhancement, and land use change. The Front Range flooding of September 2013 resulted in the formation of ten new watershed coalitions that developed master plans focusing on stream restoration.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.

The State of Colorado recommends partnerships form anAn organizational structure that consists of a diverse stakeholder group and a coordinator. This structure is recommended whether or not the coalition chooses to become incorporatedincorporate. 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 that actions to improve watershed health will be successful. Engaged community members arewill be more likely to participate in building political will, developing management options, and supporting project implementation. Stakeholder representation includes 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 paid watershed coordinator that works for the coalition improves the chances for continued coalition success by servicingbecause the coordinator serves all coalition stakeholders equally, and representingrepresents 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.[11]

Ideally partnerships work to develop a watershed plan.Watershed planning can happen at different levels depending on the coalition's mission, objectives, and goals. A watershed plan is a strategy that defines a coalition's mission, goals and objectives along withprovides assessment and management information for a geographically defined watershed, including the analyses, actions, participants, and resources related to developing and implementing the plan. It may include or be informed by a streamflow management plan (defined in Chapter 6.6). It can be developed as a guide for mitigation of fires, floods, or the development of new infrastructure. It can also be developed as a holistic approach for the rehabilitation of stream systems. The development of a watershed plan will require a leader with a certain level of technical expertise and the participation of a variety of stakeholderspeople with diverse skills and knowledge to. Different members of the coalition have varying skill sets that aid in the assemblage and assimilation of watershed information (e.g., geographic information systemsGIS 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 processes.~~productivity and function.~~ This approach expedites cooperative and integrated water supply planning, which leads to successful implementation of watershed health management strategies. Examples of partnerships formed to address these issues are detailed below.

Forest Health Partnerships

Fires are a part of Colorado's forest ecosystems. Forest management to prevent fires has proven to exacerbate burn intensity.[12] 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.[13] 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, and local governments~~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), the Colorado State Forest Service, the U.S.~~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. The 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. It is the success of partnerships like the Watershed Wildfire Protection Group that serve as examples for

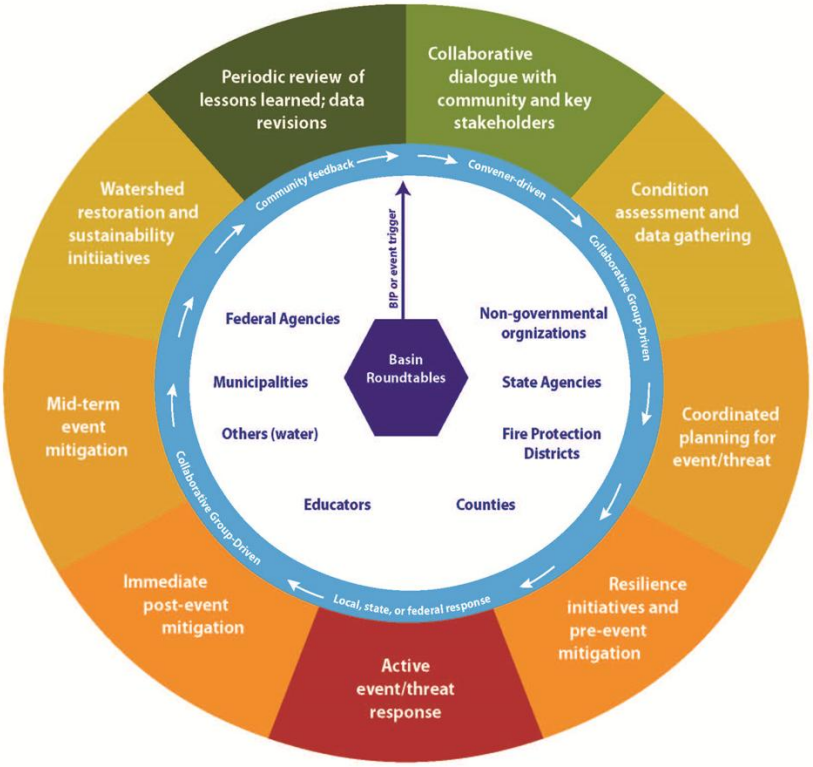
other watershed partnerships in the effort to build consensus among diverse stakeholders and implement cost-effective strategies that benefit all interests.

Basin Implementation Plan Strategies

~~BIP strategies~~

Watershed health for ~~the~~ individual basins is largely focused on forest health concerns. The 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.

Figure 7.1-3: Coalition Stakeholder Figure



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.[14]

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 and is closely aligned with that of the Arkansas Basin's approach to watershed health. 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 the ~~RWEACT (~~Rio Grande Watershed Emergency Action Coordination Team (RWEACT) has modeled post fire hydrology, improved their ability to forecast storms, identified ~~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.[15]

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.[16]

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 dialogue and action fostered by these efforts can help protect critical water supplies from fire risk, contaminants or other hazards.[17]

The Yampa, White, and Green Basin state that more than 1/3~~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~~Wildfire~~ planning is frequently~~frenquently~~ recommended for watersheds critical to water supply. They provide composite hazard rankings for wildfire hazards, flooding/debris flow risk, and soil erodibility. This data are~~is~~ combined with Source Water Assessment and Protection data to prioritize critical watersheds.[18] 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.[19]

The Gunnison Basin is addressing forest health concerns by partnering with the Colorado State and U.S. Forest Services to manage forests, insects, and wildfire. They also expect~~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. However, there are several local watershed groups working in the Gunnison Basin to address general watershed health and specific water quality challenges. These groups have developed comprehensive watershed plans.[20]

A goal of the North Platte Basin is to enhance forest health and management efforts for wildfire protection and beetle kill impacts to watershed health. To reach this goal the basin has funded a

majorThe 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.[21]

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 and there are currently 18 Community Wildfire Protection Plans within the basin.[22].

Actions

To better understand and promote watershed health, it is importantand to support the 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 action plans should bethe actions are the watershed coalitions andor forest partnerships. Water supply stakeholders should participate inare responsible for the development of effective watershed coalitions. Coordination across watershed divides shouldcan 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, the 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 to identifywith tools and resources thatto 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 andor 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

Colorado's Water Plan promotes water resource resilience from natural disasters through strategic preparedness and response.

Natural disasters are potentially devastating natural events that maycan have detrimental effects onimpacts to the state and its economy. In Colorado we are prone to droughts, floods, earthquakes, tornados, and wildfire. Since the turn of the century, Colorado has experienced many record breaking natural disasters including: our most intense single year drought (2002), most expensive wildfire (Waldo Canyon, 2012), most destructive wildfire (Black Forest Fire, 2013), most expensive winter storm (2003), and the most expensive summer storm (2009).[23] In fact, 54 percent of all homeowner insurance claims from 2009-2013 were a result of catastrophe, more than double the rate for the previous 12 years.[24] Natural disasters do not just affect people and property, but mayNatural 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; additionally climate change has the potential to influence the frequency and severity of these events in the future. .

Climate Change Effects on Natural Disasters

In nine out of every ten years, a portion of the state experiences some level of drought conditions.[25] As discussed in Chapterchapter 4, droughts and floods that make our water availability so variable maycan 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 effects.impacts.

Given that water influences nearly all sectors of Colorado's economy, and that too little or too much can have a substantialsignificant 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 (CWCB) has examined how water resources will be effectedimpacted by climate change through manya 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.[26]

The most likely effectimpact of future climate change on water supplies is a shift in the timing of runoff. Projections indicate that runoff timing will shift one1 to three3 weeks earlier by mid-century because of, due to increased temperatures.[27] 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.[28] At the same time, increased population and higher crop irrigation requirements will put additional pressure on a changing water supply.[29]

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.[30] 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.[31] 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, substantial~~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.[32]

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~~State~~ to modify and adapt planning processes as new information becomes available, increasing flexibility and resiliency.

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 involved~~involving~~ damaged water infrastructure and diversion structures, facilities that were severely disconnected from the stream or river channels, streams and rivers that substantially~~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. The~~ but then able to be irrigated in 2014 because the~~ State and others responded expediently~~quickly~~ with grant and loan resources. This teaches~~, teach~~ us two things:

1. 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.
~~1.~~2. 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 and less costly. In fact, studies have shown that for every one dollar of investment in natural hazard mitigation, society saves four dollars in response.[33]~~.~~

Following~~For instance, following~~ the 2013 floods, the U.S. Department of Housing and Urban Development ~~(HUD)~~ approved Colorado's Community Development Block Grant – Disaster Recovery ~~(CDBG-DR)~~ to include the Watershed Resilience Pilot Program.~~-~~ This innovative holistic program, developed jointly by the CWCB and the Department of Local Affairs~~, (DOLA),~~ is designed to provide watershed restoration, risk mitigation and community and economic development using a collaborative, coalition-of-partners approach. There is an immediate need to focus on capacity building, comprehensive watershed planning and project implementation to address long term catalytic watershed system improvements. The program will support ~~-~~capacity building, additional watershed master planning and conceptual design activities (~~,~~ including modeling and mapping)~~,~~ planning for multi-objective uses such as~~—-~~ green infrastructure, greenways, recreation, transportation and recreation and funding for the implementation of projects agreed to in cooperative planning efforts. The amount allocated to this pilot program is $25 million. The U.S. Department of Housing and Urban Development~~HUD~~ has never before approved a watershed resilience pilot program.

The 2013 floods did result in an opportunity to implement various resiliency aspects during the recovery period, opportunities that may continue to be used in the event of future flood events throughout the State. As an example, the 2013 flood resulted in unprecedented levels of damage to water supply infrastructure, creating the need to quickly rebuild to restore water management capabilities. The CWCB, CPW, and other partners encouraged water providers to consider multiple-objective designs when repairing diversion structures and other damaged infrastructure. These multiple-objective designs encourage processes that can enhance fish passage, recreational uses, and movement of sediment. Many rebuilt structures were able to incorporate these design elements. However, as the 2013 flood recovery demonstrated, current levels of funding and the need for quick rebuilding often hampered well-intentioned efforts to incorporate these new features. New or enhanced funding sources for these activities must continue to grow to have them readily available at key times when they can be implemented into this infrastructure.

Other processes were successfully implemented during the recovery from the 2013 floods. As an example, the CWCB and CDOT have begun a very successful partnership to incorporate design principles for stream restoration and highway rebuilding into a complimentary, holistic process. This has resulted in more resilient stream and highway corridors while saving money during the construction process. This is a model that must continue in road/stream alignments, especially in the steep canyon environments.

The damaged streams that resulted from the 2013 floods highlighted the need for updated floodplain mapping that more accurately reflects post-flood conditions. A restudy of the hydrology of the flood affected areas indicated that in many of the damaged watersheds, the regulatory flood hydrology that had been in place for as much as 40 years understated the flood risk. State funded mapping processes put into place in Senate Bill 15-245 will accurately reflect this higher level of risk. Nevertheless, this process underscored the point that updated studies using modern methods are necessary throughout the State to insure that flood risk to landowners is adequately conveyed for the purposes of important land use decisions.

As described in Sectionsection 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. ToIn order to support local communities and prepare for the disasters that affect our water supply, the stateState has manya 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 CWCB 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.[34]

The Colorado Drought Mitigation and Response Plan outlines the monitoring, mitigation, and response actions necessary to ensure that Colorado is adequately prepared for drought.[35] 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.

At the local level the development of drought management plans can help communities prepare for future conditions, in which droughts are projected to increase in frequency and severity.[36] Furthermore, planning and preparedness before the onset of an event can reduce both physical and economic drought related effects. The CWCB has developed many tools and resources to aid in this process and made them accessible through the Drought Planning Toolbox.[37] Additionally, the CWCB is able to provide grant funding for up to 80 percent of the cost of both developing a plan and implementing proposed measures through the Water Efficiency Grant Fund. Currently, mid-sized communities, such as the Town of Firestone, Pagosa Water and Sanitation District and the Town of Erie have sought funding for plan development and approval by the CWCB. Larger providers, such as Denver Water and the City of Aurora have current drought management plans but have not

sought state assistance or approval. Increasing the number of communities that have active drought management plans in place will increase the state's overall resilience to drought.~~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 and buffer against the effects of other natural disasters, 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 effected~~impacted~~ communities prepare for substantial~~significant~~ precipitation events. Future enhancements to tools such as~~like~~ these could provide even further benefits.

Actions

1. The state of Colorado will continue to support and expand where appropriate drought, flood, and wildfire preparedness and response programs.
2. The state of Colorado will actively encourage local communities to develop drought preparedness plans by providing tools and resources for development and implementation.
3. The CWCB and the Colorado Recovery and Resiliency Office will implement the actions identified in the Colorado Resiliency Framework to build communities that are more resilient to natural disasters.

7.3 Water Quality

Colorado's Water Plan promotes waters fully supporting their classified uses by 2050~~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 that~~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 orderExecutive 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 surveysurveys shows public health is the most compellingmotivating reason to improve water quality, followed by wildlife and fish habitat.[38, 39]

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 the Water Quality Control Commission (WQCC) and the Water Quality Control Division (WQCD) goals established to meet the intent of this legislation.

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 WQCCWater Quality Control Commission adopts regulations, guidance and policies required by the federal Clean Water Act (CWA), the federal Safe Drinking Water Act, and the , 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:

Figure 7.3-1: Black Lake No. 1 and No. 2*



***The lakes** were enlarged so that stream flows could be maintained during snowmaking season.

- 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 Wildlife (CPW), 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 CWA~~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 amongbetween 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 WQCC and the WQCDWater 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.

Figure 7.3-2: Gross Reservoir*



***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 WQCD'sWater Quality Control Division's water quality certification of federal permits and licenses

under Section 401 of the CWA~~federal Clean Water Act~~ as implemented through WQCC~~Water Quality Control Commission~~ Regulation No. 82 (known as 401certification~~401 certification~~). Section 401 of the CWA~~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. WQCC~~Water Quality Control Commission~~ Regulation No. 82 gives the WQCD~~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 WQCD~~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 CWA~~Clean Water Act~~ Section 404 individual permit from the Army Corps of Engineers, a 401 water quality certification is required from the WQCD.~~Water Quality Control Division.~~ Section 9.4 discusses the 401 water quality certification in more detail.

The WQCC's~~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 WQCC~~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 many~~a number of~~ entities, which create~~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 WQCC and the WQCD~~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:

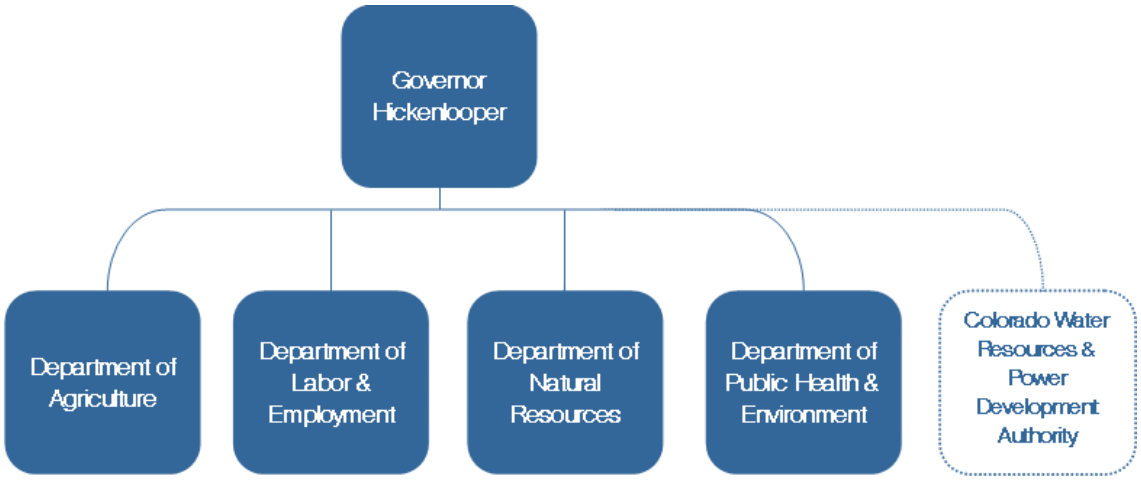
- The Division of Reclamation, Mining and Safety~~.~~

- 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~~.~~

These agencies have initial responsibility for implementing groundwater quality classifications and standards adopted by the WQCC.~~Water Quality Control Commission.~~ These implementing relationships are defined through a Memoranda of Agreement. The WQCC~~Water Quality Control Commission~~ can intervene in the event that 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.

Figure 7.3-3: Colorado State Agencies and Quasi-governmental Organizations with Quantity and Quality Responsibilities



The WQCC~~Water Quality Control Commission~~ and the WQCD~~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 WQCC~~Water Quality Control Commission~~ rulemaking hearing notices and all notices include a provision requesting information from the public regarding potential impacts on water rights.

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, many~~a number of~~ documents were reviewed including the CWA, ~~federal Clean Water Act,~~ federal Safe Drinking Water Act, the U.S. Environmental Protection Agency's (EPA) strategic plan, Colorado's Water Quality Control Act, the WQCD's~~Water Quality Control Division's~~ strategic goals, the WQCC's~~Water Quality Control Commission's~~ strategic water quality goal and the Basin ~~Roundtable~~ Implementation Plans (BIPs).~~.~~ 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 CWA~~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 EPA~~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 EPA~~U.S. Environmental Protection Agency~~ states, and water systems work together to make sure that these standards are met. The EPA's~~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."

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 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.

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 protect, maintain and improve the quality of state waters for beneficial uses including domestic, wildlife and aquatic life, agricultural, industrial and recreational uses.

- Dischargers of pollutants may be required to meet a high degree of treatment to protect water rights.
- The WQCC and the WQCD must 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.
- Nothing in the state act is to be construed or applied to cause or result in material injury to water rights.
- The WQCC and WQCD shall not require an instream flow for any purpose.

The WQCD's mission is to protect and restore water quality for public health and the environment in Colorado. The WQCD's strategic plan states that it will achieve its mission by pursing 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 CWA and Colorado Water Quality Control Act and associated regulations.
- Restore impaired water quality to attainable standards through improved implementation of the CWA and Colorado Water Quality Control Act and associated regulations.

Finally, the WQCC's strategic water quality goal is that Colorado's waters will fully support their classified uses by 2050 and these uses could include drinking water, agriculture, recreation, aquatic life and wetlands.

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.

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~~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 WQCD~~Water Quality Control Division~~ will provide basin-scale water quality information to the basin roundtables~~Basin Roundtables~~ for their use in updating their future BIPs~~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 WQCD~~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 WQCD~~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 WQCD's~~Water Quality Control Division's~~ Integrated Report and WQCD's~~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 WQCD's~~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 WQCC~~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 EPA~~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.

Figure 7.3-4: Current Water Quality Conditions[40]

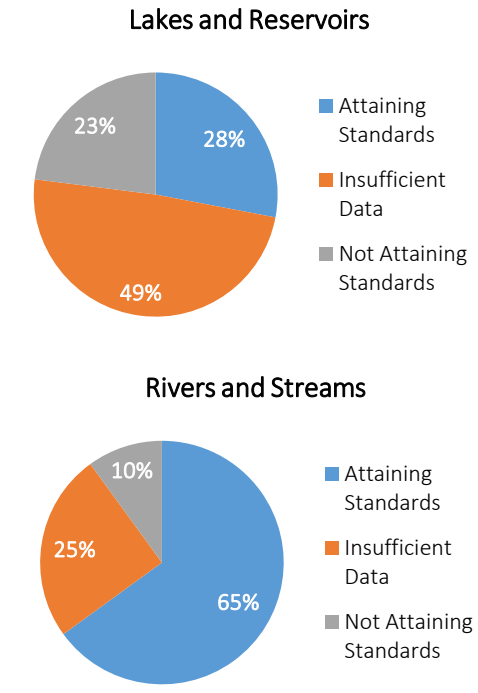


Figure 7.3-4 presents~~is~~ statewide information and is based on available water quality data. Different regions or basins within the state have varying water quality conditions and may have unique water quality challenges. Water quality impairments may also exist in streams or lakes that either have little to no available data or have yet to be assessed through the Integrated Report process.

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 conditions~~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 substantial 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 among~~between~~ different constituents that are not now known. These potential effects~~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:[41]

- 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 substantial~~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.

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 earlier in 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. ClassifiedSubsection 7.3.2 discusses classified uses and the water quality standards established to protect these uses are also discussed. Both are critical to protecting and restoring water quality in the state and are established through WQCCWater 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 WQCD usesThe 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 (WQCCWater 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 WQCCWater Quality Control Commission through public processes.

When streams and lakes are identified that do not meetmeeting 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 amongbetween 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 (TMDL).. There is a public notice process associated with TMDLTotal Maximum Daily Load development that provides the opportunity for input as the restoration plan is produced. Once the TMDLTotal Maximum Daily Load is approved by the EPAU.S. Environmental Protection Agency, the TMDLTotal 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, TMDLsTotal Maximum Daily Loads can also result in a re-evaluation of standards and sometimes classifications. Implementation actions can be defined in a TMDLTotal 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 WQCDThe 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 WQCD isWater Quality Control Division also actively engaged in promoting and supporting source water protection planning across Colorado through the Source Water Assessment and Protection (SWAP) Program. The program is designed to define drinking water supply areas and identify potential water quality and contaminant risks to drinking water systems. The SWAP program, in collaboration with the Colorado Rural Water Association, provides technical and financial support to encourage voluntary local planning efforts and the implementation of best management practices (BMP's) to minimize source water quality impacts. This effort is a collaborative stakeholder process that contributes to protecting and restoring water quality in the state.

The WQCD uses information from all these local plans to support its own planning efforts. For example, the WQCDWater Quality Control Division produces a Statewide Water Quality Management Plan for approval by the WQCCWater 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, WQCCWater Quality Control Commission policies, and other WQCDWater Quality Control Division documents, supports the WQCD'sWater 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 usedutilized by the WQCDWater Quality Control Division include Section 401 water quality certifications (discussed in Sectionsection 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 CWAClean 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 CWAClean Water Act, the primary discharge permit program in Colorado is administered by the WQCDWater Quality Control Division rather than by the EPAU.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 Sectionssections 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 Sectionsection 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.
- -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. In Colorado, stormwater has not typically been considered a source of supply but this could be explored in the future.
- 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.
- Green~~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 the green infrastructure concept 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 a 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 WQCD~~Water Quality Control Division~~ provides various financial assistance opportunities to assist with efforts to protect public health and the environment. The WQCD administers the following financial~~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~~Structural~~ and nonstructural water projects or activities.

Water Quality and BIPs

The various basin roundtables have addressed water quality in the BIPs 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 WQCD~~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~~roundtable~~ established the following goal: "Make progress toward meeting applicable water quality standards throughout the Basin."[42] ~~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.[43]~~ This approach demonstrates how the basin may use the planning process to work closer with the Colorado Department of Public Health and Environment~~CDPHE~~, to make progress toward meeting established standards.

The Yampa/White/Green Basin Roundtable~~roundtable~~ references water quality, as it relates to uses within the basin, in their goals~~Goals~~: "Maintain and consider the existing natural range of water quality that is necessary for current and anticipated water uses."[44] 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, ranging~~: these range~~ from assessment of wildfire restoration, to sediment mitigation projects, to mine remediation.[45] 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.[46] 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.

Actions

The WQCD~~Water Quality Control Division~~ worked with the Colorado Water Quality Forum and the WQCC~~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:

A. Integrated water quality and quantity management.
B. Policy considerations.
C. Financial considerations.
D. Stakeholder and public outreach.

In addition, these recommendations need to be assigned to a responsible party and prioritized for implementation over time.

Integrated Water Quality and Quantity Management Actions

~~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 statues 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:

1. Evaluate water quality impacts associated with proposed solutions and scenarios presented in the BIPs 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 among~~between~~ all involved parties.
2. Define opportunities in cooperation with basin roundtables, the~~Basin Roundtables,~~ CWCB and others for projects or processes that restore and enhance existing water quality conditions to address potential water quality effects~~impacts~~ resulting from implementing water quantity solutions. An initial step to implement this recommendation is to assist the basin roundtables~~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 BIPs. This collaboration supports the basin roundtables~~Basin Roundtables~~ in identifying projects and methods that integrate water quality and quantity management to protect and restore water quality.
3. Define green infrastructure approaches for the arid west and explore how green infrastructure can be used~~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.
4. 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.
5. Examine how new or existing supply projects can be designed and operated~~and/or operated~~ to advance water quality objectives. Actively pursue incorporation of these design and operation considerations into proposed projects.
6. 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 use~~utilize~~ these resources. Reuse and identified actions are discussed further in Section 6.3.
7. Promote the use of aquifer storage and recovery since water quality impacts associated with this storage strategy are minimal.
8. 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.

9. 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.
10. Identify the risks of climate change as they relate to integrated water quality and water quantity management. Develop specific recommendations for addressing these risks.
11. Explore how the CWA requirements and Safe Drinking Water Act~~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:

1. 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.
2. 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.
3. 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.
4. 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 effects~~impacts~~ on downstream flows and possible water rights impacts would have to be understood and addressed before such a strategy could be implemented.
5. Continue to work with neighboring states to address interstate water quality and quantity issues to protect Colorado's compact entitlements.
6. 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.

1. Continue to fund nonpoint source pollution management efforts. Identify new funding opportunities and nonpoint source pollution control strategies.
2. Identify costs and funding sources for implementation of green infrastructure and reuse.
3. Pursue state funding of regional watershed-based water quality planning to better integrate current and future water quantity efforts.
4. 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.
5. 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.
6. Develop and implement funding mechanisms for the protection, restoration or enhancement of water quality values in river or stream reaches.
7. 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 9.5 of Colorado's Water Plan.

1. 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 use~~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.
2. 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.
3. Develop additional water quality goals and performance measures based on the completed BIPs from the basin roundtables~~Basin Roundtables~~.
4. Conduct joint CWCB and WQCC~~Water Quality Control Commission~~ meetings at least annually to discuss water quality and quantity integration issues.
5. The WQCC~~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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[1] 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.
[2] Richard M. Edwards and Greg Sundstrom, *Colorado Forestry Best Management Practices, Forest Stewardship Guidlines for Water Quality Protection, 2012 Field Audit Report* (Colorado State Forest Service, 2013), 2.
[3] J.E. Williams, C. A. Wood, and M.P. Dombeck, *Watershed Restoration: Principles and Practices* (Bethesda, Maryland: American Fisheries Society, 1997), 2-3.
[4] Williams, Wood, and Dombeck, *Watershed Restoration: Principles and Practices*, 5.
[5] Edwards and Sundstrom, *Colorado Forestry Best Management Practices, Forest Stewardship Guidelines~~Guidlines~~ 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
[7] Colorado State Forest Service, *Report on the Health of Colorado's Forests, Caring for Colorado's Forests: Today's Challenges, Tomorrow's Opportunities* (2013), 5.
[8] United States Environmental Protection Agency, *Climate Change and Watershed Health*. Accessed October 27, 2014, http://water.epa.gov/polwaste/nps/watershed/climate_change.cfm
[9] ~~Colorado State Forest Service, *Colorado Statewide Forest Resource Assessment- A Foundation for Strategic Discussion and Implementation of Forest Management in Colorado*, 42.~~
[10] Colorado State Forest Service, *Colorado Statewide Forest Resource Assessment- A Foundation for Strategic Discussion and Implementation of Forest Management in Colorado*, 42.
[11] Carol Ekarius, "Building Successful Watershed Coalitions" (presented at the Colorado Watershed Symposium, Loveland, Colorado, July 18, 2013).
[12] Colorado State Forest Service, *Report on the Health of Colorado's Forests, Caring for Colorado's Forests: Today's Challenges, Tomorrow's Opportunities*, 12.
[13] United States Forest Service, *Quarter 2 Progress Report: High Performance Partnerships* (Rocky Mountain Region, 2014), 3-6.
[14] West Water, CDM Smith, Shively, CH2MHILL, and Peak Facilitation, *Arkansas Basin Implementation Plan*.
[15] DiNatale Water Consultants, *Rio Grande Basin Water Plan.*
[16] *HDR, WestSage Water Consultants, South Platte Basin Implementation Plan.*
[17] Harris Water Engineering, *Southwest Basin Implementation Plan.*
[18] 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.
[19] AMEC, *Yampa/White/Green Basin Implementation Plan.*
[20] Wilson Water Group, *Gunnison Basin Implementation Plan.*
[21] Wilson Water Group, *Gunnison Basin Implementation Plan.*
[22] SGM, *Colorado Basin Implementation Plan.*

[23] Rocky Mountain Insurance Information Association, "Catastrophe Fact & Statistics," accessed June 25, 2015, http://www.rmiia.org/catastrophes_and_statistics/catastrophes.asp
[24] Rocky Mountain Insurance Information Association, "*Trends in Homeowners Insurance Claims,*" accessed June 25, 2015, http://www.rmiia.org/catastrophes_and_statistics/Homeowners_Insurance_Trends.asp.
[25] Colorado Water Conservation Board, *Colorado Drought Mitigation and Response Plan,* 49.
[26] Colorado Water Conservation Board, *Colorado River Water Avaliability Study* (2012); Jeff Lukas, *Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation Second Edition*, (Colorado Water Conservation Board, 2014); Mark Woodbury, Mark Baldo, David Yates, and Laurna Kaatz,

Joint Front Range Climate Change Vulnerability Study, (Denver: Water Research Foundation, 2012); Colorado Water Conservation Board, *Colorado Drought Mitigation and Response Plan, Annex C*; United State Bureau of Reclamation, *Colorado River Basin Water Supply and Demand Study,* (U.S. Department of Interior, Bureau of Reclamation, 2012).

[27] ~~Jeff~~ Lukas, *Climate Change in Colorado~~: A Synthesis to Support Water Resources Management and Adaptation Second Edition, 2014~~*, 75.

[28] ~~Jeff~~ Lukas, *Climate Change in Colorado~~: A Synthesis to Support Water Resources Management and Adaptation Second Edition, 2014~~*, 75.

[29] Colorado Water Conservation Board, *Colorado Water Availability ~~Avaialability~~ Study Phase I Report, ~~pg~~* ES12-15.

[30] ~~Jeff~~ Lukas, *Climate Change in Colorado~~: A Synthesis to Support Water Resources Management and Adaptation Second Edition, 2014~~*, 36.

[31] Colorado Water Conservation Board, "Colorado Drought Mitigation and Response Plan," 2013. Annex C. C.5-C.6

[32] Colorado Water Conservation Board, *Colorado River Water Avaliability Study- Phase I Spell Statistics (refinement to CRWAS Phase I Task 6.7) Techinical Memo,* Online http://cwcbweblink.state.co.us/WebLink/ElectronicFile.aspx?docid=158382&searchid=e42eb888-af4f-4350-a4c8-e63266c40c51&dbid=0

[33] Multihazard Mitigation Council. *Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities, Volume 1. 2005,. 5.*

[34] Colorado Water Conservation Board, *Colorado Flood Hazard Mitigation Plan,* 2013.

[35] Colorado Water Conservation Board, *Colorado Drought Mitigation and Response Plan,* 2013.

[36] Lukas, *Climate Change in Colorado,* 29-32.

[37] Colorado Water Conservation Board, Drought Planning Toolbox. http://dnrwebmos07:7171/technical-resources/drought-planning-toolbox/Pages/main.aspx

[38] Water Quality Control Division~~,. 2007.~~ *Public Opinions on Water Quality Issues* (WQCD, 2007)~~,. Prepared by Corona Research.~~

[39] Colorado Water Conservation Board~~,. 2013.~~ *Public Opinions, Attitudes and Awareness Regarding Water in Colorado* (CWCB, 2013)~~,. Prepared by BBC Research & Consulting.~~

[40] "Integrated Water Quality Monitoring and Assessment Report," Water Quality Control Division, Colorado Department of Public Health(2012).

[41] U.S. Environmental Protection Agency~~,~~ *Watershed modeling to assess the sensitivity of streamflow, nutrient and sediment loads to potential climate change and urban development in 20 U.S. watersheds* (EPA, 2013). ~~Accessed 2014.~~ http://cfpub.epa.gov/ncea/global/recordisplay.cfm?deid=256912.

[42] DiNatale Water Consultants, ~~*Draft*~~ *Rio Grande Basin Water Plan* (Boulder: DiNatale Water Consultants, 2014), 9~~) 121~~.

~~[43] DiNatale Water Consultants, *Draft Rio Grande Basin Water Plan* (Boulder: DiNatale Water Consultants, 2014) 131.~~

[44] AMEC, ~~*Draft*~~ *Yampa/White/Green Basin Implementation Plan* (Denver: AMEC, 2014), Section 1, 12~~) iii~~.

[45] HDR, WestSage Water Consultants, ~~*Draft*~~ *South Platte Basin Implementation Plan* (Denver: HDR, West Sage Water Consultants, 2014),~~)~~ Appendix D.

[46] Wilson Water Group, ~~*Draft*~~ *Gunnison Basin Implementation Plan* (Denver: Wilson Water Group, 2014), 168-169~~) 88-94~~.

coloradowaterplan.com
cowaterplan@state.co.us
Direct: 303-866-3441

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 while ensuring the long-term viability of Colorado's interstate compacts and relationships. Colorado will focus planning efforts on maintaining healthy systems and avoiding a Colorado River Compact deficit rather than on its response to compact curtailment. ~~.~~

B. Encourage multi-partner, multi-purpose, cooperative projects through financial incentives and technical support.

C. Consider using~~Use~~ the Draft Conceptual Framework~~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 (TMD) 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.

Existing Stakeholder Agreements and Projects

Colorado has many~~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 among~~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 (BOR)~~.~~.

The Arkansas River voluntary flow agreement helps meet the environmental and recreational needs in the Upper Arkansas Basin~~basin~~ by providing increased recreational flows on the river and beneficial

flows for wildlife. The BORs~~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 1 ~~1st~~ to August 15~~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 (CRCA)

In the fall of 2013, 18~~eighteen~~ parties that are reliant on water from the Colorado River completed~~finalized~~ the 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 40~~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 Basin Implementation Plans (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 BOR~~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 the Colorado Water Conservation Board (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 5000~~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 the 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 among~~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 13~~thirteen~~ project participants are committed to addressing environmental effects~~impacts~~ caused by the firming project.– The subdistrict, on behalf of project participants, spent several years

negotiating measures to mitigate environmental effects.~~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 effects~~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 among~~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 Firming Project progress to meet water supply needs on the eastern slope.

Water, Infrastructure, and Supply Efficiency (WISE) Partnership

The 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.

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 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~~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 that 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 the CWCB as a component of Colorado's Water Plan and the Statewide Water Supply Initiative~~SWSI~~.

Scenario planning is a critical part of the No-and-Low-Regrets Action~~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-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 Framework~~conceptual agreement~~

A long-standing controversial issue in Colorado is the development of water supply from the Colorado River Basin~~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. Generally, eastern slope roundtables identify the need for a balanced program to preserve the option of future development of Colorado River System water, while western slope roundtables express concern regarding the potential for future development on the western slope, as well as the potential for overdevelopment related to both a Colorado River Compact deficit and critical levels for system reservoir storage, such as the minimum storage level necessary to produce hydroelectric power reliably at Glen Canyon Dam (minimum power pool).

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 TMDs~~transmountain diversions (TMD)~~ "should be the last 'tool' considered as a water supply solution, once the many and complex questions are addressed over hydrology."[1] The South Platte/Metro BIP advocates to "simultaneously advance the consideration and preservation of new Colorado River supply options."[2] 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 Framework~~conceptual agreement~~ seeks to find a path forward that considers the option of developing a new TMD, while addressing ~~many of~~ the concerns of roundtables statewide, stakeholders, as well as environmental concerns.~~expressed by the Colorado Basin roundtable and others.~~

In 2013, the IBCC focused its discussion on a Conceptual Framework~~conceptual framework~~ for future detailed negotiations on a potential new TMD.- As expressed in the draft Framework~~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-regrets 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 Conceptual Framework sets out seven principles to guide future negotiations between proponents of a new TMD and those communities who may be affected were it built. The Framework reflects areas of statewide concern. In generating it, the IBCC's diverse stakeholders thoroughly explored the difficult issues that would surround a new TMD. As such, this Framework may help accelerate future negotiations. However, the Framework cannot take the place of specific negotiations and agreements. The principles provide a way to think about how entities in Colorado might develop a future increment of Colorado River System water. The Framework states the realities and issues proponents for a new TMD should expect to address.

The First Draft Conceptual Framework~~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. To~~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.

After publication~~The Draft Conceptual Agreement has been incorporated into elements~~ of the first draft~~BIPs~~ of Colorado's Water Plan in December 2014, basin~~the Southwest, South Platte/Metro, and Rio Grande~~ roundtables discussed the Conceptual Framework, ~~, as a step forward in~~ identifying points of consensus and points of concern. Roundtable members recognized that the conceptual Framework represented a new and holistic way to discuss the controversial issue of a TMD, though there were~~myriad of issues associated with such a project. The Gunnison roundtable has expressed~~ concerns about terms used within the Conceptual Framework, and how those terms might be interpreted by a project proponent or affected parties.

Informed by basin roundtable discussion, public input, stakeholder feedback, and CWCB discussion, the IBCC defined a process to revise the Framework. It started by first renaming the document the "Conceptual Framework." As stated, the Framework explores the issues surrounding a new TMD, but does not take the place of an ~~some points in the~~ agreement among any identified parties, ready for implementation. The IBCC then tasked a subcommittee with addressing these concerns.

The subcommittee includes representatives from every western slope basin, both eastern slope basins, and the metro area. This includes IBCC members, representing agricultural interests, municipal and industrial water providers, conservancy districts, and environmental concerns. CWCB members also participated in the subcommittee's work. Informed by the discussion to this point, the subcommittee

seeks clarify the Conceptual Framework based on roundtable feedback. Specifically, terminology addressing "firm yield" from a TMD, the triggers under which a new TMD would be managed, "environmental resiliency," and further explanation of the "insurance policy" in principle 4 were further defined.

The subcommittee will present further proposed edits of clarification to the IBCC in July 2015, and the results of that meeting will be incorporated into subsequent drafts of this chapter. Moving forward, it is crucial to have the basin roundtables and CWCB members continue to participate in ~~further~~ discussion about the Draft Conceptual Framework. ~~Agreement to further inform identified discussion points and project considerations.~~

The complete First Draft Conceptual Framework~~Agreement~~ is included in full in Appendix D.~~-~~ Once completed~~finalized~~, these points of consensus may serve as the foundation for any new future TMD projects seeking state support. These considerations will act as a guide to move a project forward with state support.

Actions

The following are next steps that will support the policies, conceptual agreements, and points of consensus:

1. The CWCB will monitor ongoing conceptual framework discussions and consider adopting the conceptual framework.
2. ~~1.~~ The 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. Colorado will focus planning efforts on maintaining healthy systems and avoiding a Colorado River compact deficit rather than on its response to compact curtailment.
3. ~~2.~~ The 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 in the Colorado River System.~~-~~ This concept is further described in the IBCC's conceptual agreement (Appendix D), under point #4 and Section 9.1. The~~.~~ 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.~~

Table 8-1: Colorado River Development - Discussion in BIPs		
Basin	**Compact Discussion**	**TMDs~~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;" **"Policy Statement:** The Arkansas Basin Roundtable supports the full development of Colorado's entitlement under the Colorado River Compact, for use in Colorado."[3]	"In particular, a future without New Supply, as that term is understood in the lexicon of the Statewide Water Supply Initiative~~SWSI~~ 2010, is detrimental to the future of agriculture in the Arkansas Basin."[4]
Colorado	"Recent studies show that continued~~Continued~~ development from the ~~mainstem of the~~ Colorado River toward full Compact entitlement is simply unsustainable"[5]~~not sustainable and will harm all of Colorado."~~	"The core principle is that a TMD should be the last not the first tool out of the box to deal with water supply shortages statewide. This principle is equally applicable to any basin, including the Colorado Basin where the focus is on meeting the needs of the basin from resources within the basin."[6] ~~"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."[7]~~
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, new development planning should be focused on avoiding hydroelectric power disruption, a Colorado River Compact deficit, or development in excess of Colorado's allocation under the Upper Colorado River Basin Compact. The Gunnison Basin Roundtable believes that evaluating new development using this standard will leave Colorado well positioned to respond to the ultimate risk of over development."[8]~~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"[9]
North Platte	*Colorado Compact concerns not addressed within the BIP.*	*No position taken on TMDs~~transmountain diversions~~.*
Rio Grande	*Colorado Compact concerns not addressed within the BIP.*~~"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."~~	*No position taken on TMDs.* ~~"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~~

Table 8-1: Colorado River Development - Discussion in BIPs

Basin	Compact Discussion	TMDsTransmountain Diversions
		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."[10]
South Platte/ Metro	"The Metro and South Platte Roundtables encouragebelieve 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, 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. The Roundtables support the Conceptual Framework developed by the IBCC (and as outlined in Colorado's Water Plan) as the means whereby new Colorado River Basin supply options could be investigated and potentially developed.."[11] " "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."[12]	"The South Platte and Metro Basin RoundtablesBRTs 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. *All "four legs of the stool plus storage" need to be simultaneously considered as the development of Colorado's Water Plan continues."* "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."[13]
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'sBasin's agriculture to meet downstream water needs for compact compliance and/or obligations. Therefore, the Roundtable agrees on eightseven factors to be addressed prior to considering a new TMD."[14]	"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 amongbetween roundtables regarding how to approach a potential future TMDtrans-mountain diversion from the west slopeWest Slope to the eastEast, including the discussion of a possible future use allocation. The Southwest Basin is actively engaged in the West Slope Caucus discussions and supports further refinement of the seven points of framework (IBCC Draft Conceptual Agreement; July 2014). The Roundtable would like the opportunity to review and comment on any future refinements to said Framework. The Southwest Basin'sFuture Use Allocation. Another cross-basin cooperative effort is through the Southwestern Water Conservation

Table 8-1: Colorado River Development - Discussion in BIPs

Basin	Compact Discussion	TMDsTransmountain Diversions
		District's participation as a member of the Water Bank Working Group to develop a Compact Water Bank.."water bank."[15]
Yampa/ White/ Green	"How the Yampa/White/Green Basin fits into meeting Colorado's compact obligations within and beyond the state is a principal concern. The Yampa/White/Green Basin is part of Colorado River Basin, and is caught among the needs of the downstream states, the needs of the urbanized east slope of Colorado, and its own in-basin needs. The Yampa/White/-White-Green Basin Roundtable must consider these competing needs in its water planning effort. In this regard, the Yampa/White/Green Basin Roundtable also recognizes that the overdevelopment of water in thelimited Colorado River and its tributaries posessystem water is a serious risk that would impact all users of Colorado River Basin water.."." "The State of Colorado is party to the 1922 Colorado River Compact and the 1948 Upper Colorado River Compact. Currently, the state is discussing methods (e.g. contingency planning, demand management, water banking) to minimize the risk of a "call" under compact administration. The role of the Yampa/White/Green Basin flows in meeting the state's compact obligations is a central issue in the Yampa/White/Green BRT's planning efforts. In the event of a compact deficit, the State Engineer would have to develop rules by which to curtail Colorado River water users to remedy the condition. How the state administers a curtailment could greatly affect Colorado River water rights users across the state. If administration is based upon a statewide application of the prior appropriation system in the Colorado mainstem and tributary basins, the burden would likely fall disproportionately on the Yampa/White/Green Basin as its water rights are relatively junior to those of other Colorado River basins."[16] "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 Water Plan, as it was in previous interstate agreements, and envisioned by the HB05-1177	"The Yampa/White/Green Basin Roundtable's position is that a negotiated equitable native flow allocation for all basins tributary to the Colorado River should be the basis for such a rulemaking. The Yampa/White/Green Basin Roundtable recognizes that negotiations for allocations of Colorado River water should include all users including TMDs that have historically diverted from Colorado River tributaries."[17] "[18]"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 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."[19]

Table 8-1: Colorado River Development - Discussion in BIPs		
Basin	**Compact Discussion**	**TMDs~~Transmountain Diversions~~**
	~~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."~~	

[1] SGM, ~~*Draft* *Colorado Basin Implementation Plan* (Glenwood Springs: SGM, 2014).~~ 45.
[2] HDR, WestSage Water Consultants, ~~*Draft* *South Platte Basin Implementation Plan* (Denver: HDR, West Sage Water Consultants, 2014).~~ 1-21.
[3] WestWater Research, CDM Smith, CH2MHILL, Peak Facilitation, *Arkansas Basin Implementation Plan* (Colorado Springs: WestWater Research, 2014), 166.
[4] WestWater Research, CDM Smith, CH2MHILL, Peak Facilitation, ~~*Draft* *Arkansas Basin Implementation Plan*, (Colorado Springs: WestWater Research, 2014)~~ Section 4-8.
[5] SGM, *Colorado Basin Implementation Plan* (Glenwood Springs: SGM, 2014) 136.
[6] SGM, *Colorado Basin Implementation Plan* (Glenwood Springs: SGM, 2014) 14.
~~[7] SGM, *Draft Colorado Basin Implementation Plan* (Glenwood Springs: SGM, 2014) 4.~~
[8] Wilson Water Group, *Gunnison Basin Implementation* Plan, 40.
[9] Wilson Water Group, *Gunnison*~~*Draft North Platte* *Basin Implementation Plan*~~ (Denver: Wilson Water Group, 2014) 39-41.
~~[10] DiNatale Water Consultants, *Draft Rio Grande Basin Water Plan* (Boulder: DiNatale Water Consultants, 2014) 17.~~
[11] HDR, WestSage Water Consultants, *South Platte Basin Implementation Plan* (Denver: HDR, West Sage Water Consultants, 2014) Section S-14.
[12] HDR, WestSage Water Consultants, *South Platte Basin Implementation Plan* (Denver: HDR, West Sage Water Consultants, 2014) 4-116.
[13] HDR, WestSage Water Consultants, ~~*Draft* *South Platte Basin Implementation Plan*~~ (Denver: HDR, West Sage Water Consultants, 2014) Section 4.8.2.
[14] Harris Water Engineering, *Southwest Basin Implementation Plan* (Durango: Harris Water Engineering, 2014), page 2.
[15] Harris Water Engineering, ~~*Draft* *Southwest Basin Implementation Plan*~~ (Durango: Harris Water Engineering, 2014) 106~~Exec Summary, page 102~~.
[16] AMEC, *Yampa/White/Green Basin Implementation Plan (*Denver: AMEC, 2014) 1-2.
[17] AMEC, *Yampa/White/Green Basin Implementation Plan,* 1-2.
[18] AMEC, *Yampa/White/Green Basin Implementation Plan (*Denver: AMEC, 2014) ii-iii.
~~[19] AMEC, *Draft Yampa/White/Green Basin Implementation Plan (*Denver: AMEC, 2014) ii-iii.~~

coloradowaterplan.com
cowaterplan@state.co.us
Direct: 303-866-3441

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 (BIPs) 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 among~~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 Protecting Colorado's Compacts and Upholding~~compacts & upholding~~ Colorado Water Law~~water law~~

Colorado's Water Plan upholds Colorado's water law system, interstate water compacts and equitable apportionment decrees, and local control structures. Colorado will focus planning efforts on maintaining healthy systems and avoiding a Colorado River Compact deficit, rather than focusing on the state's response to a compact curtailment.

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 by

respecting the designated~~appropriate~~ roles of the State of Colorado and the federal government regarding water management within Colorado. Colorado's Water Plan continues to support state-based solutions to needs identified by federal agencies, which best balance water needs in Colorado, and to ensure that water rights for environmental purposes can be appropriately administered within Colorado's water law. These state and federal partnerships have been successful in several instances and are described in more detail below. 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 for being~~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 water entitlements allocated to Colorado through equitable apportionment decrees.[4] Colorado's Water Plan reaffirms Colorado's dedication to protecting its compact and decree entitlements. Colorado has a litigation account that is available to the Colorado Water Conservation Board~~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 has adequate resources to protect its water resources. In addition, Colorado should make every effort to comply with its compact and decree obligations. While interstate compacts have beenproven to be a solid foundation upon which water allocation occurscan occur, interstate compacts also have been also been flexible and are ableenough to address issues in times of drought and other unforeseen circumstances.

In working to protect the state'sState's valuable water resources, Colorado recognizes that federal agenciesFederal Agencies have a role in the management of federal lands and water resources within the state. ItState. The trick is important to balancein balancing and coordinatecoordinating the different stateState and federalFederal roles and responsibilities to remain consistent with their respective authorities and obligations. The Wild and Scenic Rivers Act and the Endangered Species Act are two federal statutes that could affect Colorado's ability to fully use its compact and decree entitlements. To avoid this possibility, the State of Colorado is committed to working with federal agenciesFederal Agencies to ensure they implement assure that their responsibilities are implemented in a way that respects Colorado's compact and decree entitlements and authorities to administer waters within the state. AnState. A perfect example of such compromise exists within the Upper Colorado River Endangered Fish Recovery Program, which operates to help protect and recover endangered fish species while allowing water users to continue to develop the state'sState's compact entitlements. The State of Colorado should continue to support such programs such as this one, and explore ways to develop similar programs when appropriate. In addition, Colorado's Instream Flow Program iswas an effective tool that was used in the Upper Colorado River Wild and Scenic Rivers Act Management Plan. This Management Plan provides protection for flow related "Oustandingly Remarkable Values" associated with the Upper Colorado River, while respecting the need for water managers to have flexibility in the future. It, and it should serve as a model for future endeavors in state and federal collaboration.

The State of Colorado will continue to assure the proper balance between the stateState and federalFederal roles in Colorado's water law and water management system.

The State of Colorado has always vigorously defended Colorado's water allocation and management system. Recently, certain federal agencies' decisions and proposed actions called into question the balance in stateState and federalFederal roles as they relate to water management within Colorado.withinColorado. 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. In the context of these areas, and other federal water related issues, the State has also had to grapple with federal assertions of authority to mandate bypass flows as a resource management tool. To the extent they interfere with and potentially undermine water rights as decreed and administered within the stateState, Colorado maintains that bypass flows should not be a preferred method for managing water on federal lands. Rather, before federal agencies seek to impose bypass flows as a resource management tool, they should work with the State to identify how such use will comport with the water rights administration under Colorado law. In these and

other instances, Colorado is committed to ensuringassuring that the federal and state roles in water management remain appropriately balanced.

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. The local control structure within Colorado is discussed in more detail in Section 2.3 of Colorado's Water Plan. The range of local authorities This includes broadly authorizing counties and municipalities to balance environmental protection with the need to provide for 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.

The State of Colorado will support strategies to maximize use of compact water while actively avoiding a Colorado River Compact deficit.

Basins using Colorado River System[a] water emphasized the need for protection of existing uses, while proposing some increment of future development. All users of Colorado River System water have an interest in the security of Colorado's compact entitlement. Ongoing interstate discussions, such as the Colorado River drought contingency planning efforts being developed by the states of the Upper Division discussed in Chapter 2, will inevitably affect water management within Colorado. These efforts include: weather modification; extended reservoir operations (releasing water from upper Colorado River Storage Project reservoirs to protect critical reservoir elevations at Lake Powell); and managing demands to influence Lake Powell elevations. Hydrologic conditions in the face of climate change and increasing demands will require Colorado water users to creatively and collaboratively manage the resources at hand. These intrastate efforts, such as those addressed in Colorado's Water Plan, will be distinct from, but necessarily informed by, ongoing interstate processes and negotiations.

The Interbasin Compact Committee (IBCC) discussed the concept of a collaborative program to protect existing uses and some increment of future use statewide in early drafts of the *IBCC Conceptual Framework.* Moving forward, the IBCC placed the highest priority on working on a collaborative, programmatic approach to managing consumptive uses, with the end goal of avoiding a compact deficit. This programmatic approach would ideally involve water banking concepts, though at present this approach has not been sufficiently developed to provide full coverage for protected uses. While water banking may be an important part of the programmatic approach, it will likely be one piece of a multifaceted program.

[a] As defined in the Colorado River Compact of 1922: "that portion of the Colorado River and its tributaries within the United States of America."

This programmatic approach involves augmentation and storage management as initial tools, and demand management as a tool of last resort. Demand management efforts would be based on voluntary, temporary, and compensated reductions in eastern and western slope consumptive use. Under such an approach, willing water users will be temporarily compensated for voluntary reductions of consumptive use. Such reductions in use will be monitored and verified to assure benefit to the Colorado River System. Pre- and post- compact water rights, by definition, are subject to distinctive levels of risk in a compact curtailment situation. Though the purpose of a collaborative program would be to avoid curtailment entirely, it is important for program participants to recognize the potential differences in impacts to these different types of water rights in a curtailment.

Actions

The following actions will promote continued collaboration among the State of Colorado and federal, state, tribal, and local entities on interstate and intrastate water management issues. These actions seek to protect Colorado's compact entitlements while encouraging collaborative solutions to protect existing and future uses within the state.

A. **The State will continue to uphold the prior appropriation doctrine.**
   1. The Colorado Water Conservation Board (CWCB) encourages ongoing efforts to make the water court system more efficient, such as the work of the Water Court Committee of the Colorado Supreme Court. These efforts seek to make the process more efficient and easily navigated, while maintaining the protection of these important private property rights.
   2. The IBCC work on potential legislative solutions suggests that broad stakeholder input is necessary to garner support for process improvements to be achieved through the legislative process. The CWCB will explore potential avenues for broad input on improvements to the water court process, be it through the roundtable and the IBCC process or other mechanisms.

B. **The State will continue to uphold Colorado's water entitlements under Colorado's compacts, equitable apportionment decrees, and other interstate agreements.**
   1. The CWCB will continue to maintain a sufficient balance in the litigation fund to assure that the State has adequate resources to protect its water resources.
   2. The CWCB, with support from the Attorney General's Office and the Division of Water Resources, will continue to make every effort to comply with compact and decree obligations.
   3. The CWCB, in concert with the Attorney General's Office, will continue to work with federal agencies to assure that their responsibilities are implemented in a way that respects Colorado's compact and decree entitlements and authorities to administer waters within the state.

C. **The State will continue to assure the proper balance between the state and federal roles in Colorado's water law and water management system.**
   1. The CWCB and Attorney General's Office will remain involved in maintaining the balance of state and federal roles within Colorado. As federal procedures and

policies are developed and implemented, the state will defend Colorado's water allocation and management system, to the extent that proposed federal actions may interfere with and potentially undermine water rights as decreed and administered within the state.

D. The State of Colorado will continue to work within Colorado's local structure.

1. In proposing innovative strategies to meet Colorado's existing and future water needs, the CWCB will continue to work collaboratively with local governments, recognizing the authority of the state's counties and municipalities in making water development and management decisions.

E. The State of Colorado will support strategies to maximize use of compact water while actively avoiding a Colorado River Compact deficit.

1. The CWCB will continue to support water banking efforts and prioritize the development of the programmatic approach as described over the next several years. This development will require extensive stakeholder participation and educational efforts statewide.
2. Future study and collaborative stakeholder input by the CWCB will gauge the potential for a programmatic approach to meet existing and future needs while maintaining equitable distribution of the reduced consumptive use. Multiple types of water use and locations on eastern and western slopes should share the burdens of demand management.

As the CWCB begins technical investigation of a potential collaborative program, a key issue to be resolved will be the potential scope of demand management: the greater the amount of existing uses to be covered by such a collaborative program, the greater the number of voluntary reductions and compensation that will be necessary.

9.2. Economics and Funding~~& 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 CWCB has partnered with various water providers throughout Colorado to conserve, develop, and protect Colorado's water for future generations. The 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, the CWCB contributed over $200 million. 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.[b] ~~7~~

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 demands~~needs~~ in the long-term through a combination of constructive legislation, partnerships, and state and federal grant and loan programs. It is the CWCB's intent to promote, and potentially support financially and politically, projects that evaluate water supply, storage, and conservation efforts from a regional, multi-purpose, multi-partner, multi-benefit basis and projects that evaluate the consolidation of services where practical, feasible and acceptable.

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.

Statewide Water Infrastructure Financing Need~~water infrastructure financing need~~

The 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, and among basins.~~.~~ As part of the BIPs, the basin roundtables identified a list of projects and methods~~that~~ they believe address the long-term needs of their basin. An initial summary of the costs identified in the BIP's is included in Table 9.2-1. It needs to be emphasized that at this time the vast majority of projects identified did not have costs associated with them. 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.

Table 9.2-1: Project Costs Identified in the Basin Implementation Plans*

Basin	Single purpose projects & methods			Multi-purpose projects	Total
	Env., rec., or water quality	Municipal & industrial	Agricultural		
Arkansas	$30,000	$20,000,000		$65,000,000	**$85,000,000**
Colorado	$1,500,000	$4,000,000		$132,000,000	**$137,000,000**
Gunnison	$8,000,000	$46,000,000	$9,000,000	$423,000,000	**$486,000,000**
North Platte	*Forthcoming*	*Forthcoming*	*Forthcoming*	*Forthcoming*	***Forthcoming***
Rio Grande	*Forthcoming*	*Forthcoming*	$80,000	$130,000,000	**$131,000,000**
South Platte / Metro	*Forthcoming*	*Forthcoming*	*Forthcoming*	*Forthcoming*	***Forthcoming***

[b] Chatfield Reallocation Project ($62 million CWCB Investment - $80 million Loans), Animas- La Plata Project ($37 million Water Purchase) Rio Grande Cooperative Project ($5 million Grant – $15 million Loan/Grant), and Elkhead Enlargement Project ($11 million)

Southwest	$60,000,000	*Forthcoming*	*Forthcoming*	*Forthcoming*	**$60,000,000**
Yampa/White/Green	$5,000,000	*Forthcoming*	*Forthcoming*	*Forthcoming*	**$5,000,000**
TOTAL	**$74,530,000**	**$70,000,000**	**$9,080,000**	**$750,000,000**	**$904,000,000**
Percent of total	**8%**	**8%**	**1%**	**83%**	

* Most identified projects did not have associated costs. Therefore, additional cost estimating and refinement of existing project costs will be forthcoming to develop an overall statewide summary of water project funding needs. Costs were rounded to three significant figures.

The Statewide Water Supply Initiative (SWSI)~~It is~~ estimated that between $17 billion and $19 billion will be needed for municipal and industrial water infrastructure improvements by 2050.[8, c] 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 substantial~~significant~~ structural changes or channel reconfiguration.[9] To better determine the amount of river restoration work and other similar types of work that may be required~~;~~, up to 90 watershed or stream management~~level master~~ plans are necessary at an estimated cost of $18 million statewide.[10] As basins and stakeholders identify their environmental and recreational needs, further projects and methods will need to be developed and funded to meet those needs. For planning purposes, however, one could estimate a $2 billion to $3 billion environmental and recreational statewide need or approximately 10 to 15 percent of the municipal and industrial water infrastructure cost estimates. Additionally, the long term funding to support the sustainability of agriculture will need to be developed based on further identification of projects and methods. Funding for agriculture should not only include legal and engineering support alternatives to reduce agricultural dry-up, but also water infrastructure to deliver water from agricultural areas to urban areas on a shared basis~~recreational and agricultural needs, further projects and methods will need to be developed and funded to meet those needs~~.

Further refinement and identification~~Future calculated level~~ of ~~financial~~ water infrastructure financial needs through~~to be identified in~~ the BIP process will be required~~BIP's,~~ as we move forward. The~~further discussed and refined in 2015. In 2015,~~ CWCB will review the results of these efforts~~BIPs~~ to develop a list of project priorities~~priority projects~~. The criteria for a priority project include funding, if it is multiple-purpose, if it has multiple partners, or if it provides multiple benefits, and is regional in nature. The~~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.

Note that estimated overall funding needs of approximately $20 billion is associated with meeting the municipal and industrial (M&I) gap and maintaining current infrastructure. Specifically, these funds would support:

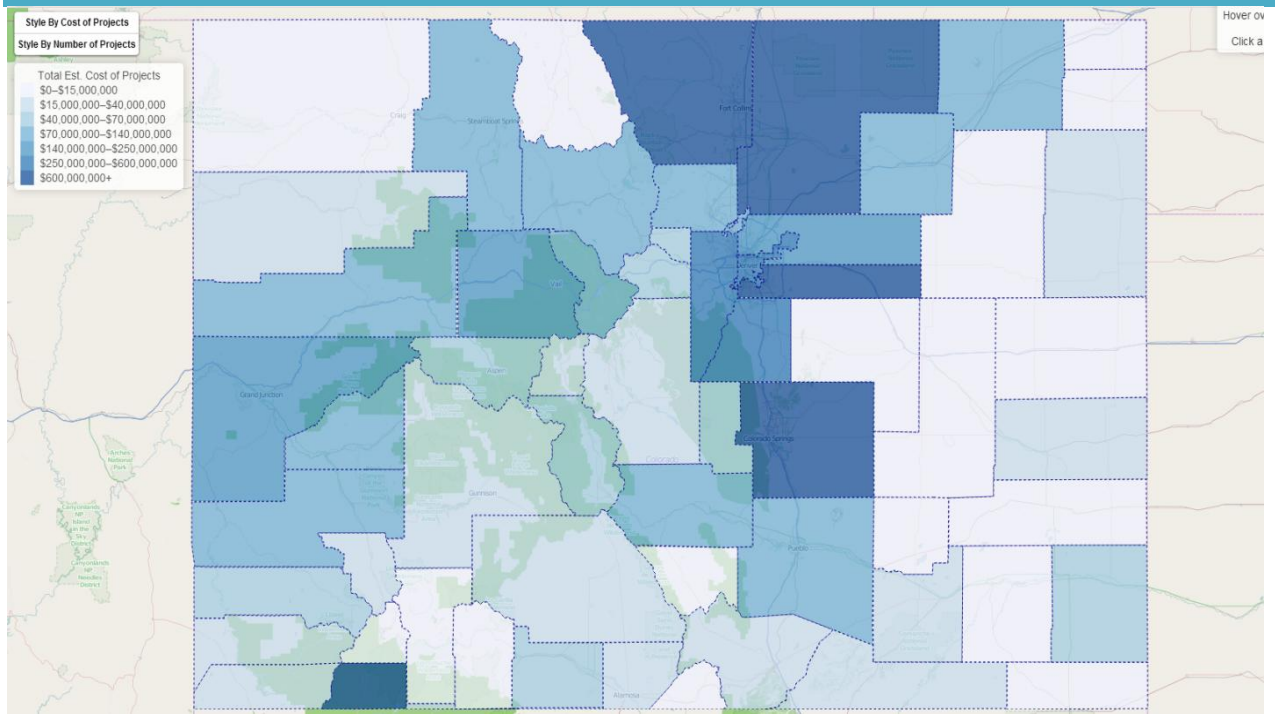
1. The Identified Projects and Processes (IPP) identified in the SWSI,
2. Short and long term maintenance needs of existing water delivery systems,
3. Alternatives to agricultural transfers

[c] This number is based on an estimated $14 billion to 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. The ~~. However, the~~ numbers, however, are being refined based off the BIPs~~.~~.

4. Active water conservation.

Additionally, financial support is needed to address environment and recreational needs throughout the State and to support agricultural viability. Treated water projects, such as drinking water treatment and distribution as well as waste water treatment, is not included in this number.

Figure 9.2-1: Estimated Near-Term Infrastructure Need[11]



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 89~~70~~ percent of its population resides east of the continental divide, yet 70 percent of the state's water supply originates~~lies~~ west of the continental divide.[12]

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.[13] The public perceives water as an affordable, accessible, and continually available resource.[14] 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 a fuel, electricity, food, etc.[15,d] 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.[16] This lack of awareness of the true cost of water could be either an issue with what the public is willing to pay~~can afford~~ or a learned response to the apparent low cost that consumers have historically paid for treated water delivered to their homes. With the current demand and future increased demands on water supplies, it is important to focus on education. Water users need to be aware of the true costs inherent in providing water.

State Funding Resources~~funding resources~~ and Other Funding Opportunities~~other funding opportunities~~

Current Funding Opportunities~~funding opportunities~~

Though the statewide funding needs for both the consumptive and non-consumptive water projects is substantial~~significant~~, a planned, phased approach with existing and potential alternate funding sources could address a majority, if not all 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, use 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 challenges~~problems~~ and accelerate the construction of a project. The Water Infrastructure and Supply Efficiency (WISE) Project is a perfect example where several~~over eighteen~~ entities, including South Metro Water Supply Authority members, Denver Water, Aurora, and the CWCB, shared infrastructure, water, and financing to provide critical renewable water to offset well usage in Douglas County.[17]

There are many~~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, the CWCB's Water Supply Reserve Account (WSRA) Fund, the Species Conservation Trust Fund, Non-consumptive funding programs as identified in SWSI 2010 Non-consumptive Toolbox, 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.

[d] Colorado average household income, 2008 to 2012 = $58,224. 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.

The CWCB Water Project Loan Program

Recognizing the importance of funding raw water projects, the Colorado General Assembly, in 1971 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.[18] 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 million to $20 million is available annually for water project loans from this fund.[19] In addition to the Construction Fund, in 1995, the Severance Tax Trust Fund was created under section 39-29-109, which directs 25 percent of the State's severance tax revenues into this fund, which is currently capped at $50 million annually.[20] Annual severance tax revenues provided to the CWCB range from $20 million to $50 million.[21] A portion of available Severance Tax Trust Fund revenues could be directed to assist in meeting investment return obligations on impact bonds issued in support of environmental and recreation needs throughout the State.to $50 million.[22]

The Water Project Loan Program has, on average, between $50 million andto $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 Account (WSRA)

WSRA 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 $10 million annually, which is split between the Statewide and Basin Accounts. Funding comes from annual severance tax revenues to the State, and has varied from $5.7 million to $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]

The WSRA roundtables process has proven to be a grassroots platform for engaging local basin, regional, and cross-basin discussions on water issues. Continued support and additional funding should be considered to maintain and enhance this successful program. The existing process and structure of how the WSRA grant funds are distributed from the basin and statewide accounts should be re-evaluated to encourage multi-benefit and multi-partnering projects, and to promote planning and technical support to smaller communities and water providers. A collaborative, regional approach should always be encouraged and considered in the planning process for projects that are funded through this program.

Watershed Restoration Program

The CWCB's Watershed Restoration Program provides grants for watershed/stream restoration and flood mitigation projects throughout the State. Over the years it has leveraged substantial outside entity dollars to promote watershed health. It has had an annual funding allocation of $250,000, but has recently seen a substantial increase in funding, because of legislation approved for phreatophyte control and flood and fire mitigation. The 2015 CWCB Projects Bill also approved an additional $1 million in funding for this program to assist with funding stream management plans, as discussed in Section 6.6. If additional revenues sources were successfully developed to

support environmental and recreational projects, this program could serve as the program to managed and disburse those funds.

Species Conservation Trust Fund

The Native Species Conservation Trust Fund was created in 1998, pursuant to HB98-1006. This fund is used by the CWCB and Colorado Parks and Wildlife (CPW)~~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 Species Conservation Trust Fund authorizes millions of dollars of work by the CWCB and CPW each year, and this authorization occurs through the annual Species Conservation Trust Fund 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, the Water Pollution Control Revolving Fund (WPCRF), the Small Hydropower Loan Program, and the Water Revenue Bond Program (WRBP).~~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. Note~~It should be noted~~ that the WRBP can provide funding well above $500 million with legislative approval.[27]

The Drinking Water Revolving~~Revoling~~ Fund and the 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 Small Hydropower Loan Program 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 of five megawatts or less.[28] Agencies seeking more than the first $2 million available through the Authority can apply through the CWCB.

Grant Programs

The CWCB also offers many~~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 WSRA 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.

CWCB Program Overview

~~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. To~~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 substantial~~significant~~ environmental and recreational enhancements that meet the criteria of the Interbasin Compact Committee (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 (~~WSRA~~)~~ and another grant programs for meeting future needs.[34]

Federal Funding Options

Federal funding options are also a potential source for meeting financial needs. For scientific and research-based projects, the Bureau of Reclamation's (BOR~~BOR'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 substantial~~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 is a federal fund comprised of funds appropriated from the U.S.~~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), BOR, the United States Department of Energy Western Area Power Administration, and the Colorado River Energy Distributors Association signed a memorandum of agreement (MOA)~~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.

Potential Future Funding Opportunities

Many stakeholder efforts, such as the IBCC, environmental groups, and the recently created Statewide Water Investment Funding Committee, have explored other~~Other~~ avenues of funding ~~have been explored~~ to meet Colorado's future water needs. The IBCC explored several financial options in the no-and-low-regrets~~No/Low Regrets~~ Action Plan listed below:[35]

- A~~a~~ federal/state partnership similar to the Central Arizona Project, -
- A~~a~~ state water project similar to the California State Water Project,-
- A~~a~~ state/local partnership in which the state facilitates the project, but the end-users finance and manage it,-
- A~~a~~ public/private partnership similar to those used to build transportation projects (e.g., E 470),-
- Enactment~~enactment~~ of a "water" mill levy (the assessed property tax rate used to raise revenue),-
- Additional~~additional~~ bonding authority for the State of Colorado,-
- Severance~~severance~~ tax increases,-
- A~~a~~ statewide sales tax,-
- Federal~~federal~~ loan guarantees,-
- Expanded~~expanded~~ authority of Great Outdoors Colorado funding,
- Specific~~specific~~ Farm Bill initiatives that appropriate funds for enhancing agricultural operations while supporting nonconsumptive needs,
- Regional~~regional~~ taxing,
- Statewide~~statewide~~ user fee,
- Statewide~~statewide~~ tax on internet-based transactions, and
- Debt~~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:

Productive Legislation – Water providers, the CWCB's recently created Statewide Water Investment Funding Committee, 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 $10~~20~~ million per year.

- Increase the funding cap~~levels~~ to the WSRA Grant Program account, currently limited to~~capped at~~ $10 million per year. 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.[37]
- Expand the CWCB's authority to improve the management and distribution of existing funds, enabling the CWCB to fund treated water 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 to support replacement of residential outdoor turf with plants that use less water and efficient outdoor irrigation systems.
- Amend governing statutes to water providers that provides them specific authority to use P3s.
- ~~.~~ 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 $123~~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, $40~~30~~ million has been returned.[38] These funds could be directed to various water projects, environmental and recreational projects, watershed and stream management, project management, and others.

Public-Private Partnerships (P3s~~) –)~~ Provide funding to create a State sponsored Center of Excellence, to research the pros and cons of P3's,~~P3s~~ and to develop a preliminary ~~model of a possible~~ water infrastructure P3 model. The Center of Excellence would be a centralized clearing house for water providers or entities to talk with experts in the field and to obtain information on working P3 models. Based on their expertise, the basin roundtables, in association with the WSRA process, should assist with this discussion to provide guidance to project proponents on the potential value of P3s for specific project/s being considered.

In general,~~.~~ P3s have the potential to reduce both capital investment and risk, while drawing on the respective strengths inherent of~~to~~ both the public and private sectors. Nevertheless ~~However~~, care must be taken to achieve an appropriate balance among~~between~~ public and private resources, costs, control, and long-term revenue streams. Lessons can be learned from the transportation sector, which used 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.[39]

State Repayment Guarantee Fund – For larger water projects that have many participating entities, it has proven difficult to develop an overall project financing package that equitably

distributes risk and repayment. Smaller participating entities with lower credit ratings, minimal revenue streams and service areas, can create a disincentive for larger water providers to participate in a bundled financing package for the project, given they would be subjected to higher interest rates, repayment, and risk. To address this problem the State could develop a Repayment Guarantee Fund that would act as overall repayment guarantee to the financial entity that is issuing the bond for the project. This State managed repayment guarantee would reduce the level of risk to the lender and participating entities, while providing a mechanism for smaller water providers to participate in regional water distribution/supply projects, without negatively affecting larger water providers.

The CWCB and the Statewide Water Investment Funding Committee would recommend that this fund be develop with a starting balance of $300 million. Lenders typically require a 10 percent repayment guarantee on a bond issuance, which would therefore support $3 billion in water project construction. Given that the amount of repayment guarantee diminishes over time once bonds are issued, those funds that are no longer needed to guarantee repayment on the original total bond amount, could then be reinvested into other needed environmental programs.

Impact Investment Capital (Green Bonds) – If a State Repayment Guarantee Fund is successfully developed, it could potentially support $3 billion in water infrastructure projects throughout the State. To assist in providing funding for environment and recreational projects that may or may not be attached to a specific water infrastructure project, it is recommended that the CWCB work with specific environmental groups to secure private capital through the issuance of bonds (Green Bonds), to provide meaningful, immediate funding for environmental and recreation projects throughout the State. The Green Bonds could be issued in incremental amounts over time to support projects that have been identified previously, which would minimize debt investment return costs under one large bond issuance. In summary, only issue bonds that can actually be spend in a specified time frame. The CWCB recommends that these funds be managed and disbursed through the CWCB's Watershed Restoration Program, requiring substantial reorganization of that program.

The long term obligation and repayment of the Green Bonds could come from a combination of revenues from the CWCB's Severance Tax Perpetual Fund, or public initiative, as further discussed below.

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 challenges.

In 2003, the Coloradans voted on Colorado Water Projects Referendum A, a ballot initiative that would have allowed the 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 percent against and 33 percent in favor. Though Referendum A was initiated to resolve a long-term water challenges~~problem~~ in the state, it was not accompanied by a comprehensive plan outlining how to

address that challengeproblem, a quantification of the magnitude of financial need, or where and how the money would be spent.

Since 2003, a substantialsignificant amount of time and resources have gone into developing a comprehensive overview of the state's current and long-term water needs. In 2005, HB 1177 was passed creating the Inner Basin Compact Committee, the basin roundtables, and the WSRA. In 2010, the State completed the SWSIStatewide Water Supply Initiative Study (SWSI) that provided a detailed assessment of the state's current and future water needs. In 2011, the Colorado River Water Availability Study (CRWAS) was completed, and in 2015 the basinsthis year, initial drafts of the BIPs were completed the BIPs, which identified basin-specific needs, and projects and methods.

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. P&I 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, in November of 2014 the State of California approved Proposition No. 1, which allows 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 four4 to eight8 mills on their property taxes to provide critical water project funding in their area and to offset affectsimpacts to other areas. This could generate approximately an additional $215 million to $430 million dollars per year and reside in a water investment fund as described above.[40] For comparison, typical Fire

District revenues are based on 8 mills. This option might be better handled at local levels based on specific water provider needs within a specific service area.

Container Fee Ballot – –In 2010, two citizens filed a Ballot Initiative seeking a fee on beverages containers 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.[41] It is an initiative that could help offset the negative environmental impact of plastic containers (i.e., bottled water). If the Container Fee Ballot were successful, it would play a key role in moving many of the funding issues identified in this Section forward.

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.[42] Colorado alone has nearly $20~~over $18~~ billion in identified water project needs, including water supply, environmental and recreational projects.[43].[44] There is no easy or inexpensive way to provide Coloradans~~Coloradoans~~ with a sustainable long-term water supply. The overarching goal is to provide clean, reliable water, at an affordable price, for many generations.

Action Summary:

Realistic, long term funding sources are essential to meeting the future water funding needs of the State. It cannot be assumed that existing programs and revenue streams are sufficient to address the long-term water supply and environmental needs of the state or to maintain existing water supply infrastructure. The following actions, as described below, could greatly assist in meeting the State's water funding needs over the next decade and assist in developing the necessary momentum in addressing the long term funding need of the State. The CWCB will work with the water investment funding committee to explore options to implement the following initiatives:

1. **Public funding sources:** Identify and determine a path to develop a new viable public source of funding, such as through a container fee ballot initiative to support a guarantee repayment fund, green bonds, and to provide additional support grants and loans for the water supply reserve account, education, alternative transfer methods, conservation, and agricultural viability.
2. **State repayment guarantee fund**: Establish a state repayment guarantee fund.
3. **Green bonds**: Develop issuance and repayment strategies needed to establish a green bond program to provide a funding source for large environmental and recreational projects.

4. **Water education and outreach:** Fund a water education and outreach grant program based on basin roundtable education action plans and the initiatives indicated in Colorado's Water Plan.
5. **WSRA**: Provide additional state account funds to the water supply reserve account program.
6. **Public-Private-Partnerships:** Modify Colorado's statutes to clearly allow for public private partnerships for water projects (§C.R.S. 43).
7. **Conservation:** Explore a tax credit for homeowners who install efficient outdoor landscapes and irrigation as part of the integrated funding plan.

Colorado's Water Plan identifies the following actions:

- The CWCB will work the water investment funding committee to develop a sustainable funding plan that integrates a guarantee repayment fund, green bonds, and additional support grants and loans for the water supply reserve account, education, alternative transfer methods, conservation, and agricultural viability.

The CWCB will assess~~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 guides~~a guide~~ (e.g., municipal, environmental, industrial, recreational, agricultural, conservation, education and outreach, among others).
- The CWCB will determine~~Determine~~ the economic benefits and effects~~impacts~~ of meeting or not meeting Colorado's future water needs.
- ~~The CWCB will work with the Encourage Colorado's~~ General Assembly and state agencies to align~~fund vacancies in DWR.~~
- ~~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. The State will take the following actions ~~Options to consider include~~:
    - Develop a common grant inquiry process coordinated across funding agencies for environmental and recreational project proponents. This will include revisiting and reorganizing how the current State Funding Coordinators Meeting is conducted.~~proponent,~~
    - Review the CWCB's financial policies to consider providing financial incentives to move projects and methods forward and to assist small water providers in addressing upfront planning costs, such as reduced interest rate categories, extended terms (40 years), et al.
    - ~~Pursue additional funds 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 one to three 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 one to two 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.~~
- ~~In years where there is a surplus in the Department of Natural Resource's severance tax operational account revenues, consider allocating all or a portion of them to address priority opportunities expressed in Colorado's Water Plan.~~

- ~~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 Real 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 because ofdue to reduced water usage. Develop funding recommendations.

- Assess whether there are additional loan opportunities for municipal conservation practices.
- Pursue funding Assess whether there is an opportunity to establish a water education and outreach grant program and develop recommendations on funding..
- Assess opportunities for additional Develop amended WSRA grant funds. As part of this, work to amend the WSRAFund guidelines on how any additional funding iscould be allocated, approved and disbursed. This could be an area where additional funding could be directed to prioritizeenvironmental and recreational projects that providedthroughout the greatest benefit to Coloradostate.
- Seek an amendment toDevelop draft amended statutory language to expand the CWCB's loan program's authority to fund treated provide funding for water supply, reuse, conservation, environmental, and recreationaltreatment projects and methods.
- Continue to provide $1 million annually to support stream management and watershed plans, and develop an established funding source.
- In partnership with the water investment funding committee, review and prioritize water projects identified in the BIPs, in coordination with the basin roundtable representatives, to develop a funding planother areas for those that could move forward. Based on the identified funding level, develop funding strategies that use existing and new funding sources to move high-priority projects forward in one to three years.
- Investigate the potential for the CWCB to become a project beneficiary through an arranged partnership for projects that are central to fulfilling the goals of Colorado's Water Plan.
- Identify and develop, in two 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 public-private partnership projects will move forward, considering best procurement practices, maintenance and operation, water administration and management, et al.
- Continue to use the water investment funding committee, made up of representatives from each basin, the CWCB, the Water and Power Authority, Executive Director's Office, large water providers, and the private sector, to evaluate the funding recommendations contained within Colorado's Water Plan 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 met over the course of 2015 and will continue to meet to provide funding and implementation recommendations to the CWCB.

- Over the next year, continue 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.
- Consider allocating all or a portion of any surplus in the Department of Natural Resource's severance tax operational account revenues, for efforts prioritized in Colorado's Water Plan.

- The State will explore near-term opportunities to increase funding resources by implementing the following actions:
  - Develop preliminary support data for various public funding options, such as state referendums, individual county mill levy increases, the insurance tax premiums, user fees, or other potential funding mechanisms.
  - Explore a Center of Excellence to create a working model of public-private-partnerships for water projects and methods.
  - Explore how a water investment (public tax) fund could be created, managed and disbursed.
  - Work with other applicable state agencies to develop a reserve fund that would act as a security or repayment guarantee by the State to water providers seeking bond funds through the Authority.
  - Explore the concept of a container fee ballot initiative.
  - Develop issuance and repayment strategies in issuing Green Bonds, as early as~~consideration in CWCB's~~ 2016, for environmental and recreational projects. It's recommended that Green Bonds be issued incrementally based on identified need to minimize repayment costs.
  - Reassess the Instream Flow Tax Credit program to determine how to make it more usable.
  - Work with various stakeholders, Department of Real Estate, the Department of Revenue, and appropriate legislative committees to develop strategies to maximize the conservation tax credit program.
  - Explore potential uses of Conservation Tax Credit revenues for stream and watershed restoration.
  - Explore with water providers the possibility of issuing a state tap fee for future taps installed statewide. Funds developed could be used to support the CWCB Water Efficiency Grant Program and/or water education. The amount assessed per tap would need to be determined based on the estimated number of new taps issued statewide and target revenue ~~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 Corps and the EPA as they implement WIFIA.
  - Work collaboratively with foundations and nonprofits to support the environment, recreation, and education priorities through philanthropy.

9.3 State Water Rights and Alignment~~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 that are 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 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.

Inventory of State Agencies' Water Rights~~state agencies water rights~~

The CWCB

Mission and Statutory Authorities~~statutory authorities~~

Colorado established the CWCB in 1937 with the~~whose~~ mission ~~is~~ to *c*onserve, develop, protect, and manage Colorado's water for present and future generations.[45] Section 37-92-102(3), C.R.S. (2014) 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.

The CWCB Water Rights Inventory~~water rights inventory~~

The CWCB currently holds 1595 decreed instream flow water rights that protect approximately 9180 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, the CWCB owns two storage rights in Bear Creek Lake in Jefferson County for approximately 2000 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 5230 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 the 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 Decision (ROD), 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.[50] The new space will be used to store water supply for multiple uses.

Uses of the CWCB's Water Rights~~CWCB water rights~~

The CWCB uses its instream flow~~Instream Flow~~ and natural lake level~~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 nonconsumptive~~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 partnership with the Colorado Water Trust, also has acquired an interest in the McKinley Ditch, located in the Gunnison River Basin. The CWCB will use the water in~~process of negotiating~~ a split-season arrangement, under which a lessee will use the water to irrigate ~~water acquisition with irrigation~~ in the early season and the CWCB will use the water for instream flow use for the remainder of the irrigation season. These creative ~~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, to sustain agriculture, and to 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~~Instream Flow~~ and natural lake level~~Natural Lake Level~~ water rights recognized the need to "correlate the activities of mankind with some reasonable preservation of the natural environment."[51] The General Assembly imposed ~~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 multi-purpose projects described above are an innovative and important way to benefit the natural environment while maintaining other uses of water. 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 Colorado Water Plan water values.

Colorado Parks and Wildlife (CPW)

Mission and Statutory Authorities~~statutory authorities~~

CPW was created by the merger of the Division of Parks and Recreation and the Division of Wildlife in 2011.[e] The~~, the~~ two state agencies are 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]

CPW Water Rights Inventory~~water rights inventory~~

At present, CPW holds or manages approximately 1320 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 propagation, wildlife and recreation, and domestic rights for employee housing and water supply for~~to provide~~ drinking and sanitary purposes~~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 CPW Water Rights~~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. Nearly all of the~~All~~ water rights owned or leased by CPW are dedicated to this purpose.[f] 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.

[e] House Bill 11-208 established the merger of the Division of Parks and Recreation and the Division of Wildlife. House Bill 12-1317 established the composition of the new Parks and Wildlife Commission

[f] 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.

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~~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 percent of Coloradans report that they regularly visit state parks. Recent studies indicate that roughly 18 percent of Coloradans are anglers and almost 5 percent of Coloradans hunt. Additionally, over 80 percent of all Coloradans use trails and over 50 percent 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 in reservoirs
    - 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 non-governmental 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 and the Tamarack Ranch groundwater recharge project. ~~still in formation.~~
- Development of data to understand water quality issues and support wise water quality management.
- The Habitat Partnership Program 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. Habitat Partnership Program committees are responsible for finding local solutions to local problems. This program 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 the CWCB on the protection and enhancement of streams and lakes through the Instream Flow Program. For example, in 2012, CPW loaned water to the CWCB from Lake Avery for instream flow use on Big Beaver Creek and the White River.
- Work with the Colorado Department of Public Health and Environment 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 (SLB) 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 optimize~~maximize~~ the use of water to benefit~~benefits~~ Coloradans without diminishing the protect wildlife, habitat, and recreational facilities.

Colorado State Land Board (SLB) of Commissioners

Mission and Constitutional/Statutory Authorities~~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~~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:

Table 9.3-1: SLB Water Assets~~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~~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 Colorado's~~the Colorado~~ Water Plan 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 the 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]

Table 9.3-2: History Colorado Water Assets

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

History Colorado Water Rights Inventory~~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:

Uses of History Colorado's Water Rights~~water rights~~

History Colorado uses its water rights in connection with the operation and maintenance of its museums and historic sites.

Colorado Department of Corrections (DOC)

Mission and Statutory Authorities

The DOC is governed by Article 17, C.R.S. (2014). The DOC's mission is "To protect the citizens of Colorado by holding offenders accountable and engaging them in opportunities to make positive behavioral changes and become law-abiding, productive citizens."[58] Section 37-88-101 authorizes the DOC to own ditches, canals and reservoirs for irrigation and domestic purposes.[59] Section 17-24-106 authorizes the Division of Correctional Industries to own real and personal property, which includes water rights.[60]

The DOC Water Rights Inventory

The DOC owns a number of water rights, including surface and groundwater rights and one storage right, located in Water Divisions 2, 4, and 5. The decreed uses of these water rights include: irrigation, (including irrigation by reuse and successive use of treated wastewater), domestic, exchange, augmentation and recreational (including fish and wildlife), storage and subsequent application to beneficial uses, sanitary, commercial, industrial, stock watering, mechanical, horticultural, fire protection, and manufacturing.

Uses of the DOC's Water Rights

Currently, the DOC uses most of its water rights for landscape irrigation and to support the Division of Correctional Industries agribusiness program (e.g. raising pasture grass and hay to support cow-calf dairy herd development). The DOC uses the wells and reservoir associated with the Rifle Correctional Center in Garfield County to support all functions at the facility, including irrigation needs.

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;

~~a.~~b. Encourage sharing and optimal use of water among state agencies where efficiency savings might be realized, and ~~and~~

~~b.~~c. 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 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 the early stages of future multi-purpose projects as a water rights holder when such partnership is needed to ensure the success of the project, minimize environmental impacts of a project, or otherwise ~~and will~~ further the water values in Chapter 1.
7. In coordination ~~CPW will continue to work~~ with the CWCB and interested stakeholders, CPW will take ~~to maximize~~ the lead on identifying opportunities to use ~~of~~ CPW's water rights to help fill environmental and recreational gaps while maintaining consistency with its mission, statutory mandate, and rules/policies governing the use of CPW property.[g] ~~.~~

9.4 Framework for ~~on~~ a More Efficient Permitting Process ~~more efficient permitting processes~~

Colorado's Water Plan advocates ~~promotes more~~ effective and efficient permitting in which State of Colorado ~~by encouraging state~~ agencies ~~to~~ work together to ~~and~~ complete their work early in the permitting process. This will provide the opportunity for state endorsement without being pre-decisional.

[g] Colorado Parks and Wildlife is funded primarily through the sale of hunting and fishing licenses, parks passes and permits, and the receipt of associated federal parks and wildlife funds. All real property interests, including water rights, purchased with wildlife cash, parks cash, or associated federal funds are required to be used only for parks and wildlife purposes. *See* sections 33-1-112(1), 117, 118, and 119, 33-9-107 and 109, 33-10-108(1), 111, 112, and 113, C.R.S.; *see also* 16 U.S.C. 669 to 669i, 16 U.S.C. 777 to 777l, and 16 U.S.C. 460l-4 to 460l-11. As such, there is limited ability to use such water rights for any purpose other than the originally intended parks and wildlife purposes. Any secondary or shared uses must be consistent with, and not otherwise impair, the water rights' originally intended parks and wildlife purposes.

Introduction

Governor Hickenlooper's May 2013 Executive Order reiterated that ~~what has been known for years in Colorado~~ the gap between Colorado's~~our~~ water supply and water demand is real and looming. While conservation is a key strategy to narrowing the gap across the state, it alone cannot solve the problem. Scenario ~~alone. In fact, scenario~~ planning indicates that at least 80 percent (350,000 acre-feet) of already planned projects ~~will~~ need to be implemented, and many of these still~~will~~ need to go through the permitting process.[61] Ideally, the permitting process ensures~~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. The current ~~To ensure this, the~~ permitting process needs review and~~. To encourage this review,~~ the Executive Order directed the CWCB to "streamline the State~~state~~ role in the approval and regulatory processes regarding water projects."[62]

The objective~~purpose~~ of this section is to explore how permitting in Colorado can be ~~made~~ more effective and efficient. Tackling permitting is extremely difficult because of the complexity of the projects, the challenges in understanding and reducing environmental impacts, and the condition of many of the aquatic systems. The section describes the current permitting and licensing processes ~~that project proponents must currently go through~~, the challenges that arise during the process, and the reforms that could ~~help~~ make the process more efficient and effective for all parties involved. The proposed solutions ~~proposed in this chapter mainly~~ focus on how the State~~state processes~~ can be more effective and eliminate and reduce redundancies. The section also ~~, and~~ touches on the benefits of~~that result from the~~ cooperation among federal agencies, local governments, and stakeholders. The approach described in this section~~the chapter~~ allows the State~~state~~ to endorse a project without predetermining the outcome of an environmental permit, certification, or mitigation plan.

Summary of Each Process~~the process for each process~~ within Water Permitting~~water permitting~~

This section ~~will~~ briefly explains~~explain~~ the state and federal process that~~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.

National Environmental Policy Act (NEPA) Process

~~The~~ NEPA is a federal law that establishes a structured planning and decision making framework required for any federal decision with the potential to significantly impact the human environment.~~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. Importantly, NEPA provides opportunities for citizen~~Citizen~~ involvement in government decision making through public disclosure and formal opportunities for public input ~~is required~~ as the environmental effects are evaluated.[63] ~~Both of these requirements are fundamental to NEPA because they should lead to implementation of NEPA's policies:~~

There are three situations in which a water supply project may trigger NEPA's procedural requirements:

- One or more project components will occur on federal lands (e.g: National Forest or Bureau of Land Management lands)
- The project or its components will be funded in part or whole by a federal funds; and
- The project will require~~"(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."~~[64]

~~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 permit~~agency has discretion to choose among one~~ or license

~~more alternative means of accomplishing a particular goal.~~ For ~~state~~ water projects in Colorado, the most common federal actions that lead to a NEPA environmental review are: a Bureau Of Reclamation~~BOR~~ contract for storage of water in a facility managed by that agency, a U.S. Army Corps of Engineers (Corps) Clean Water Act (CWA) Section 404 permit, a project component that will be built on federal land, or a Federal Energy Regulatory Commission hydropower license.[65]

The NEPA process is intended to help public officials make decisions that based on an understanding of environmental consequences and take actions that protect, restore, and enhance the environment.[66] NEPA regulations instruct federal agencies to use the NEPA planning process "to identify and assess the reasonable alternatives to proposed actions that will avoid or minimize adverse effects of these actions upon the quality of the human environment" and to use all practicable means "to restore and enhance the quality of the human environment and avoid or minimize any possible adverse effects of their actions."[67] It is through public and agency input that these goals are to be achieved.

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 needs~~will need~~ to take ~~the~~ action is the lead agency and is the agency~~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 when a project may have~~because~~ significant environmental impacts~~effects may occur if the projects are implemented~~.[68]

NEPA regulations direct federal agencies, to the fullest extent possible, to integrate the requirements of NEPA with other planning and environmental review procedures required by law or by agency practice so that all such procedures run concurrently rather than consecutively.[69] This goal is often not met, leading to an extended, consecutive planning process. To successfully achieve the goal of concurrent planning, the NEPA process must start at the earliest possible time within the water supply project planning process. It is recommended that proponents assess whether a project proposal is likely to trigger NEPA planning requirements at the start of planning and then engage the relevant federal agencies immediately.

Clean Water Act~~CWA~~ Section 404

Section 404 of the 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).

In summary, the Code of Federal Regulations (CFR) 40 Part 230 Section 404(b)(1)(Guidelines) states~~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~~
- Causes or contributes to violations of any applicable state water quality standard
- It violates any applicable toxic effluent standard
- It jeopardizes the continued existence of species listed as endangered or threatened under the Endangered Species Act
- The nation's water would be substantially degraded; and unless steps have been taken which will minimize potential adverse impacts of the discharge on the aquatic ecosystem.

Like NEPA, Section 404 requires specific, structured planning steps and information most efficiently addressed at the initial stages of project planning, and development. Various federal agencies have different Section 404 roles and responsibilities. The Corps administers the day-to-day permitting 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 EPA develops and interprets policy, guidance and environmental criteria used in evaluating permit applications. The EPA also determines the scope of geographic jurisdiction and evaluates the applicability of any exemptions, approves and oversees state and tribal assumptions, and reviews and comments on individual permit applications. The EPA has the authority to prohibit, deny or restrict the use of any defined area as a disposal site under section 404 (c)~~,~~ may elevate specific cases for further evaluation under Section 404(q), and enforces Section 404 provisions. The U.S. Fish and Wildlife Service (FWS) evaluates impacts on fish and wildlife of all new federal projects and federally permitted projects, including projects subject to the requirements of Section 404. The FWS also elevates specific cases or policy issues about an~~pursuant to Section 404(q).~~

~~An~~ individual permit that 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 the~~CWA Section 404(b)(1)~~ Guidelines, and NEPA regulations if they are applicable~~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.[70]

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 to protect water quality.~~.~~ The Water Quality Control Division (WQCD) is required by Colorado statute (C.R.S., §25-8-302(1)(f)) to review federal licenses and permits under Section 401 of the CWA Colorado Water Quality Control Commission (WQCC). Regulation No. 82 (5 CCR 1002-

82) authorizes the division to certify, conditionally certify or deny certification of federal licenses. It also ~~and it~~ sets forth best management practices (BMPs) applicable to all certifications, with one exception~~,~~ noted below.[71] Regulation No. 82 applies to division certification of CWA 404 permits issued by the Corps, licenses for hydropower projects issued by the Federal Energy Regulatory Commission, and other federal permits involving a discharge including CWA Section 402 discharge permits issued by the EPA.[72] The exception is for 402 discharge permits issued by the EPA for facilities on tribal lands, for Section 404 permits issued by the Corps on tribal lands, and for 402 permits issued by the EPA for federally owned facilities on federal lands. For~~: for~~ these facilities, the EPA issues the 401 certification.[73] Individual certification review is not required for Section 404 general or nationwide permits issued by the Corps, except for activities covered by certain nationwide permits on tribal lands. Except for the activities on tribal lands, ~~These~~ general or nationwide permits are certified under statute (C.R.S., §25-8-302(1)(f)) without additional conditions.

The WQCD~~division~~ issues a Section~~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~~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. House Bill 15-1249 passed during the 2015 legislative session. It repeals and reenacts statutory fees for clean water and drinking water programs in the WQCD of the Colorado Department of Public Health and Environment (CDPHE). One of the many provisions of the bill authorized new fees for the CDPHE certifications related to projects affecting regulated water quality standards in jurisdictional waters of the United States, known as 401 certifications. The WQCC establishes 401 certification fees by rule according to a tiered schedule, with these fees taking effect starting in FY 2016-17.~~division will issue the certification with the necessary conditions included.~~

Fish and Wildlife Mitigation Plans

~~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 CPW Commission for review and approval. If ~~mutual agreement on the plan is reached by~~ the applicant and the Commission reach a mutual agreement, the proposed ~~commission, the~~ plan is forwarded to the CWCB for Board~~board~~ adoption as the official state position~~ on the plan~~. If the Commission~~commission~~ rejects an applicant's plan, it is still forwarded to the CWCB. If the CWCB disagrees~~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 mitigation 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.[74] The CWCB has grant funds ~~grants may be made~~ available for~~to~~ applicants to help implement the mitigation plans. The CWCB has ~~Criteria have been~~ established criteria for such grants ~~for distribution when funds are available~~.[75] Examples of completed or in progress Section 122.2 plans ~~that are completed or in process~~ include Southern Delivery System (SDS), Windy Gap Firming Project, Moffat Collection System Project, and Chatfield Reservoir Reallocation project.

Reclaimed Water Regulation~~water regulation~~

The Colorado Water Quality Control Commission Regulation No. 84 (5 CCR 1002-84) and the WQCD's~~Water Quality Control Division's~~ reclaimed water program is designed to promote the use of reclaimed water in Colorado. It includes requirements and minimal standards for reclaimed water ~~to meet minimal standards,~~ and for treaters and users of reclaimed water to employ Best Management Practices for~~BMPs and oversee~~ its use. These minimal standards are necessary to protect public health and the environment. Regulation ~~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 ~~The type of reclaimed water use triggers the~~ treatment and best management practices required before and during use depends on the use of the reclaimed water.

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 WQCD~~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, the major extension of existing domestic water and sewage treatment systems, the site selection and development of new communities, and the efficient utilization of municipal and industrial water projects as "activities of statewide interest."~~.~~ 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~~existing~~ Colorado Efforts

In~~efforts to make~~ the past~~permitting process more effective & 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~~general assembly~~ in 1983 to improve the environmental permitting process primarily for energy development. The CJRP was never fully completed for any project.[76] 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 coordinate the~~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 DNR was designated as the administrator of the council. 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 required~~require~~ permits, approvals or compliance from federal, state, or local governments.[77] 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, 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."[78]

Recently, the State and various Federal agencies have made progress ~~has been made~~ through the use of Memorandums of Understanding (MOUs). No~~) among the State and various Federal agencies. While no~~ formal legislation was passed to initiate the development of MOUs. These~~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.[h] Progress~~Additionally, although not formalized and signed, progress~~ has been made on a Collaborative Approach to Water Supply Permit Evaluation (CAWS) through a series of facilitated conversations, among several parties an informal agreement resulted in~~MOU,~~ which ~~would treat~~ conservation could be treated either as a demand reducer or~~rather than~~ as an alternative to the project**.** The process was initiated by the DNR to mutually understand state and ~~educate~~ federal permitting processes~~partners about state planning~~ and requirements and identify areas with potential for improved efficiencies~~permitting issues~~.[i]

~~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.[j],[79]~~

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, CPW and the WQCD~~Water Quality Control Division~~ have become cooperating agencies for several projects undergoing the EIS process of ~~the~~ NEPA. Project proponents indicated ~~during the interview process for this section~~ that this has been a helpful, collaborative effort.[80] In addition~~Furthermore~~, there is~~has been~~ increased coordination within the DNR.

[h] 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.

[i] 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.

~~[j] 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.~~

InAdditionally, in 2012, the President Obama issued Executive Order 13604, on "Improving Performance of Federal Permitting and Review of Infrastructure Projects."[81] SpecificThe involved federal agencies reportedly applied an expedited review process to 50fifty pilot projects;, each with project having an accelerated schedule, with clear project review milestones, and a designated lead coordinating agency. The, with project progress wasbeing tracked on a "Federal Infrastructure Permitting Dashboard." The Dashboard containedcontains an IT platform wherepursuant to which involved agencies couldmay develop a cooperative schedule, share project documents, and quickly communicate with one another as concerns arise.[82]

Basin Roundtable and Inter Basin Compact Committee Concepts Concerning Permittingroundtable and IBCC concepts concerning permitting

The Interbasin Compact Committee's (IBCC)IBCC's no- and- low regrets action plan andas well as the BIPs developed by the basin roundtables discussdiscussed permitting in depth. Of the eight BIPs, six discussdiscussed 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 Outreachstakeholder outreach

To further understand the needs, issues, and potential solutions for the permitting process, the CWCB staff met with and interviewed a variety of water providers, environmental groups, and state and federal partners. The following is a list of organizations the CWCB met with or received comments from concerning permitting. In addition, several individuals provided comment, but are not listed.

The CWCB staff will continue to meet with state and federal permitting and licensing partners throughout the development of Colorado's Water Plan. Staff methas 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
- United States Forest Service
- BLM
- USFS
- National Resource Conservation Service (NRCS)
- Environmental Protection Agency
- 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 believebelieved that these two aspects would shorten the time it took for permitting time while upholdingnot reducing the environmental protections permitting secures. Multipleaffords to the environment. Other themes expressed by multiple stakeholders also express interest in reducing included the need to reduce duplication, increasingincrease resources, loweringlower costs, unifyingunify methods, increasingincrease clarity, examiningexamine reuse permitting, improvingimprove quality of draft EISs, and encouragingencourage multi-purpose projects.[83]

One common concept iswas to bring back something akin to the Colorado Joint Review Program described above. The establishment of a joint NEPA review process, beginning before land use authorization applications are submitted for new water projects, may prove to facilitate a more efficient process. The Bureau of Land Management's experience is that applicants who are willing to have pre-application discussion of potential impacts and perform analysis of alternatives before submitting land use authorization applications experience much shorter wait times.

Table 9.4-2: Stakeholder input

	Met with the 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	
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 (Corps)	X	
Environmental Protection Agency (EPA)	X	
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	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

Table 9.4-2: Stakeholder input		
Fountain Valley Authority		X
Douglas County		X

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 Statestate 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 Firming 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~~presidential executive order~~ 13604 described above.

Permitting Issues~~issues~~ and Potential Process Improvements~~potential process improvements~~

Several common potential process improvements emerged after~~After~~ reviewing the work of the IBCC and~~,~~ basin roundtables~~,~~ and the 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 CWCB identified the following process improvements to explore~~should be~~ further ~~explored~~:

1. **Improve Coordination**
   - Coordinate~~coordination – eliminate redundant~~ review efforts by different state~~State~~ agencies.

~~1.~~2. Coordinate EIS document review across state~~State~~ agencies with the goal of increasing efficiency.

3. **Increase Early Involvement**

~~2.~~4. Examine~~early involvement – examine~~ opportunities for state agencies, local governments, stakeholders, and federal agencies to get involved earlier in the NEPA process.

- Involve NEPA and CWA Section 404 lead agencies (if applicable) at the very initiation of project planning to assure a concurrent (vs. sequential) planning process. This will facilitate early identification of required planning steps and information needs.

5. **Coordinate Technical Methods**

~~3.~~6. Reduce~~technical methods – reduce~~ duplication of technical methods across state agencies, respecting the various authorities and obligations within existing law**.**

7. **Increase State~~state~~ and Other Resources**
   - Shorten~~other resources –~~ the length of time to complete the required environmental reviews ~~should be shortened~~ while maintaining a robust decision-making process.

~~4.~~8. Evaluate ~~At the beginning of permitting process the State should evaluate~~ potential future state staff demands and associated resources to complete the reviews in a timely manner at the beginning of permitting process. .

9. **Increase Clarity**
   - Increase~~clarity – increase~~ understanding of the information required for environmental reviews.

~~5.~~10. 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.~~

- Understand the role of conservation in purpose and need development.
- Develop a state~~**Improve the quality of Draft EIS documents** – this would allow for State~~ certification and mitigation handbook for project proponents and stakeholders.

11. **Improve the Quality of Draft EIS Documents**

- Enhance efficient completion of state certification, federal permitting, and mitigation plan processes.

~~6.~~12. ~~process to be completed more efficiently.~~ Emphasize issue identification earlier in the EIS process by involving all parties with a decision-making role and by collecting baseline environmental data.

13. **Encourage Multi~~multi~~-purpose Projects**

~~7.~~14. Facilitate~~**projects** – incentivize~~ projects with multiple objectives such as municipal, industrial, hydropower, environmental, recreation and agricultural by increasing sources and availability of funding for these types of projects. ~~purposes. The State should work with project proponents and other beneficiaries to explore opportunities to streamline permitting processes and to equitably allocate mitigation responsibilities.~~

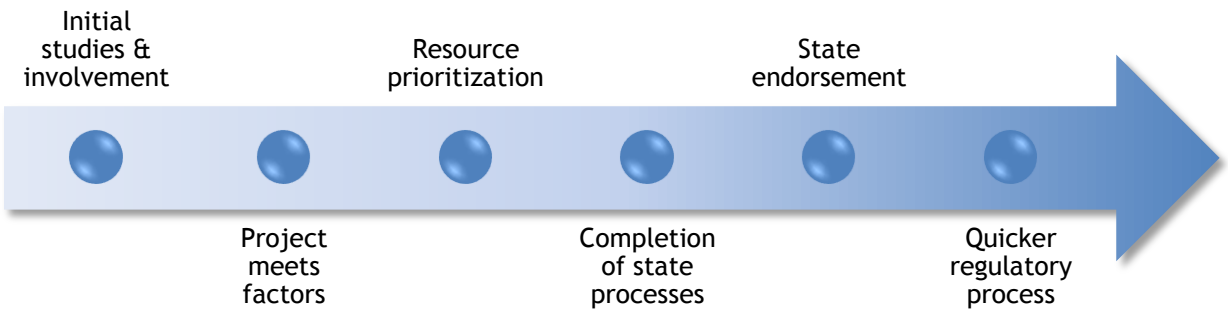
- Explore opportunities to streamline permitting processes, to equitably allocate mitigation responsibilities, and to provide state support and endorsement for these types of multi-purpose projects with project proponents and other beneficiaries.

Potential Conceptual Framework~~conceptual framework~~ for State~~state~~ of Colorado Support~~support~~ of a Project~~project~~

The State of Colorado could develop a more effective and efficient pathway for a water project to receive state~~a State~~ endorsement ~~and facilitate a quicker regulatory process~~ (Figure 9.4-1) while continuing~~). The purpose is to continue~~ to uphold state and ~~-~~regulatory review responsibilities. The state ~~while making the process more effective and efficient. This~~ could identify~~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.

~~AFor the first draft of Colorado's Water Plan, a~~ conceptual framework is explored below to ~~encourage for the purposes of~~ more discussion among state agencies and stakeholders ~~during the year of the draft~~.

Figure 9.4-1: Conceptual Framework~~framework~~ for a Project~~project~~ to Receive~~receive~~ State Endorsement~~endorsement~~



Initial Studiesstudies and Stakeholder Involvementstakeholder involvement

If technical or financial support is being sought for initial planning, baseline environmental studies, alternatives analysis, 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 Factorsmeets factors

Project proponents who participate in the cooperative approach should commit to factors that align the project with Colorado's Water Values (see Chapter 1):

- Addresses an identified gap through one of the following:
    - Is identified in a BIP,
    - 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 enhancesenhance water quality, and
    - Mitigates or avoids impacts on agricultural and rural community[k]
- Involves local government consultation
- Includes a stakeholder and public input process
- Establishes fiscal and technical feasibility

State Resource Prioritizationresource prioritization

WithIf more state resources become available, these factors, could allow for the State couldstate to commit to a resource-intensive approach at the beginning of the permitting process if more state resources become available. 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

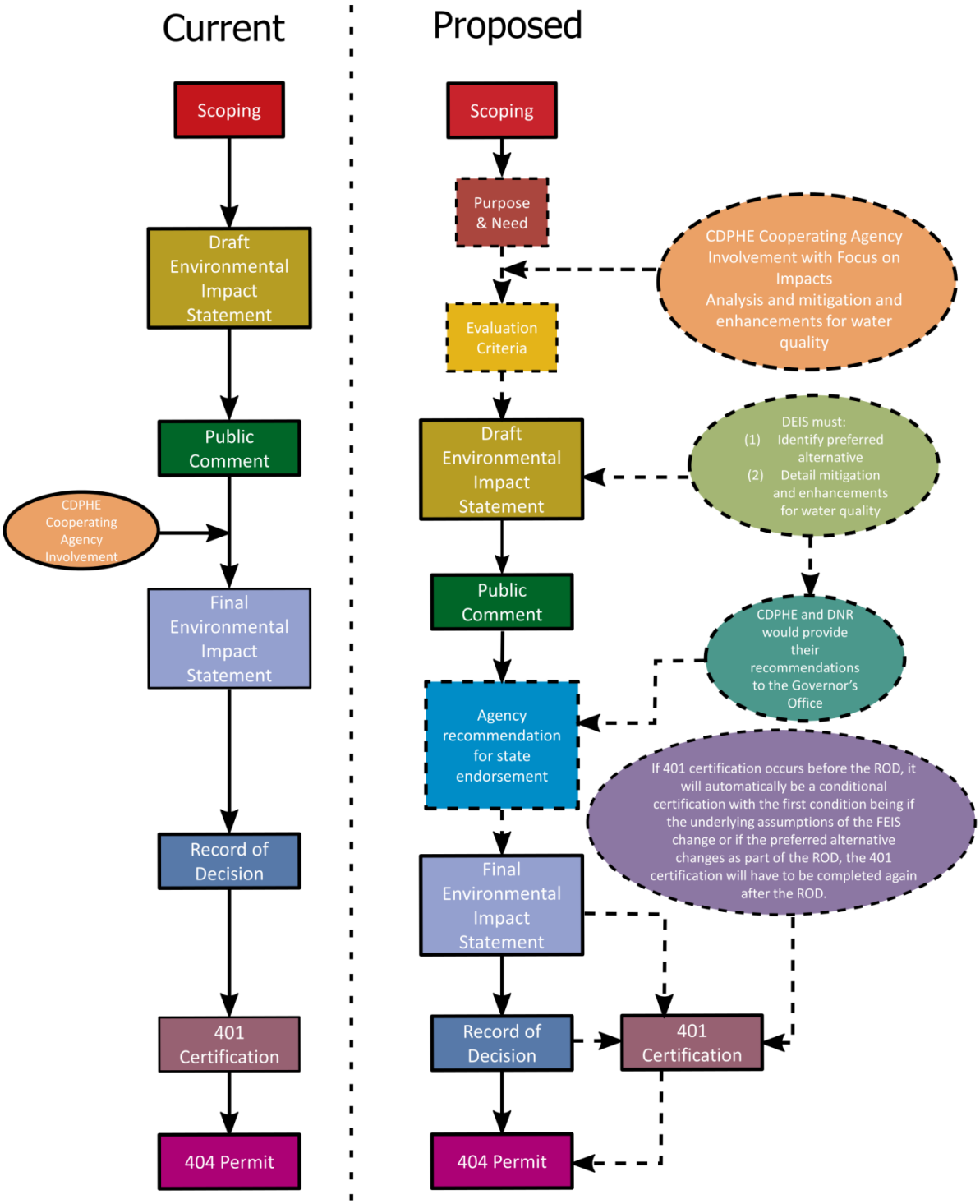
[k] This could take the form of an agricultural impact statement.

necessary permits. Existing regulations suggest that a coordinated approach is allowable under ~~state~~ existing state 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."[84]

Preliminary Technical Review ~~technical review~~ for State Processes

The current **state processes** for involvement in the federal 404 permitting process are summarized in Figure 9.4-2. The DNR's wildlife mitigation process is guided by CRS 37-60-122.2. In 1987, the Colorado General Assembly passed HB 1158 which created a process by which agencies within the DNR come to consensus regarding fish and wildlife impacts from water resource development

Figure 9.4-2 State Involvement in Federal 404 Permitting Process



projects and the mitigation of such impacts. The statute establishes (among other things) a process that involves a project's proponent, the Parks and Wildlife Commission, and the CWCB that results in the state's official position on the mitigation of fish and wildlife impacts associated with the development of water resources for the state's citizens. Historically, this process is initiated by the project proponent's presentation of a draft mitigation plan to the Commission after which CPW staff has 60 days to review the proposed plan and provide further input to the Commission.

At the end of a 60 day period, the commission and project proponent must agree upon a plan or the different versions of the plan are forwarded to the CWCB for their separate deliberation and decision. If the Commission and proponent agree, the CWCB simply endorses that agreement and that becomes the official ~~The~~ state position. If the CWCB disagrees with the plan and modifies it in any way, it goes to the Governor to affirm or modify the plan resulting in the official state position. Irrespective of the route that the plan has taken, the official state position is then transmitted to each local, state and federal governmental entity. The statute and process is constructed in such a way that it encourages agreement between the project proponent and CPW – this greatly reduces the amount of time that this process takes thus resulting in an expedited state regulatory process. The CDPHE involvement in the federal 404 permitting process has typically occurred towards the end of the permitting process. The CDPHE's participation as a cooperating agency has generally occurred after a draft EIS is issued. Additionally, the CDPHE has typically waited until the project's Record of Decision has been completed before its official 401 certification review process.

As discussed above, if resources are prioritized for earlier state agency involvement in the federal permitting process, improvements to the current state process could be implemented. The State has an obligation to not~~be a neutral party so as not to~~ be pre-decisional in 401 certification and wildlife mitigation plan processes. However, earlier state agency involvement in ~~If state processes are coordinated during the draft EIS, then~~ the EIS process would allow for early identification and resolution of~~more fully encompass and address~~ state concerns which should result~~, resulting~~ in a high quality draft EIS. This early state agency involvement could be accomplished by using the steps highlighted in Figure 9.4.-3. As shown in Figure 9.4-3, the CDPHE could be involved earlier in the EIS process~~product~~. In this case, much of the State's~~state's~~ review work could be done prior, during, and immediately after the Draft EIS process.

The CDPHE's involvement could start shortly after the project proponent establishes the objective for the project or as the project proponent develops evaluation criteria for the EIS alternatives analysis. The CDPHE's input on the evaluation criteria is critical as the State's methodologies for assessing water quality should be used in the EIS process. In addition, with early involvement the CDPHE's input on mitigation and enhancements could also be included in the Draft EIS.

Once the Draft EIS is completed, the CDPHE and CPW's review~~Review~~ of comments from stakeholders and local government on the DEIS would give the State~~state~~ a good idea on regarding support for~~of~~ the project and/or any outstanding issues related to the project resulting from early involvement in the projects development or scoping, the CDPHE would evaluate whether the preferred alternative adequately addresses water quality impacts, and includes sufficient mitigation and enhancements for water quality. Likewise CPW staff would have had early communication and collaborative efforts with the project's proponents and would have already initiated work on the framework of a mitigation plan for the project. Then, at the appropriate time (after the publication of the Draft EIS and after the 122.2 process has been completed), each agency would then provide the Governor's office their recommendations on the project. The CDPHE's recommendation would most likely be in letter form and would specify whether the CDPHE could certify the preferred alternative identified in the DEIS. The CDPHE would provide this recommendation after the DEIS public comment period~~. 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 permitted~~approved~~ through a 404 permit ~~the NEPA process~~ must be certified with a~~through the~~ 401 certification and the 404 permit ~~process, final certification~~ cannot be issued before the completion of the EIS, 401 certification needs to occur after the Final~~final~~ EIS. However, if state processes are coordinated during the DEIS~~draft EIS~~, as noted above, then, unless the preferred alternative changes or underlying assumptions~~details~~ of the DEIS~~a project~~ change, the 401 ~~in such a way that it would impact water quality, the final~~ certification could be completed ~~shortly~~ after the ~~final~~ EIS is issued, provided that all required processes for public notice and review per Water Quality Control Commission Regulations #21 and #82 are followed. If the 401 certification is completed before the ROD, it would automatically be a conditional certification with the first condition being that if the underlying assumptions of the EIS change or if the preferred alternative changes as part of the ROD, the 401 certification will have to be completed again after the ROD.~~.~~

Potential Fish and Wildlife Mitigation Process Changes

The legislation that created the 122.2 process for the mitigation of fish and wildlife impacts associated with water project development is somewhat constraining in that official communications between the project proponent and CPW staff are not initiated until after the release of a Draft EIS. Further, 122.2 has some rigid timelines that make it difficult for project proponents and CPW staff to jointly develop a quality comprehensive mitigation plan. It is also difficult for stakeholders' early engagement in the process. Also, currently there is little written guidance (outside of the words in the statute) for either project proponents or stakeholders. Therefore, the DNR and the Parks and Wildlife Commission should develop a written policy, administrative directive, or formal rules regarding the implementation of the provisions of 122.2. This written policy should encourage and provide an avenue for early communication and collaboration between project sponsors and CPW staff regarding impacts and mitigation strategies. The policy should also provide an avenue for early stakeholder engagement on the mitigation of impacts.

State Endorsement

If improvements to the state's involvement in the permitting process are implemented as described above, the State could provide **endorsement** of the project before the Final EIS. As described above, each state agency would provide their recommendations to the Governor's office that could then communicate to the appropriate federal agency that the State supports or does not support a given project.

~~Once State Processes are complete, state endorsement is possible without being pre-decisional.~~

Quicker Regulatory Process~~regulatory process~~

Such state endorsement would allow the State~~state~~ to encourage completion of the ~~final~~ EIS and ROD.

Actions

One of the main goals~~purposes~~ of the Colorado's Water Plan is to find ways to support the implementation of the BIPs. 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:

- The CWCB will host a series of lean events with relevant permitting agencies and stakeholders to examine current processes and determine how to make them more efficient and effective. The lean events will specifically examine how to eliminate redundant review efforts, reduce duplication of technical methods, and increase clarity on the required technical elements, and assessment methodology.
- The DNR~~CWCB~~ will coordinate the development of a permitting, certification and mitigation handbook in partnership with local, state, and federal agencies.
- State agencies with permitting authority will actively participate as a cooperating agency from the outset of the regulatory process and parallel processes are encouraged.
- Where more than one agency has jurisdiction over a particular issue, a lead state agency will be identified.
- The State of Colorado will explore options~~The DNR will work with state and federal partners to finalize the CAWS MOU, which factors conservation in as a demand reducer.~~
- ~~The DNR 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.
- The will work with state and federal partners to encourage cooperation through the CAWS MOU process, which factors conservation in as a demand reducer.
- State agencies with permitting authority will work with local governments and stakeholders to determine how Colorado will endorse a project after preliminary or contingent 401 certifications and fish and wildlife mitigation plans are completed.

coloradowaterplan.com
cowaterplan@state.co.us
Direct: 303-866-3441

Table 9.4-3: Summary of the IBCC No-and-Low-Regrets Action Plan and the BIP Comments on Permitting[85]

IBCC & Basin Roundtables~~BRTs~~	Challenges	Solutions
IBCC No-~~-~~and-Low-~~-~~Regrets Action Plan	"Needs assessment work conducted as part of the 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-~~no~~-and-Low-Regrets Action Plan~~low regrets action plan~~, the IBCC considered several potential actions in relation to permitting: As part of the No-and-Low-Regrets Action Plan~~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~~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~~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: the 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: the CWCB, members of the IBCC and the basin roundtables~~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	"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 ROD by the Corps, 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 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."

	alternatives."	
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 CJRP or~~CJRPor~~ Colorado Coordination Council." In Strategies to address regulations, the following bullet points are included to streamline permitting or develop collaborative solutions: Collaborate with the 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 the 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	In Strategies to address regulations, the following bullet points are included to streamline permitting or develop collaborative solutions: Collaborate with the 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 the CWCB to identify financial support mechanisms for Federal permitting activities.

	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."	
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 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."	"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 approved, but it would create an analysis from which future specific approvals can rely." "Starting in 2010, the Corps, the DNR including the CWCB, and the US EPA embarked upon a process called 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~~state~~ of Colorado could encourage the Corps and EPA Region 8 to revise their 1990 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~~401certification~~ 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."

coloradowaterplan.com
cowaterplan@state.co.us
Direct: 303-866-3441

9.5 Outreach, Educationeducation, and Public Engagementpublic 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 well-informed 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 over 24,000 local stakeholders and the public in the formation of 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.[86] 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.[87]

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 helphelps 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 recent statewide outreach and education by the CWCB, over the past 10 years the nine basin roundtables held more than 1000125 meetings to engage the public, and each roundtable held additional public meetings as they developed their BIPs. Additionally, many water providers, watershed groups, schools, districts, and authorities offer many ongoing water education activities. Currently, there are nonprofits solely dedicated to water education and water providers working with school districts to engage younger generations in smart water use. The recommendations in this section of Colorado's Water Plan involve strategies designed to continue to advance these outreach, education, and public engagement efforts toand enhance the overall water supply planning process.

Overview of Outreach, Education, & Public Engagement ~~outreach, education, & public engagement related to water supply planning~~

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.[88] Following John Wesley Powell's historic 1869 journey down the Colorado River, Powell brought his concerns on water supply "west of the hundredth meridian" to Congress.[89] 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 very different than in the past~~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~~ongoing efforts~~ and Research~~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. The 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."[90]~~"91.~~

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 of the IBCC and basin roundtables.[92] In addition, the workgroup is tasked with creating a mechanism for providing public input to IBCC and roundtable members. The PEPO Workgroup is comprised of 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 from the~~through~~ CWCB, the CFWE ~~has~~ facilitated the PEPO Workgroup from~~workgroup since~~ 2008~~-2015. In July 2015, the CWCB started managing the PEPO Workgroup directly~~.

Led and funded by the CWCB, several of the 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~~supporting~~ a statewide public education initiative;
- Developing~~developing~~ information and communication tools that can be used statewide;
- Establishing~~establishing~~ long-term funding for intrastate and interstate collaboration opportunities;
- Coordinating~~coordinating~~ efforts across state agencies; and
- Increasing~~increasing~~ coordination with the Colorado Department of Education on K-12 water resource content.[93]

The CFWE assumed management of the Water Education Task Force after the report was published in 2008. The 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.[94] The group commented on the 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, commissioned by the CWCB, which consisted of a statewide survey and report of public opinions, attitudes, and awareness regarding water in Colorado.[95]

There are numerous efforts that address public engagement in Colorado's water supply issues. Below are just a few examples. As Colorado's Water Plan is finalized, the groups listed below, in addition to other groups not included here, will serve as critical resources in implementing the outreach, education, and public engagement actions identified by the plan.

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 the Colorado Department of Public Health and EnvironmentCDPHE, funds outreach efforts to improveon water quality through Section 319 of the "Clean Water Act" of 1972.
- Colorado Parks and WildlifeCPW has many education programs that focus on engaging 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.[96] Colorado Parks and Wildlife also supports Project WILD, which engages students in environmental education and conservation.[97]
- The CWCB funds and coordinates stakeholder outreach through the basin roundtable process. The CWCB provides education funding through thetheir Water Efficiency Grant Program for water conservation projects and also helps to fund the 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.

- The CFWE is a source of balanced water education for all Coloradans.
- The 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 NGOs, such as Conservation Colorado, Trout Unlimited~~TU~~, the Audubon Society, The Nature Conservancy, and Western Resource Advocates~~WRA~~ 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.

- The Colorado Water Institute and the 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 at Colorado Mesa University 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.
- Colorado Springs Utilities reaches over 5000 adults through xeriscape classes, water system tours, business partnerships and landscape efficiency training programs.
- 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 provide~~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 in their respective areas of the Colorado River Basin.~~.~~
- 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~~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.
- The Community Agriculture Alliance assisted the Yampa/White/Green Basin Roundtable with public education and outreach on the BIP.

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. Other numerous~~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~~The SMWSA'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 partner~~partners~~ with the United States Forest Service~~USFS~~ 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.

Ute~~Outreach, education, & public engagement activities for 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.~~

coordinates the state's largest children's~~Overview of statewide outreach, education, & 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 festival, reaching~~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:~~
~~-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.[98] 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.~~ 2500 fifth graders in the Grand Junction area each ~~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.~~

~~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:~~

~~In addition to assistance from the BIP consultant teams during the drafting of the respective BIPs, each basin roundtable used their~~Funding

~~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 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, Education, and Public Engagement Activities ~~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~~

Figure 9.5-1 CWCB Education Funds Used Per Fiscal Year

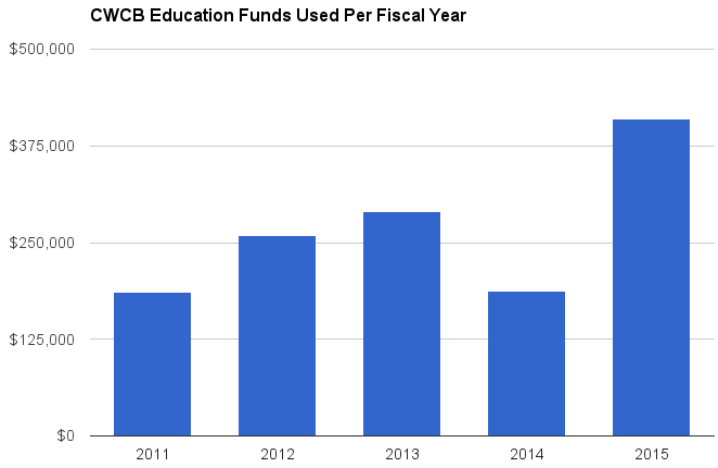


Figure 9.5-2 includes the total amount of CWCB funds allocated for education including PEPO funds, Education Action Plan funds, WSRA funds for educational projects (not including BIP contract funds), Water Efficiency Grant Program Public Education Grants, and the annual funds given to the Colorado Foundation for Water Education. The chart does not include outreach and education funds used by consultants for BIPs.

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, TU, 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.[99]

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 additional to the regular basin roundtable meetings were scheduled and continue developing the BIP.

~~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 the 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 Water Supply Reserve Account (WSRA)~~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. Figure 9.5-2~~The following graph~~ illustrates CWCB~~the state~~ funds allocated to education and outreach through the PEPO Workgroup, the basin education action plans, the Water Efficiency Grant Program Public Education and Outreach grants, the annual allocation from CWCB to CFWE, and related WSRA grants. ~~The peak in FY2012 is directly linked to increased WSRA grants to support the Colorado Water 2012 initiative.~~

The state funding provided for the roundtables is not sufficient for the level of outreach they need to succeed. On average, the costs for outreach activities have been between $15,000 and $50~~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~~roundtable~~, for instance, spent an additional $40,000 on outreach~~,~~ beyond what was originally planned, and already projects that with increased funding they could spend up to an additional $10,000 for activities outlined in their 2015 education action plan alone~~plans~~.[100] Without securing this additional funding from state and local sources, implementation of the long-range education action plan activities may~~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.[101] Despite insufficient funds, each roundtable increased their outreach activities, which is impressive.

~~Despite the insufficient funds, each roundtable increased their outreach activities.~~ In the future, the roundtables may struggle to maintain this level of outreach due to a few factors. First, they will not likely 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 support 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.[102] 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 $50005,000 annually. The report stated that limited resources should provide additional incentives and focus for federal and state funding agencies.[103] Should funding be created, some of it should be allocatedFunding 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 concludeend in 2015 and that funding for such activities increasesincrease as water supply solutions arebegin to be implemented.

The CWCB's Rolerole in Water Outreach, Education, and Public Engagementwater 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 InitiativeSWSI are an ongoing and iterative effortseffort. 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 provideproviding 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 as implementation begins. In the long-term, the partnerships and communication channels developed by these entities over the past several years will be crucial forin the effort to conduct public outreach and education activities on water supply planning and to solicit input forto implement balanced solutions. Each BIP articulated long-term goals and strategies for cultivating a supportive and engaged citizenry. These are a few, 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 conversation~~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.

Through this new fund and as recommended in the actions set forth at the end of this section, CWCB should work with state, local, and federal partners to develop a water education and outreach strategy that includes, but is not limited to, the topics listed below they relate to Colorado's Water Plan. These topics are explicitly mentioned within Colorado's Water Plan; however other topics will likely be added to the education and outreach strategy as it is developed:

- Colorado's Water Plan
- Colorado's eight Basin Implementation Plans
- Colorado's water challenges, solutions, and the need to be adaptable to changing conditions
- Connection between climate change and water
- Water conservation & reuse
- Integrating land use and water supply
- Water quality – "use a watershed approach for outreach and community engagement."
- Agricultural viability options, alternative transfer methods (ATM), education for farmers on available incentives for on-farm implementation of agricultural conservation measures, water sharing opportunities, and other tools available to growers
- Education and outreach to support environmental and watershed strategies, such as for imperiled warm water fish species, cutthroat trout, and forest health
- Outreach to energy companies to encourage and promote the most water efficient technologies for energy extraction

Outreach, Education, & Public Engagement Activities for Colorado's Water Plan

Colorado's Water Plan outreach, education, and public engagement efforts are unprecedented and build on a decade of stakeholder involvement. During development of Colorado's Water Plan, the CWCB received over 24,000 comments before the second draft of the plan was released in July 2015. Because Colorado's Water Plan rests upon stakeholder engagement, it is critical to highlight

the education and outreach efforts to date. This is a grassroots effort and this section demonstrates the high level of local and volunteer efforts to reach out to the public.

Statewide Outreach, Education, & Public Engagement Activities

Throughout the development of Colorado's Water Plan, public engagement, coupled with consistent and clear communications, has been crucial. Both statewide and within each basin, information has been 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 ten 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 and manage negativity; and
- To share the responsibility of implementing and executing communications about Colorado's Water Plan across the CWCB leadership and key stakeholders to foster a collective voice.

Table 9.5-1: Outreach Methods

Basin Roundtable Engagement	The CWCB and basin roundtables (through PEPO and BIP consultants) developed communication materials and messaging about Colorado's Water Plan and BIPs
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.) to partner with to distribute Colorado's Water Plan materials. The CWCB engaged these groups in the development of the plan and distributed information to their constituents. These groups also provided important speaking opportunities at various meetings and gatherings.
Public Input and Response	The CWCB solicited public input for all communication materials related to Colorado's Water Plan. The agency built a public comment form into the Colorado's Water Plan website, and established a new email account (cowaterplan@state.co.us) to receive public input. Also created were guides for submitting public input. All comments received and the staff responses are available for review online. At each of the CWCB Board Meetings from

Table 9.5-1: Outreach Methods	
	September 2013 through September 2015, an opportunity for public input was provided to encourage comment regarding Colorado's Water Plan. The CWCB also encouraged members of the public to engage directly with their basin roundtables.
Media Relations	The CWCB worked with the press to clearly articulate Colorado's Water Plan development process and to establish a foundation of knowledge and awareness in the media.
DNR/CWCB/IBCC Leadership Presentation Circuit	Meetings with the DNR, the CWCB, and the IBCC leadership helped enhance understanding of and build support for Colorado's Water Plan in the water community. The CWCB met and worked with over 100 key organizations and individuals listed in Appendix E. In coordination with the IBCC and the basin roundtables, the 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). The CWCB arranged speaking engagements, and developed materials and training sessions for spokespeople. 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.
Materials and Branding	The CWCB developed an overarching brand (logo, templates, and consistent look and feel) that reflected Colorado's Water Plan purpose and values. The 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.
Digital Engagement – Web and Social Media	The 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. 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. The website included a master calendar of events to promote existing opportunities to reach key stakeholders. The CWCB created Facebook and Twitter accounts and integrated them into the Colorado's Water Plan website. The 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. The CWCB staff monitor and administer these accounts and regularly post relevant information, answer questions, and participate in the conversation.

Input generated on Colorado's Water Plan between September 2013 and May 2015

Since work on the first draft of Colorado's Water Plan began in September 2013 through May 1, 2015 the CWCB received, reviewed and responded to over 24,000 comments for consideration in the second draft of the plan. Those comments included over 1000 unique submissions and over 20,000 form letters. Over 250 documents were also reviewed. To date, the CWCB staff members have with over 150 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 (WRRC) held public hearings in each basin during summer 2014 for comment on Colorado's Water Plan.[104] Input submitted to the CWCB on November 1, 2014 included over 200 public comments. The WRRC will hold additional hearings during summer 2015 and the input received will be summarized in the final draft of Colorado's Water Plan.

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 members of the CWCB's 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 was considered as the CWCB staff prepared the second draft of Colorado's Water Plan. There is a public comment period that ends September 17, 2015 before the final draft of Colorado's Water Plan is submitted to the Governor no later than December 10, 2015. The CWCB will also continue to forward input related to specific basin roundtables to the basin outreach teams as they move forward with implementation.

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, the 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 June 30, 2015 there were over 12,000 unique visitors to the website.

The website will continue to be the primary access point for the public to review and comment on the second draft 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 commenter's by the CWCB.

Basin Outreach, Education, and Public Engagement Activities

This section provides an explanation and summary of the basin roundtable and PEPO outreach efforts, over the development phases of the Basin Implementation Plans and Colorado's Water Plan. Each basin's PEPO education liaison and roundtable leadership supported information and input opportunities. The scope of these efforts far exceeds any other period of voluntary, roundtable driven outreach activities and the impact of these programs was realized through a significant increase in public engagement and ultimately an inclusive, comprehensive, and supported water supply planning process.

Data captured during the BIP process has provided quantification on:

- The number of technical outreach meetings held by each roundtable, the BIP consultants and stakeholder groups to identify specific water needs and projects;
- The number of dedicated public meetings to obtain responses to the BIP goals, needs assessments, and proposed projects;
- The number and type of attendees at each stakeholder and public meeting;
- The type of input the roundtables received;
- How the input was factored into the BIPs;
- The other outreach activities of each roundtable; and
- A summary of future planned outreach activities.

Between February 2014 and April 2015, the basin roundtables collectively hosted over 150 dedicated public meetings, in addition to regular basin roundtable meetings. All in all, nearly 4000 participants were counted among those basin roundtables that collected data on attendance. A summary of these meetings by basin can be found in each BIP. In addition to hosting public meetings, the roundtables employed innovative approaches to education and outreach. They published hundreds of local newspaper articles, participated in radio shows, developed and maintained websites to share BIP information, produced printed materials to hand out at local events, gave presentations at various community events, surveyed basin residents on BIP issues, solicited public input and incorporated comments into their BIPs, and targeted diverse stakeholder groups and individuals basin-wide. A total of 954 public comments from the three reporting basins that tracked that data were documented and incorporated in the final BIP documents. Most basins did not have the capacity to report on this level of detail.[105]

Sustaining Long-term Strategies

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, utilizing the $2000 available annually (which increased to $6500 annually beginning fiscal year 2016) through the PEPO Workgroup. Many roundtables used current funds and staff to implement outreach activities while others sub-contracted with the BIP consultants or are relied on external partnerships. Some basins used WSRA grants to fund more comprehensive education and outreach programs. Regardless, all the roundtables collaborated with their outreach teams more than ever before and it will be imperative to consider how to sustain this momentum into the future.

The extent and detail of each basin's education and outreach efforts can be found in those respective sections of their BIP. In comparing the commonalities of these long-term strategies, all basins articulated the need for active roundtable membership, coordinating partnerships, defining critical audiences and building relationships with key constituencies. The following section features a unique activity in each basin on how public viewpoints were incorporated over the course of the BIPs as well as the outreach strategies identified by the basin that are critical as they move forward.

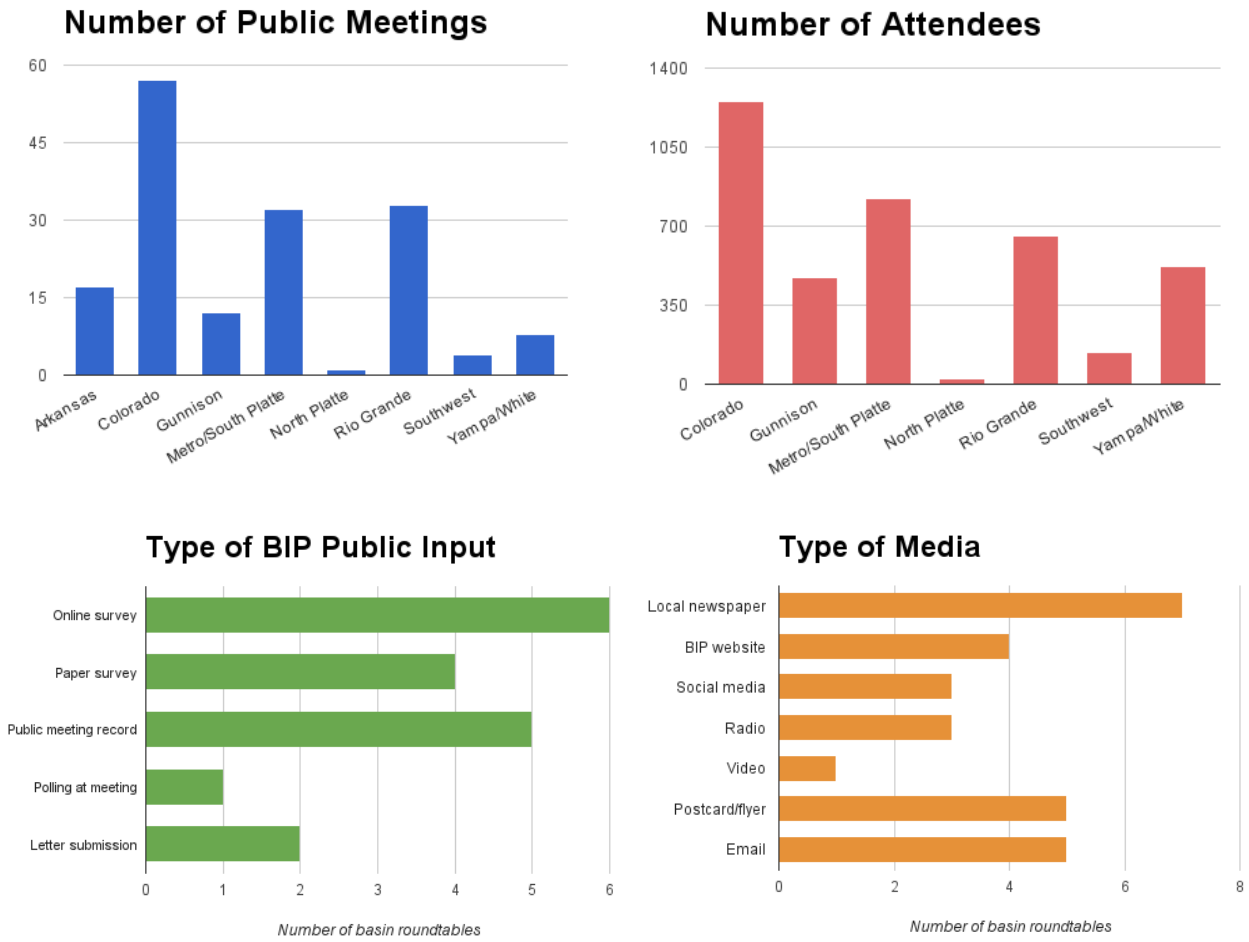
Arkansas Basin

Featured Activity

Through the outreach efforts of the BIP process, the Watershed Health Working Group, in partnership with Colorado Springs Utilities and funded through a WSRA grant, brought together basin roundtable members, representatives from federal and state natural resource agencies, NGO

stakeholders, and local government officials. The group worked on strategies to improve communication and collaboration between entities responding to watershed health-related threats and events, developing value maps and an action plan for the basin. An outcome of this internal capacity-building process was the creation of the Arkansas River Watershed Collaborative.

Figure 9.5-2: BIP Public Meeting Data



Featured Strategy

Acting as a catalyst to productive partnerships among community leaders, media outlets, and active citizen groups, the basin plans to undertake a structured public relations effort to maintain and improve relationships with individuals and organizations while enhancing efforts to educate various stakeholder groups on the purpose and progress of the water planning process in the Arkansas Basin, such as a white paper for public policy makers. These efforts will require significant resources to define critical audiences, craft calls to actions and measure effectiveness of communication channels.

Colorado

Featured Activity

Outreach during the BIP process included a WSRA grant with Colorado Mesa University's Water Center to solicit input from the public through online surveys advertised by a series of newspaper articles, open discussions at 57 meetings for 1250 attendees, as well as comment letters and emails. Working with Roaring Fork Conservancy, Eagle River Watershed, Trout Unlimited, and Club 20, surveys collected over 500 responses from adult audiences and student groups, reflecting significant concern about future water supplies and the health of the environment in the Colorado Basin. It was from this data collection that the six major "themes of the basin" were developed.

Featured Strategy

The basin roundtable plans to use the partnerships and communication channels developed through the process of conducting outreach on the BIP to continue to educate the public on the activities of the basin roundtable and regional and statewide water needs, and to encourage their input on how these needs should be met. The results of these activities will be shared with the CWCB as their planning efforts continue. Longer term strategies will engage the public on the water challenges and opportunities in the basin and statewide, maintaining a steady presence in both traditional and social media and ensuring members and partner organizations have the tools to inform their constituencies and collect public input on basin roundtable issues.

Gunnison

Featured Activity

The development of the BIP prompted an organized outreach effort with representatives from each of the six sub-basins of the Gunnison Basin, including educational entities and watershed groups. The resulting information-and-input opportunities utilized *The Gunnison River Basin, A Handbook for Residents*[106] for town hall meetings with the general public to obtain responses to the goals, needs assessments, and proposed projects. Overall input demonstrated strong support for the BIP Basin Goals and Statewide Principles.

Featured Strategy

A long-term strategy focuses on engaging non-roundtable stakeholders to contribute input and feedback on key BIP elements to help the basin roundtable reach out to potential new project proponents and partnerships. To help address the basin's water needs, various concepts and activities are encouraged by 2025, such as educating the next generation and political leaders and research on climate change adaptation and the ten "tier one" projects within the BIP. Due to limited resources, the successful continuation of education and outreach activities will require careful coordination with existing organizations, programs and resources.

Metro/South Platte

Featured Activity

During the development of the draft and final BIP, a total of 32 public meetings were hosted in unique locations across the basin and publicized through local media. At least 820 participants attended representing a wide variety of interests including agriculture, municipal, industrial,

business, recreation and environmental. Public and stakeholder comments were collected via survey during the meetings and shared with the basin roundtables for analysis and incorporation into the joint BIP.

Featured Strategy
A facilitated Metro/South Platte basin education committee workshop will identify the staffing and coordination needed to identify common priorities and develop implementation strategies. An initial strategy is a joint communications plan targeted at stakeholders, including water users, political leaders, and leaders of major businesses and industries throughout the state. This plan will maximize existing opportunities and avoid duplication of efforts to generate a lasting baseline of public awareness and support on the need for innovative water rate structures, energetic conservation measures, and more integrated land use and water supply planning.

North Platte

Featured Activity
During the BIP process, basin roundtable members participated in a public outreach meeting and targeted technical workshop meetings with both consumptive and environmental and recreational stakeholders. The public outreach meeting was announced in the local paper and 22 members of the public attended to learn about the history of the roundtable and the current planning efforts.

Featured Strategy
Public education and outreach programs can effectively address adverse perceptions and increase acceptance of projects. By working closely with organizations that specialize in facilitation of public education and outreach programs, the basin will increase public understanding and participation in important water issues and capitalize on previous educational efforts of the basin's education liaison.

Rio Grande

Featured Activity
The BIP process strengthened the existing comprehensive outreach program using numerous media platforms throughout the basin, such as weekly newspaper articles, monthly radio programs, a dedicated website and a water 101 booklet developed specifically for the basin. This program has resulted in increased public attendance at regular roundtable meetings as well as momentum to create a forum to discuss "Multiple Use Project Implementation."

Featured Strategy
Through a continued partnership with the Rio Grande Watershed Conservation and Education Initiative, the basin will establish a long-term education and outreach strategy for water use and needs in the basin, building its public communications on three key ideals – outreach, education and participation – across all demographics, including water users, public officials, communities and water leaders. This can be achieved through active and diverse basin roundtable members, educational opportunities and strategic planning forums.

Southwest

Featured Activity

Unique to this basin is the "social hour" before each roundtable meeting, where nearly as many members of the public attend to learn and network as roundtable members themselves. An additional set of meetings provided local decision makers with information on the CWP and BIP along with discussion topics to spur participation and input, resulting in a greater understanding of public concerns and interests as they relate to water development and uses within the basin. Similarly, attendees were asked to widely share the CWCB's fact sheets and the winter 2015 issue of *Headwaters* magazine with their constituents.

Featured Strategy

Working with the Water Information Program, the roundtable plans to continue to inform local decision makers and the public about consumptive and nonconsumptive needs and planned projects, promoting partnerships, how they are represented on the roundtable and disseminating information on natural variability of river flows and the hydrologic cycle. One short-term strategy to achieve the BIP goals of conservation, land-use planning and water reuse is to implement a pilot conservation and land-use planning session.

Yampa/White/Green

Featured Activity

Through a WSRA grant, the Community Agriculture Alliance implemented and facilitated education and outreach activities for the basin, including a partnership with three local National Resources Conservation Service (NRCS) conservation districts to host and widely advertise a water forum and Q&A session at their annual meetings, thereby expanding the basin roundtable's constituency. Input surveys were administered to the 255 attendees and to other stakeholders throughout the BIP process, resulting in 3 new IPPs for consumptive use projects and 17 additional IPPs for environmental and recreational projects.

Featured Strategy

The basin roundtable recognizes the importance of including stakeholders in the process of developing and implementing IPPs and will therefore serve as a source for information exchange. Participation in the public process will be encouraged to provide transparent and open dialogue amongst all involved parties. Additionally, some IPPs can impact stream flows both upstream and downstream of the project location and as such, the basin roundtable can facilitate public awareness of the projects and help to build consensus on the water management challenges as well as opportunities.

Actions

Based on the analysis presented in this section~~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:** As part of the funding package discussed in Section 9.2, the DNR will evaluate a
   - A new outreach, education, and public engagement grant fund toshould 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 the CWCB through the basin roundtables. Grant

1. The grant fund specifics could includeshould be modeled on the following:
   - Similar to WSRA program. It should consist of statewide and basin funds, these funds could be available for eligible outreach, education, and public engagement projects that meet specific criteria and guidelines developed by the CWCB that align with Colorado's Water Plan goals.
   - Lists of proposed projects for outreach, education, and public engagement already exist within the BIPs and each basin roundtable's PEPO Education Action Plan.
   - Guidelines couldshould 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 in through the BIP, basin roundtable Needs Assessments, Statewide Water Supply Initiative, IBCC, and Colorado's Water Plan or the BIPs.processes and products.
   - Guidelines wouldshould stress the importance of measuring success, targeting specific audiences and approaches, and include other education and outreach best practices that lead to successful public engagement.

2. **Create a data-based water education plan:** Over the next two years, the CWCB will create a data-based water education plan by:
   - ConductingGuidelines 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, and;
     - Determiningdetermine 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 WSRA grantWRSA Grants' criteria and guidelines.

- The CWCB will initiate efforts to improve coordination between state agencies on outreach and education activities. This willshould include the development of performance metrics and a database to track efforts.
- The 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] § 37-60-106 2014, C.R.S.
[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] § 37-60-121 2014, C.R.S.
[6] § 37-60-121 2014, C.R.S.
[7] Chatfield Reallocation Project ($62 million CWCB Investment - $80 million Loans), Animas- La Plata Project ($37 million Water Purchase) Rio Grande Cooperative Project ($5 million Grant – $15 million Loan/Grant), and Elkhead Enlargement Project ($11 million)
[8] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010* (Denver, 2011).) 7-29.
[9] Personal Communication, Colorado Parks and Wildlife, 2014.
[10] Personal Communication, Colorado Parks and Wildlife, 2014.
[11] Water Information Network of Colorado (2014).
[12] B. Harding, *Analysis for CWCB* (2014).
[13] W.M. Hanemann, *The Economic Conception of Water, Chapter 4*, (University of California Berkley), Section 3.4.
[14] Lewis Solomon, *American Water and Waste Water Crisis, The Role of Private Enterprise*, (2011).
[15] United States Census Bureau, "Colorado," accessedAccessed November 2014, http://quickfacts.census.gov/qfd/states/08000.html.
[16] Kevin Riedy, *Initial Analysis from HB 1051* (2014).
[17] House Bill 14-1333 (2014).
[18] Title 37-60-121. C.R.S.
[19] Colorado Water Conservation Board, *Annual Financial Compilation Report* (2014).
[20] Title 39-29-109, C.R.S.
[21] Colorado Water Conservation Board, *Compilation of 2001-2013 CWCB Severance Tax Revenues* (2014).
[22] Colorado Water Conservation Board, *Compilation of 2001-2013 CWCB Severance Tax Revenues* (2014).
[23] Colorado Water Conservation Board, *2014 Annual Financial Compilation Report* (2014).
[24] Colorado Department of Natural Resources, *Tier 2 Severance Tax Operation Fund, Schedule 9, Cash Fund Report* (2013).
[25] Colorado Water Conservation Board, *WSRA Basin and Statewide Account Annual Report* (2014).
[26] Colorado Water Resources and Power Development Authority, "Programs," accessed July 1, 2015, http://www.cwrpda.com/programs.
[27] "Programs."[27] Colorado Water Resources and Power Development Authority. http://www.cwrpda.com/programs

[28] Colorado Water Resources and Power Development Authority, "Small Hydropower Loan Program Terms," accessed July 1, 2015. ~~Hydro Funding Policy.~~ http://www.cwrpda.com/programs/small-hydropower-loan-program.
[29] Colorado Water Conservation Board Finance Section, *Non-reimbursable Investment Summary* (2013).
[30] Colorado Water Conservation Board, ~~-~~*Non-Consumptive Toolbox Appendix E* (2011).
[31] Colorado Water Conservation Board Finance Section, *Non-reimbursable Investment Summary*.
[32] $55 million average annual available CWCB loan funds x 35 years = $1.925 billion rounded to $2 billion.
[33] $11million available x 35 years = $385 million.
[34] WSRA Funding at $10 million + $4 million in grant funding = $14 million x 35 years = $490 million.
[35] Interbasin Compact Committee *No and Low Regrets Action Plan* (2013).
[36] The Nature Conservancy Colorado River Program, *A Compendium of Financing Sources and Tools to Fund Freshwater Conservation* (The Nature Conservancy, Colorado Chapter, 2011). https://www.conservationgateway.org/Documents/TNC%20Financing%20Compendium%20FULL%20RPT.pdf.; Tamarisk Coalition, *Sustainable Funding Options for Comprehensive Riparian Restoration Initiative in the Colorado River Basin* (2011). http://www.tamariskcoalition.org/sites/default/files/files/Sustainable_Funding_Options_for_a_Comprehensive_Riparian_Restoration_Initiative_in_the_Colorado%20River%20Basin_2011.pdf.
[37] Title 39-22-533, C.R.S.
[38] Senate Bill 13-236.
[39] Committee on Transportation and Infrastructure of the House of Representatives – Panel on Public-Private Partnerships, *Public Private Partnerships: Balancing the needs of the public and private sectors to finance the nation's infrastructure Final Report* (2014).
[40] Mill levy calculations based on 4 mills, Adams $18 million, Arapahoe $30.4 million, Boulder $22 million, Denver $40.4 million, Douglas $17.2 million, El Paso $23.2 million, Jefferson $28.8 million, Larimer $15.2 million, and Weld $18 million, approximate total = $215 million. Those figures are doubled for 8 mills or $430 million.
[41] Legislative Council Staff and Office of Legislative Legal Services, *Memorandum on Proposed initiative measure 2009-2010 #91, concerning a container fee to fund water preservation and protection* (2010). http://www.leg.state.co.us/lcs/Initiative%20Referendum/0910InitRefr.nsf/dac421ef79ad243487256def0067c1de/2d3041454dfeaee7872576f2007c6116/$FILE/ATTLSOK3.pdf/2009-2010%20%2391.pdf.
[42] Committee on Transportation and Infrastructure of the House of Representatives – Panel on Public-Private Partnerships, *Public Private Partnerships: Balancing the needs of the public and private sectors to finance the nation's infrastructure Final Report*.
[43] Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010.*
[44] ~~Colorado Water Conservation Board, *Statewide Water Supply Initiative 2010.*~~

[45] § 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, 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] ~~[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 § 37-92-102(3), C.R.S.
[52] § 37-92-102(3), C.R.S.
[53] Senate Bill 11-208 and Article 9, Title 33, C.R.S. (2014).
[54] § 33-9-101 (12) (b), C.R.S. (2014).
[55] § 33-1-105(1)(a)(I) and 33-10-107(1)(a), C.R.S. (2014).
[56] "About Us," http://www.historycolorado.org/about-us/about-us.
[57] § 24-80-202(1), C.R.S. (2014).

[58] http://www.doc.state.co.us.
[59] § 37-88-101, C.R.S.,(2014).
[60] § 17-24-106(1)(k), C.R.S. (2014).
[61] CWCB, "SWSI 2016 Initial Draft Chapter 7: Scenario Planning & Adaptive Management," CWCB, Denver, 2014.
[62] Governor John Hickenlooper, Executive Order D2013-005 *Directing the Colorado Water Conservation Board to Commence Work on the Colorado Water Plan*. May 14, 2013.
[63] National Environmental Policy Act, 42 U.S.C. §§4321-4370h.
[64] National Environmental Policy Act, 42 U.S.C. §§4321-4370h.
[65] Colorado State House of Representatives, *House Report 113-24.* Online, http://www.gpo.gov/fdsys/pkg/CRPT-113hrpt24/html/CRPT-113hrpt24.html.
[66] *Code of Federal Regulations*, Protection of Environment, title 40, section 1500.1
[67] *Code of Federal Regulations*, Protection of Environment, title 40, section 1500.2
[68] 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.
[69] *Code of Federal Regulations*, Protection of Environment, title 40, section 1500.2
[70] 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.
[71] 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.
[72] WQCD, Regulation No. 82 (5 CCR 1002-82).
[73] WQCD, Regulation No. 82 (5 CCR 1002-82).
[74] §37-60-122.2, C.R.S.
[75] § 37-60-122.2, C.R.S.
[76] 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
[77] DORA, 2012.
[78] DORA, 2012.
[79] Colorado House Bill 14-1030. Accessed November 7, 2014 http://www.leg.state.co.us/clics/clics2014a/csl.nsf/fsbillcont/6463D7584236949F87257C30000622112Open&file=1030_enr.pdf.
[80] WQCD, Personal Communication, 2014.
[81] Executive Order 13604 of March 22, 2012, 77 FR 18887, March 28, 2012.
[82] Executive Order 13604 of March 22, 2012, 77 FR 18887, March 28, 2012.
[83] NWCCOG, Barbara Green, Personal Communication, 2014.
[84] WQCD, Regulation No. 82 (5 CCR 1002-82).
[85] Interbasin Compact Committee, Draft No and& Low Regrets Action Plan.

[86] BBC Research & Consulting, Public Opinions, Attitudes and Awareness Regarding Water in Colorado (Denver, 2013) Section III, 9.
[87] BBC Research, Public Opinions, Section IV, 2; 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.
[88] Reagan Waskom, "Editorial," *Colorado Water* 30 (2013): 1.
[89] Justice Greg Hobbs, "Colorado Water Law: An Historic Overview," *The Public's Water Resource: Articles on Water Law, History, and Culture*. (Denver: CLE in Colorado, 2007),) 69.
[90] Caitlin Coleman, "Celebrating 10 Years of Statewide Water Education with the CFWE." *Colorado Water* 30 (2013): 20.

[91] Caitlin Coleman, "Celebrating 10 Years of Statewide Water Education with the CFWE." *Colorado Water* 30 (2013): 20.
[92] § 35-75-106 (1) (2012), C.R.S..
[93] Colorado Water Education Task Force, *Colorado Water Education Task Force 2008 Final Report* (Denver, 2008), 3.
[94] Colorado Foundation for Water Education, *Colorado Water Initiative 2012 Final Report* (Denver, 2013), 3, 9.
[95] BBC Research & Consulting, Public Opinions, Attitudes and Awareness Regarding Water in Colorado (Denver, 2013) Section III, 9.
[96] "About Us," River Watch of Colorado, http://www.coloradoriverwatch.org/sample-page/.
[97] "Project Wild" Colorado Parks and Wildlife, http://cpw.state.co.us/learn/Pages/ProjectWild.aspx
[98] § 37-60-106 (2014), C.R.S.
[99] Gunnison Basin Roundtable, *The Gunnison River Basin: A Handbook for Inhabitants* (Grand Junction, 2014).
[100] Rio Grande Basin Roundtable, *Rio Grande Basin Water Plan* (Alamosa, 2014), 286-290.
[101] Arkansas Basin Roundtable, *Arkansas Basin Implementation Plan: Draft* (Pueblo, 2014), Section 4.1, 4
[102] Water Education Task Force, *Final Report*, 6.
[103] Water Education Task Force, *Final Report*, 6-7.
[104] § 37-60-106 (2014), C.R.S.
[105] Kate McIntire, memorandum to the Colorado Water Conservation Board, "Agenda Item 9a, Statewide Outreach Status Update – May 2014", 2014.
[106] Gunnison Basin Roundtable, *The Gunnison River Basin: A Handbook for Inhabitants* (Grand Junction, 2014).

10. Critical Action Plan

10.1. Colorado's Water Values

Colorado's Water Plan hinges upon three primary values:

- 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; and
- A healthy environment that includes healthy watersheds, rivers, streams, and wildlife.

These values shape the goals and actions of each section in the plan. The purpose of Chapter 10 is to further describe each of these values, and then describe the goals and critical actions needed to meet them. These high-impact actions are a subset of a broader set of actions found throughout the plan in chapters six through nine, and eleven.

1. Colorado's Water Plan values a productive economy that supports vibrant and sustainable cities, viable and productive agriculture, and a robust skiing, recreation and tourism industry: Colorado will continue to face natural stressors such as deep droughts, destructive wildfires, and catastrophic floods. The best science available indicates that these conditions will only get worse with climate change. Past events in Colorado, as well as recent droughts in Texas and California, serve as important warnings that these challenges harm Colorado's economy and way of life. As Colorado's economy continues to grow with the influx of new residents and industry, water planning for the future must reflect careful deliberation and balancing of the many municipal, industrial, and agricultural uses throughout the state. Critical actions must recognize the value of water to Colorado's economy, and identify options for maintaining a viable agricultural industry. Coloradans at all levels – individually, locally, regionally, and statewide – must work proactively to best mitigate for and respond to these inevitable natural pressures so that Colorado can continue to flourish. In addition, these natural pressures can create uncertainty for interstate compact compliance, and Colorado must work to reduce risks associated with meeting Colorado's compact obligations.

2. Colorado's Water Plan values efficient and effective water infrastructure: Beyond addressing underlying natural pressures, Colorado must contend with the growing and changing needs of our communities, farms, and ranches. Colorado is one of the fastest growing states in the country, and growing cities could mean the significant loss of agriculture if Colorado continues on its current path. Innovative solutions and additional conservation and efficiency are needed to stretch Colorado's water supplies and maintain aging reservoirs, canals, and distribution systems. New water systems that address several needs and involve multiple partners will also be necessary.

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.

3. Colorado's Water Plan values a strong environment that includes healthy watersheds, rivers, streams and wildlife: Colorado's identity includes the grand snowy mountains and sweeping rivers, majestic valleys and easy access to all of this raw beauty. Underlying Colorado's natural splendor are populations and communities of fish, birds, amphibians, and wetland plants. Colorado is home to endangered and imperiled species along with exemplary pristine ecosystems. It is important to protect and restore Colorado's natural environment with the most effective tools available. A resilient natural environment is the long-term goal of the critical actions which address this value.

10.2. Measures of success and adaptive management

Colorado's Water Plan is a living document. The Plan and the supporting work of the Basin Implementation Plans (BIPs) and the Statewide Water Supply Initiative (SWSI) will need to be updated periodically to respond to changing conditions and improved information. Part of this work will require measuring success for each action and adapting over time. Future iterations of Colorado's Water Plan will evaluate the progress made and identify or refine future actions.

As stated in Chapter 11, Colorado's Water plan will be updated as values, conditions, or data warrant. The CWCB will determine when the next version of Colorado's Water Plan will be completed within the next five to ten years, based on progress of the BIPs and SWSI.

10.3. Strategic Goals and Actions

The State of Colorado intends to take the following actions to address Colorado's water challenges and seize its water opportunities. Additional information and context for each of the critical actions is further explained in the referenced section. Each action is labeled as one of the following types:

- **Legislation:** Legislative actions require the Colorado General Assembly to pass a bill changing or adding language in the Colorado Revised Statutes. Prior to developing legislative proposals necessary to implement Colorado's Water Plan, the Department of Natural Resources will conduct a thorough review of input provided by the Water Resources Review Committee, the Colorado Water Conservation Board, and interested stakeholders. Any legislative recommendations in the Action Plan will be evaluated in light of administration priorities and the state budget. To the extent that legislation is necessary to execute Colorado's Water Plan, legislative recommendations will be offered in concert with the phased implementation of the plan over subsequent years.
- **Programmatic:** Programmatic actions can be accomplished within existing authority and existing state programs. Changes only need to be made at the programmatic level to accomplish these actions. These changes may have resource impacts that will need to be addressed prior to accomplishing the action.

- **Board Policy:** Board policy actions can be accomplished through a rule-making or other formal approval process by the Colorado Water Conservation Board to give CWCB staff the authority to accomplish these actions. Other state agencies may also need to adopt policies, as is noted below. Resources to develop and implement the policy changes will need to be identified.
- **Process:** Process actions indicate actions that will involve several parties or sub-committees developing a plan or making recommendations to the CWCB or other appropriate authority. Process actions can be accomplished within existing statutory authority.

I. Develop a multi-purpose funding plan

a. **Align existing funding:** 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.

Critical actions to align funding	Section	Partners	When	Type
1. Seek an amendment to expand the CWCB loan program's authority to fund treated water supply, reuse, conservation, environmental, and recreation projects and methods.	9.2, 6.3.2, 6.3.1	CWCB, DNR, General Assembly	Near-term[a]	Legislation
2. Create a public private partnership center of excellence that models how to develop P3 agreements and explores financial incentives for regionalization.	9.2	CWCB & Funding Committee	Near-term	Programmatic
3. Develop a common grant inquiry process coordinated across agencies for environmental and recreational projects and methods.	9.2	CWCB, CPW, DNR, CDPHE	Near-term	Programmatic
4. Encourage regional and multi-purpose projects and methods by providing financial incentives such as an interest rate reduction or extended loan repayment periods.	9.2	CWCB, Water & Power Authority	Near-term	Board policy
5. Continue to provide $1 million annually to support stream management and watershed plans.	9.2	CWCB & General Assembly (Projects Bill)	Near-term	Legislation
6. Investigate the potential for the CWCB to become a project	9.2	CWCB	Mid-term[b]	Programmatic

[a] Near term is defined as occurring within three years following the finalization of Colorado's Water Plan.
[b] Mid-term is defined as occurring within six years following the finalization of Colorado's Water Plan.

beneficiary through an arranged partnership for projects that are central to fulfilling the goals of Colorado's Water Plan.				

b. **Assess funding:** 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).

Critical actions to assess funding	Section	Partners	When	Type
1. Develop a sustainable funding plan that integrates a guarantee repayment fund, green bonds, and additional support grants and loans for the Water Supply Reserve Account (WSRA), education, conservation, alternative transfer methods (ATMs), and agricultural viability.	9.2	CWCB & Funding Committee	Near-term	Process
2. Assess funding needs across multiple sectors as part of SWSI, using the BIPs and other resources as a guide.	9.2	CWCB	Near-term	Programmatic
3. Determine the economic benefits and impacts of meeting or not meeting Colorado's future water needs as part of SWSI.	9.2	CWCB	Near-term	Programmatic

c. **Explore new funding opportunities:** Develop near-term funding opportunities that maximize the smallest amount of funds possible to have the greatest benefit to implementing Colorado's Water Plan.

Critical actions to explore new funding	Section	Partners	When	Type
1. In order to support the integrated funding plan, identify and determine a path to develop a new viable public source of funding, such as through a container fee ballot initiative.	9.2	CWCB & Funding Committee	Near-term	Process, possible legislation & ballot initiative
2. Establish a state repayment guarantee fund.	9.2	CWCB & General Assembly	Near-term	Legislation
3. Develop issuance and repayment strategies needed to establish a green bond program to provide a funding source for large environmental and recreational projects.	9.2	CWCB & General Assembly (Projects Bill)	Near-term	Legislation

4. Fund a water education and outreach grant program based on basin roundtable education action plans and the initiatives indicated in Colorado's Water Plan.	9.2, 9.5	CWCB & General Assembly (Projects Bill)	Near-term	Legislation
5. Provide additional statewide account funds to the WSRA program.	9.2	CWCB & General Assembly	Near-term	Possible legislation
6. Modify Colorado's statutes to clearly allow for public private partnerships for water projects (§C.R.S. 43).	9.2	CWCB, DNR, WRRC	Near-term	Legislation
7. Explore a tax credit for homeowners who install efficient outdoor landscapes and irrigation as part of the integrated funding plan.	9.2, 6.3.1	CWCB & Funding Committee	Mid-term	Process

II. Promote multi-purpose initiatives

a. **Improve permitting processes:** Advocate for more effective and efficient permitting in which state agencies work together to complete their work early in the permitting process. This will provide the opportunity for state endorsement without being pre-decisional.

Critical actions to improve permitting	Section	Partners	When	Type
1. Conduct a series of lean events with permitting agencies and stakeholders to determine how to make permitting more efficient and effective.	9.4	CWCB (host), state, federal, & local partners	Near-term	Process
2. Create a permitting handbook to guide applicants and other interested parties through the permitting process.	9.4	State and federal permitting agencies	Near-term	Programmatic
3. Relevant state agencies will actively participate as a cooperating agency in federal NEPA permitting processes at the outset of the regulatory process to engage in scoping, developing alternatives, determining methodologies and data gaps, and developing mitigation and enhancement plans.	9.4	All state agencies w/ permitting authority on a project	Near-term	Programmatic
4. Where more than one state agency has jurisdiction over a particular issue (e.g., fish health), a lead state agency will be identified.	9.4	State agencies w/ permitting	Near-term	Programmatic

		authority		
5. Explore options for adding resources to support a more efficient and effective permitting process.	9.4	State agencies w/ permitting authority	Near-term	Possible legislation
6. Determine how Colorado will endorse a project after preliminary or contingent 401 certifications and fish wildlife mitigation plans are completed.	9.4, 6.3.1	State agencies w/ permitting authority, local governments,	Mid-term	State policies, possible legislation

b. **Promote protection and restoration of water quality:** The protection and restoration of water quality should be a key objective when planning for Colorado's current and future consumptive, recreational, and environmental water needs.

Critical actions to address water quality	Section	Partners	When	Type
1. Integrate water quality and quantity management by evaluating water quality impacts from BIP proposed projects and methods, exploring graywater and reuse potentials, and supporting green infrastructure.	7.3	CDPHE, CWCB, other state agencies	Mid-term	Programmatic, Board policy, Process
2. Support policy initiatives which relate to quality and quantity integration, such as appropriate modification of regulation and guidance documents, creative and solution-oriented actions, and greater understanding of stormwater and wastewater impacts.	7.3, 7.2	CDPHE, CWCB, other state agencies	Mid-term	Programmatic
3. Continue and expand financial support of water quality related programming, such as nonpoint source pollution management efforts and watershed-based water quality improvement planning.	7.1, 7.2, 7.3	CDPHE, CWCB, other state agencies	Mid-term	Programmatic, Process
4. Support stakeholder and public outreach efforts to meet the integration goal, encouraging a watershed approach for	7.3	CDPHE, CWCB, other state	Mid-term	Programmatic, Process

engagement on water quality issues and monitoring public opinion on water quality issues.		agencies		

c. **Facilitate alternative transfer methods:** Respect property rights and the contributions of the agricultural industry by maximizing options for alternatives to permanent farmland dry-up to share 50,000 acre-feet annually within the next decade.

Critical actions to water sharing	Section	Partners	When	Type
1. Support the maximum use of water rights by exploring opportunities to create more flexibility for various types of water transfers	6.4	CWCB, DWR, Stakeholders	Near-term	Process
2. Organize and conduct regional workshops with partners or co-sponsors to share lessons learned on actual ATM projects, and to garner additional interest in the pilot program by discussing benefits.	6.4	CWCB, partners	Near-term	Programmatic
3. Explore expanded grant funding that supports implementing actual ATM projects, related infrastructure, or entities that would help facilitate alternative transfer methods.	6.4	CWCB, BRTs, DWR, Stakeholders	Mid-term	Process

d. **Meet Colorado's water gaps:** Use a grassroots approach to formulate projects and methods that avoid some of the undesirable outcomes of the supply-demand gaps. The plan addresses the gap from multiple perspectives (e.g., water storage, reuse, recycling, integrated water management, restoration and conservation).

Critical actions to meet water gaps	Section	Partners	When	Type
1. Support and assist the basin roundtables in moving forward the municipal, industrial, environmental and agricultural projects and methods identified in their BIPs through technical, financial and facilitation support when requested by a project proponent.	6.5, 6.6	CWCB, BRTs	Near-term	Programmatic
2. Develop guidelines for basin roundtable WSRA grants to help facilitate the implementation of the BIPs.	11	CWCB, BRTs	Near-term	Programmatic

e. **Promote additional storage and infrastructure:** Assess and promote opportunities for multi-purpose and multi-partner storage projects that address strategic needs.

Critical actions to promote storage	Section	Partners	When	Type
1. Provide financial support to technical and practical innovations in the use of aquifer storage and recovery where it is practicable.	6.5	CWCB	Ongoing	Programmatic
2. Assess storage opportunities to determine where existing storage can and should be expanded or rehabilitated to prepare for climate change, improve sharing and use of conserved water, and meet Colorado's compact obligations.	6.5	CWCB, DWR, local partners	Near-term	Programmatic
3. Prioritize grants and loans to support the implementation of BIP identified multi-purpose projects and methods, taking into consideration locally identified geographic and/or seasonal gaps.	6.5, 6.6	CWCB, BRTs	Near-term	Funding
4. Explore and support opportunities to increase benefits to environmental and recreational values associated with existing and planned storage and infrastructure projects and methods.	6.5, 6.6	Project sponsors, CWCB, BRTs	Mid-term	Programmatic

III. Promote vibrant and sustainable cities

a. **Increase municipal conservation and efficiency:** Reduce Colorado's projected 2050 municipal water demands by 400,000 acre-feet through active conservation, while preserving the contribution of urban landscape to vibrancy and sustainability.

Critical actions to increase water conservation	Section	Partners	When	Type
1. Require water providers to conduct comprehensive integrated water resource planning using the water conservation best practices at the high customer participation levels where possible, as defined in SWSI.	6.3.1, 9.4	CWCB, other permitting agencies, stakeholders	Near-term	Policy
2. Provide funding, technical support, and training workshops to assist water providers with	6.3.1	CWCB, CDPHE, Colorado	Near-term	Programmatic

managing systems more efficiently, including techniques such as water budgets, smart metering, comprehensive water loss management programs, and improved data collection on customer water uses.		Water & Power Authority, water providers, conservation professionals		
3. Support legislation that would require retailers to only sell irrigation technologies that meet WaterSense specifications by providing technical details on the potential savings and hosting a stakeholder process.	6.3.1	CWCB, DNR, General Assembly, stakeholders	Near-term	Process, possible legislation
4. Adopt a stretch goal to encourage demand-side innovation that places Colorado at the conservation forefront. Support a stakeholder process that examines options for local water providers to establish targets consistent with the stretch goal and the amount of savings possible given past work and local opportunities.	6.3.1	CWCB, stakeholders	Near-term	Board policy, programmatic
5. Host a stakeholder process to explore financial incentives for outdoor water conservation measures, such as a tax credit program to incentivize retrofitting higher water landscapes with lower water landscapes and more efficient irrigation systems.	6.3.1, 9.2	CWCB, stakeholders	Mid-term	Process

b. **Encourage reuse:** Encourage the development of regional reuse solutions to maximize fully consumable water supplies.

Critical actions to encourage reuse	Section	Partners	When	Type
1. Conduct a technical review of regional reuse options and provide grants to support regional reuse plans and projects	6.3.2, 7.3	CWCB, water providers, reuse experts	Near-term	Programmatic
2. Examine the amount of water being reused, the potential to increase reuse, and the amount of	6.3.2, 7.3	CWCB, water providers,	Near-term	Programmatic

water providers plan to reuse.		stakeholders		
3. Improve the regulatory environment to foster permanent growth in the reuse of limited water supplies, while protecting public health and the environment.	6.3.2, 7.3, 9.4	CDPHE, CWCB, stakeholders	Near-term	CDPHE policy, potential legislation
4. Proactively seek applicants to use WSRA grant funds for expanded research and innovation related to the technical challenges and solutions of reuse.	6.3.2	CWCB, BRTs, reuse experts, water providers	Near-term	Programmatic

c. **Integrate land use and water planning:** Initiate the use of local land use tools, where appropriate, to reduce water demands for municipalities, and the need to urbanize agricultural lands.

Critical actions to integrate land use	Section	Partners	When	Type
1. Through voluntary trainings for local governments, encourage the incorporation of best management practices in land use for water demand management, water efficiency, and water conservation.	6.3.3	CWCB, DOLA, stakeholders	Near-term	Programmatic
2. Develop new guidance to require the incorporation of land use practices into water conservation plans.	6.3.3	CWCB, DOLA	Near-term	Programmatic
3. Examine barriers in state law for integrating water and land use solutions, such as for gray water, green infrastructure, and green buildings.	6.3.3, 7.3	CWCB, DOLA, State Plumbing Board, stakeholders	Mid-term	Programmatic

IV. Address agricultural viability and efficiency

a. **Maintain agricultural viability:** Maintain Colorado's agricultural productivity, support of rural economies, and food security (through meaningful incentives and grassroots efforts).

Critical actions to maintain ag.	Section	Partners	When	Type
1. Establish an education and assistance program for farmers and ranchers to help realize more transactions that allow for water sharing and for new	6.5	CWCB, Colorado Dept. of Agriculture	Near-term	Programmatic

Colorado farmers to own land.				
2. Host a stakeholder group to help develop a framework for an evaluation of agricultural transfers from a technical and legal perspective.	6.5	CWCB (host), local government, ag. producers, municipalities, environmental interests	Near-term	Process
3. Encourage ditch-wide and regional planning to explore system-wide conservation and efficiency opportunities, the potential for water sharing, and long-term infrastructure maintenance needs.	6.5, 6.3.4	CWCB, agricultural partners, BRTs	Near-term	Programmatic
4. Update and improve Colorado's aging agricultural infrastructure, especially where improvements could benefit other sectors.	6.5	CWCB, BRTs, agricultural partners, other stakeholders	Mid-term	Programmatic

b. **Support agricultural conservation and efficiency:** Support Colorado's agricultural industry to make it more efficient, resilient, and able to reduce water consumption without impacting agricultural productivity.

Critical actions to support ag. conservation and efficiency	**Section**	**Partners**	**When**	**Type**
1. Develop a strategic education program to promote agricultural water conservation and soil health initiatives.	6.3.4, 6.5	CWCB, BRTs, Colorado Energy Office, CDA, NRCS, CSU extension, ag. partners	Near-term	Programmatic
2. Provide grants, loans, and technical support to refurbish diversions and ditches to generate saved water and reduce losses where there are benefits to recreation, the environment, and other consumptive water users.	6.3.4	CWCB, ag. partners, local environmental groups, BRTs	Near-term	Programmatic
3. Develop model voluntary flow agreement language, facilitation, and technical support to encourage the use	6.3.4	CWCB, DWR, agricultural partners, environmental	Near-term	Programmatic, state agency policies

of these agreements when paired with irrigation efficiency practices.		groups, BRTs		
4. Support the management and removal of invasive phreatophytes with a newly established grant program.	6.3.4	CWCB, local partners	Near-term	Programmatic
~~1.~~5. Explore the development of administrative means to track and administer agricultural conserved water for the purposes of marketing these waters.	6.3.4	DWR, CWCB	Mid-term	Process

v. Support a strong environment and a robust recreation industry

a. **Recover imperiled species:** Promote restoration, recovery, and resiliency of endangered, threatened, and imperiled aquatic and riparian dependent species and plant communities

Critical actions to recover imperiled species	Section	Partners	When	Type
1. Support and participate in collaborative approaches to Endangered Species Act issues to prevent listings, promote the sustainability of endangered, threatened and imperiled aquatic and riparian-dependent species and communities (e.g., recovery programs, cooperative agreements, and other efforts).	6.6	CWCB, CPW, other agencies and stakeholders	Ongoing	Programmatic
2. Establish and achieve measurable outcomes for federally and state listed endangered, threatened, and imperiled species by developing a plan that compiles and develops near-term projects and methods. At the same time, the CWCB will support the strategic implementation of currently identified projects with technical and financial assistance.	6.6	CWCB, Colorado Parks & Wildlife, BRTs, other agencies, and stakeholders	Near-term	Programmatic

b. **Enhance environmental and recreational economic values:** 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

Critical actions to enhance economic values	Section	Partners	When	Type
Develop a plan that compiles and develops near-term projects and methods to support economically important water-based recreation.	6.6	CWCB, BRTs, interested stakeholders	Mid-term	Programmatic

c. **Protect healthy environments:** 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 resiliency

Critical actions to protect environments	Section	Partners	When	Type
1. Develop stream management plans for priority streams identified in a BIP or otherwise as having environmental or recreational value. As part of this work, the CWCB will provide guidelines and templates for developing stream management plans, and will conduct ongoing analyses through SWSI.	6.6, 7.1, 9.2	CWCB, BRTs, other stakeholder groups	Beginning near-term	Programmatic
2. Institute policies, criteria, and programmatic approaches to proactively developing projects and methods that strategically address important aquatic, riparian, and wetland habitats with existing programs.	6.6	CWCB, other state agencies, BRTs, other interested stakeholders	Near-term	Programmatic
3. Develop common metrics for assessing the health and resiliency of watersheds, rivers, and streams.	6.6	CWCB, CPW, other state agencies, BRTs, stakeholders	Mid-term	Programmatic

VI. Prepare for an uncertain future

a. **Plan for the future:** Coordinate and sequence updates to SWSI, the BIPs, and future iterations of Colorado's Water Plan to represent the most up-to-date technical, stakeholder, and policy information available.

Critical actions to plan for the	Section	Partners	When	Type

future				
1. Monitor critical drivers of water supply, demand, and other stressors through futureSWSI updates and other technical work.	6, 7, 8, 9	CWCB, other state agencies, BRTs	Mid-term	Programmatic
2. Support BIP updates of basin roundtable policies, public input, and project and method updates in a sequenced schedule through funding and technical support.	6.2, 6.5, 6.6, 8	CWCB, other state agencies, BRTs, IBCC, Coloradans	Mid-term	Programmatic, Board policy
3. Continue to use and promote scenario planning and the use of adaptive strategies.	6.1, 6.2	CWCB, other state agencies, BRTs, IBCC	Mid-term	Programmatic
4. Continue development of Colorado's Decision Support Systems to be the most up-to-date and technically sound resource for data-driven planning and decision making.	6.1	CWCB, other state agencies	Mid-term	Programmatic

b. **Protect and restore critical watersheds:** Protect and restore watersheds critical to water infrastructure, environmental, or recreational areas

Critical actions for watersheds	Section	Partners	When	Type
1. Provide technical and financial support to local stakeholder groups to develop watershed master plans for watersheds critical to consumptive or nonconsumptive water supply and quality.	6.6, 7.1, 7.3	CPW, CDPHE, CWCB	Near-term	Programmatic
2. Prioritize and implement projects identified in master planning efforts.	6.6, 7.1	CPW, CDPHE, CWCB & local coalitions	Ongoing	Programmatic

c. **Prepare for and respond to natural disasters:** Colorado's Water Plan promotes water resource resilience from natural disasters through strategic preparedness and response.

Critical actions for natural disasters	Section	Partners	When	Type
1. Provide tools and resources to actively encourage local communities to develop drought	7.2	CWCB	Near-term	Programmatic

preparedness plans.				
2. Implement the actions identified in the Colorado Resiliency Framework to build communities that are more resilient to natural disasters	7.2	Local communities, CWCB, Colorado Recovery & Resiliency Office	Near-term	Programmatic

d. **Protect compact entitlements and manage risks:** Protect Colorado's ability to fully develop compact entitlements, and continue to support agreements that strengthen Colorado's position in interstate negotiations while ensuring the long-term viability of Colorado's interstate compacts and relationships. Focus planning efforts on maintaining healthy systems and avoiding a Colorado River Compact deficit rather than on responding to compact curtailment.

Critical actions to protect compacts and manage risk	Section	Partners	When	Type
1. Protect the ability to fully develop Colorado's compact entitlements by working with federal, state, and local stakeholders and maintaining the litigation fund.	8, 9.1	CWCB, AGO, DWR, downstream states, federal agencies	ongoing	Programmatic, Board policy
2. Continue to comply with Colorado's compacts and equitable apportionment decrees and support strategies to proactively manage compact obligations.	9.1	CWCB, AGO, DWR, downstream states, federal agencies	ongoing	Programmatic, Board policy
3. Work with federal agencies to assure that their responsibilities are implemented in a way that respects Colorado's compact and decree entitlements and authorities to administer waters within the State.	9.1	CWCB, AGO, DWR, downstream states, federal agencies	ongoing	Programmatic, Board policy
4. Monitor the ongoing conceptual framework discussion and consider adopting the conceptual framework	8	CWCB	Near-term	Board policy
5. Prioritize the development of a programmatic approach to prevent a Colorado River Compact deficit.	8, 9.1	CWCB, other Upper Division States, stakeholders	Near-term	Programmatic, policy, and funding

e. **Prepare for climate change:** Respond to, monitor, and prepare for climate change.

Critical actions to for climate change	Section	Partners	When	Type
1. Promote scenario planning and the use of adaptive strategies to monitor, mitigate, prepare for and respond to climate change.	6.1	CWCB	Mid-term	Programmatic
2. Work with utilities and federal and state agencies to proactively identify and address regulatory barriers to climate preparedness and adaptation.	7.2	CWCB, CDPHE, utilities, federal agencies, other state agencies, stakeholders	Mid-term	Process
3. Incorporate the potential effect of climate change on municipal, industrial, environmental, and agricultural projects and methods.	6.5, 6.6	CWCB, IBCC & Providers	Mid-term	Programmatic
4. Work with regulators to modify existing water quality standards to factor climatic change into regulations.	7.3	CDPHE	Mid-term	CDPHE policy

VII. Advance Education and outreach

Advance education and outreach: Inform Coloradans about water issues to encourage engagement in determining Colorado's water future.

Critical actions to advance education	Section	Partners	When	Type
1. Create a new outreach, education, and public engagement grant program to fund basin roundtable education action plans and initiatives indicated in the water plan.	9.5, 9.2	CWCB, General Assembly	Near-term	Possible legislation
2. Conduct a water education assessment to help develop a plan that addresses critical gaps in water education, advances efforts in Colorado's Water Plan, and supports basin roundtable work.	9.5	CWCB, BRTs, education partners	Mid-term	Programmatic

~~10. Legislative recommendations~~

~~The draft of Colorado's Water Plan should not be considered final for the purposes of recommending legislation during the 2015 legislative session. Legislative recommendations will arise out of discussion of the draft plan and development of the final water plan. The Colorado Water Conservation Board looks forward to continuing to collaborate with the General Assembly during the 2015 session and may seek to support legislation that is in keeping with the direction of the water 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.~~

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cowaterplan@state.co.us
Direct: 303-866-3441

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 may~~can~~ change quickly. Colorado's Water Plan will~~must~~ be agile in the face of future uncertainty regarding both water supply and demand~~,~~ and will include~~adopt~~ advancements in water resource management to meet these changing conditions.

Therefore, Colorado's Water Plan will be updated periodically to ~~help~~ ensure that water is a focus of Colorado's ongoing policy development and is responsive to ongoing technical ~~work~~ and stakeholder work~~processes.~~

~~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 in the summer of~~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~~water resource review committee~~.

It is important that Colorado's Water Plan facilitates ongoing implementation of the projects and methods identified in the BIPs and the actions identified in Colorado's Water Plan at the statewide, basin, and local level. As part of this ongoing effort, the CWCB will encourage the basin roundtables to be caretakers of the Basin Implementation Plans and to be catalysts for implementation at the local and basin levels. The CWCB will also continue to rely on the Interbasin Compact Committee to deliberate and find consensus around difficult issues that warrant interbasin communication and debate.

Ongoing updates of the BIPs, the Statewide Water Supply Initiative, the IBCC, and other studies and stakeholder work will be coordinated with and incorporated into future drafts of Colorado's Water Plan. Just as important for incorporation will be measurable success demonstrated by the implementation of actions identified in the plan and the BIPs, as discussed in Chapter 10,.

Actions

1. The CWCB will work with other state agencies, the basin roundtables, and the people of Colorado to update Colorado's Water plan as values, conditions, or data warrant. The CWCB will determine when the next version of Colorado's Water Plan will be completed within the next five to ten years, based on progress of the Basin Implementation Plans and Statewide Water Supply Initiative.
2. The CWCB will develop guidelines for Basin Roundtable Water Supply Reserve Account grants to help facilitate the implementation of the BIPs. ~~Update Colorado's Water Plan to incorporate ongoing technical and stakeholder progress.~~

COLORADO'S WATER PLAN

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cowaterplan@state.co.us
Direct: 303-866-3441

Appendix A

Executive Order D2013-05

STATE OF COLORADO

OFFICE OF THE GOVERNOR

136 State Capitol Building
Denver, Colorado 80203
Phone (303) 866 - 2471
Fax (303) 866 - 2003

John W. Hickenlooper
Governor

D 2013-005

EXECUTIVE ORDER

DIRECTING THE COLORADO WATER CONSERVATION BOARD TO COMMENCE WORK ON THE COLORADO WATER PLAN

Pursuant to the authority vested in the Governor of the State of Colorado, and in particular, pursuant to powers vested in the Governor pursuant to article IV, section 2 of the Colorado Constitution, I, John W. Hickenlooper, Governor of the State of Colorado, hereby direct the Colorado Water Conservation Board to commence work on the Colorado Water Plan.

I. Background

Colorado has long been on the leading edge of water innovation and solutions. We are the home of the "Colorado Doctrine" of prior appropriation and the birthplace of the interstate water compact, of which we have nine. We are a headwater state – vital rivers and streams begin here, provide water to Colorado uses, and exit to water 18 downstream states as well as the United Mexican States. Colorado has benefited much from its water and has taken seriously its responsibilities as a headwater state. The creation of a Colorado Water Plan is in keeping with Colorado's water heritage and continued responsibility.

The Colorado Water Conservation Board (CWCB) was created in 1937 "[f]or the purpose of aiding in the protection and development of the waters of the state, for the benefit of the present and future inhabitants of the state." C.R.S. § 37-60-102. More than 75 years later, we reaffirm this purpose and seek to tap Colorado collaboration and innovation in addressing our water challenges. The Board's recently-adopted strategic framework is consistent with this mission.

We also recognize the important role the Office of the State Engineer has played throughout Colorado's water history. This office administers water rights, issues water well permits, represents Colorado in certain interstate water compact proceedings, monitors streamflow and water use, approves construction and repair of dams and performs dam safety inspections, assures the safe and proper construction of water wells, and maintains numerous databases of state water information.

The Interbasin Compact Committee and Basin Roundtable processes, established by House Bill 05-1177, have produced more than eight years worth of important discussion and information about the basins from Coloradans in each basin.

In addition, many state agencies, lead by DNR, play important roles in Colorado water including:

- The Colorado Department of Public Health and Environment that includes the Colorado Water Quality Control Division and the Commission, the administrative agency responsible for developing specific state water quality policies, in a manner that implements the broader policies set forth by the Legislature in the Colorado Water Quality Control Act. The Commission adopts water quality classifications and standards for surface and ground waters of the state, as well as various regulations aimed at achieving compliance with those classifications and standards.
- The Colorado Water Resources and Power Development Authority that provides low-cost financing to governmental agencies in Colorado primarily for water and wastewater infrastructure development.
- The Colorado Department of Agriculture that works to strengthen and advance Colorado's largest consumptive use of water, its agriculture industry.
- The Colorado Energy Office that maintains information helpful in understanding Colorado's water-energy nexus as well as state agency water use.

Throughout our state's history, other water plans have been created by federal agencies or for the purpose of obtaining federal dollars. We embark on Colorado's first water plan written by Coloradans, for Coloradans. Nevertheless, our past and current data and studies will aid in developing a plan for the future.

II. Purpose and Need

The Colorado Water Plan is necessary to address the following:

A. The gap between our water supply and water demand is real and looming. The Statewide Water Supply Initiative forecasts that this gap could exceed 500,000 acre feet by 2050. Moreover, our largest regional gap is set to occur in the South Platte Basin, our most populous as well as our largest agriculture-producing basin.

B. Colorado's drought conditions threaten to hasten the impact of the water supply gap. Indeed, the past two decades have been Colorado's warmest on record, dating back to the 1890s.

C. Coloradans find that the current rate of purchase and transfer of water rights from irrigated agriculture (also known as "buy-and-dry") is unacceptable. We have witnessed the economic and environmental impacts on rural communities when water is sold and removed from an agricultural area. For example, projected reduction in irrigated acreage in the South Platte Basin alone is currently estimated at 20% of agricultural land under production.

D. The Interbasin Compact Committee and Basin Roundtables have worked for the past eight years to engage in a visioning process and to discuss long-standing intrabasin and interbasin challenges by defining scenarios, portfolios, and strategies. These efforts have produced informed discussions, provided a forum for building consensus, and generated momentum that the Colorado Water Plan should utilize.

E. 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.

F. Our interstate water concerns are as pressing as ever and require Colorado to be vigilant in protecting its interstate water rights pursuant to its nine interstate compacts and two equitable apportionment decrees.

G. CWCB is well-positioned to conduct this work given its duties and history, statewide representation, and expertise.

III. Declaration and Directives

A. Colorado's water policy must reflect its water values. The Basin Roundtables have discussed and developed statewide and basin-specific water values and the Colorado Water Plan must incorporate the following:

- 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.

B. The CWCB is directed to commence the work necessary to submit a draft Colorado Water Plan for review by the Governor's Office no later than December 10, 2014. 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. As part of this alignment, the CWCB is directed to develop an inventory of water rights held by state agencies and evaluate the opportunities for those rights. The CWCB is also directed to ensure that financial assistance for water funding activities is in accordance with the Colorado Water Plan.

D. The CWCB is directed to align the state's role in water project permitting and review processes with the water values included in the Colorado Water Plan and to streamline the state role in the approval and regulatory processes regarding water projects. The

Colorado Water Plan should place an emphasis on expediting permitting processes for projects that stress conservation, innovation, collaboration, and other criteria as determined by the CWCB. Efficient infrastructure promoting smart land use, healthy watersheds that support Colorado's rivers and streams, and smart water conservation practices that utilize demand-management are examples of criteria to be considered.

E. In drafting the Colorado Water Plan, the CWCB is directed to utilize the Interbasin Compact Committee and the Basin Roundtables. 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. When drafting the Colorado Water Plan, the CWCB is directed to work with its sister agencies within the Colorado Department of Natural Resources as well as the Colorado Department of Public Health and Environment, the Colorado Water Resources and Power Development Authority, the Colorado Department of Agriculture, the Colorado Energy Office, and other relevant state agencies as needed. Each of these agencies is directed to cooperate with the CWCB as needed on the Colorado Water Plan.

G. The CWCB is directed to assemble ad-hoc panels of Coloradans and inter-agency water working groups to develop recommendations regarding specific topics as it deems necessary.

H. 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.

IV. Duration

This Executive Order shall remain in full force and effect until modified or rescinded by future Executive Order of the Governor.

GIVEN under my hand and the Executive Seal of the State of Colorado this fourteenth day of May, 2013.

John W. Hickenlooper
Governor

COLORADO'S WATER PLAN

coloradowaterplan.com
cowaterplan@state.co.us
Direct: 303-866-3441

Appendix B

How other states have worked to meet their gap

Arizona:

Arizona Water Banking: The Arizona Water Banking Authority (AWBA; Water Bank) was established in 1996 to increase use of the state's Colorado River entitlement and develop long-term storage credits for the state. The five person board is made up of the Director of the Arizona Department of Water Resources (ADWR), who is chair, the President of the Board of the CAP and three persons appointed by the Governor. AWBA "banks" unused Colorado River water to use in times of shortage to firm Arizona's water supplies. These water supplies help to benefit municipal and industrial users and communities along the Colorado River, fulfill the water management objectives of the state, store water for use as part of water rights settlement agreements among Indian communities, and assist Nevada and California through interstate water banking. Through these mechanisms, the AWBA aids in ensuring long-term water supplies for Arizona.

Each year, the AWBA pays the delivery and storage costs to bring Colorado River water into central and southern Arizona through the Central Arizona Project canal (this is a federal/municipal project and is 336 miles long). The water is stored underground in existing aquifers (direct recharge) or is used by irrigation districts in lieu of pumping groundwater (indirect or in-lieu recharge). For each acre-foot stored, the AWBA accrues credit that can be redeemed in the future when Arizona's communities or neighboring states need this backup water supply.

Central Arizona Project: The first State Water Plan published in the mid-1970s noted that the growth of Arizona cities and industries could only be assured if groundwater pumping was offset by the use of CAP water. In the late 1970s, there was an impasse between the farmers and the municipal and mining interests regarding groundwater management. Governor Bruce Babbitt convinced the U.S. Secretary of the Interior at that time, Cecil Andrus, to issue an ultimatum: unless Arizona enacted tough groundwater laws, he would refuse to approve construction of the Central Arizona Project.

Soon the cities, mines and agriculture asked Babbitt to mediate the discussions regarding groundwater. One of the first items of agreement was creation of the Arizona Department of Water Resources. CAP was completed in 1993, costing $3.7 billion to construct. The Arizona Department of Water Resources continues to financially support the project, but it is primarily run by a regional commission and was approved by Congress as a federal project.

California:

State Water Project: California has a State Water project, which provides drinking water for over 25 million people and generates an average 6.5 million mega-watt hours of hydroelectricity annually. It also provides water to 750,000 acres of irrigated land. Construction began in the late 1950s, with major funding approved through a 1960s bond measure. Bond measures paid for most of the project, and annual operation and maintenance costs (including debt service) are primarily paid for by beneficiaries, although the state pays for the fish and wildlife benefits. The state water project is ongoing, with additional facilities being planned. The project started as a state-supported federal project.

Quick Facts

- The Project includes 34 storage facilities, reservoirs and lakes; 20 pumping plants; 4 pumping-generating plants; 5 hydroelectric power plants; and about 701 miles of open canals and pipelines.
- By the end of 2001, about $5.2 billion had been spent to construct SWP facilities.

CALFED Bay-Delta Program: In 1994 California and federal entities signed an agreement to manage the competing demands in the Sacramento-San Joaquin Delta. There are numerous competing environmental and water supply needs related to the Delta. This is a large and ongoing component of the State Water Project.

In July of 2012, Governor Jerry Brown joined Secretary of the Interior Ken Salazar to announce plans to move a project forward that would put two tunnels under the bay to stabilize water deliveries, which have been reduced by court order over concerns for the endangered Delta Smelt. This is the latest version of the peripheral canal. There is significant opposition to the project from environmentalists, salmon sports fishermen, and local farmers, although Governor Brown said the tunnels would be the "preferred alternative" for a plan that would ensure the "co-equal" goals of reliable water supplies and delta habitat restoration. There will still be permit requirements, and an analysis is due next year.

Quick Facts:

- The project could deliver up to 7 million acre-feet.
- The proposed system would cost about $19 billion to build, operate, and manage, along with $3 to 4 billion for habitat restoration.
- The habitat costs would be funded through bonds that would be paid from the state's general fund and would require voter approval. Water users will pay for the cost of the construction and operation of the tunnels.

Read more:
http://www.sfgate.com/science/article/New-state-water-plan-tunnels-under-delta-3735999.php

State Water Plan: California also has a State Water Plan. Their five year update was published in 2013, and includes a financial plan, which is "a necessary step in implementing the strategic plan and many other California Water Plan recommendations. This new financial focus will identify critical priorities for State investment in integrated water management activities. It will also recommend innovative, stable, equitable, and fiscally responsible financial strategies and revenue sources should any funding gaps be identified as part of the water plan's development." The plan will also focus on regional solutions.

Colorado:

In addition to the technical and financial support provided by almost every state, Colorado has supported several projects in various ways. These include being a participant in a project (e.g., Chatfield Reallocation), purchasing a block of water to be able to market to various interests in the future (e.g., Animas-La Plata), providing loans and/or grants to assist a project in moving forward (e.g. Prairie Waters, Arkansas Valley Conduit), and the passing of a CWCB resolution in support of a project (e.g., Chatfield Reallocation, WISE Partnership). Several Governors have also weighed in on

water projects, including pressure to move permitting forward and explicit support for specific water projects. The latest example can be found here: http://www.denverpost.com/news/ci_21314294. Other support includes working with water providers who are working collaboratively with other stakeholders to find creative ways to administer these projects.

CWCB also undergoes significant planning activities, which support understanding Colorado's water supply gaps and avenues to meet them. The Statewide Water Supply Initiative (SWSI) gathers statewide information on municipal, industrial, agricultural, environmental, and recreational needs as well as projects and methods to meet those needs. In so doing, it provides a strategic planning framework. CWCB also staffs the Basin Roundtable and Interbasin Compact Committee processes. The stakeholder groups found across the state are charged with assessing their needs and determining projects and methods to meet those needs. SWSI 2010 used data from the basin roundtables and IBCC. SWSI 2010 also has a list of recommendations which are important components to meeting Colorado's water gaps.

New Mexico:

Regional Water Planning: The New Mexico Legislature created the state's regional water planning program in 1987 and gave the Interstate Stream Commission the responsibility of funding, overseeing, and approving the plans of the 16 regions. Through the program, regions are charged with the inventory of existing water supplies, projecting future demand, identifying supply inadequacies, and developing strategic alternatives to meet supply shortages. The New Mexico State Water calls for the State to "support and adequately fund the completion, update, and implementation of regional water plans."

San Juan-Chama Project and Navajo Nation Water Rights Settlement: The Governor, State Engineer, and the Interstate Stream Commission Director testified in support of the Settlement and associated Project. The State contributed nearly $50 million dollars to the project.

Taos Pueblo Water Rights Settlement: The Governor, State Engineer, and Interstate Stream Commission Director testified in support of the Settlement. The State, has contributed $1.5 million dollars while agreeing to future appropriations of $18.5 million dollars over time.

Aamodt Water Rights Settlement: The Aamodt Settlement (Pueblos of Pojoaque, Tesuque, Nambe & San Ildefonso) was supported by the Governor, State Engineer, and the Interstate Stream Commission Director. No appropriations have been made to date, yet the State is potentially on the hook for up to $50 million dollars.

Eastern New Mexico Water Supply Project: The Governor, State Engineer, and the Interstate Stream Commission Director supported the Settlement. The State has contributed $20 million dollars while agreeing to fund around $75 million dollars over time.

San Juan-Chama Shortage Sharing Agreement: The parties involved in the Navajo Dam and San Juan River operations, together with the New Mexico State Engineer's Office and the Bureau of

Reclamation, came to an agreement to share water losses (as opposed to traditional state water rights administration). If the shortage agreement is not adhered to, the State will administer the system in a conventional manner.

Texas:
Texas has an active regional planning effort that identifies projects and then works to fund projects that are consistent with the plan or, for some funding sources, explicitly recommended as water management strategies in the regional or state plans. They also have their own Commission on Environmental Quality which grants water right permits only if (some exceptions do apply) they are consistent with the regional water plans and the state water plan. The plans are updated every five years, and the Texas Water Development Board provides technical and administrative support. The legislature also designates "sites of unique value for the construction of reservoirs" as well as stream reaches with "unique ecological value." There are several recommendations in the 2012 state plan that have not yet been implemented. These include the recommended purchase of reservoir sites and implementation of specific water projects and methods that go through an evaluation process.

Quick Facts

- Municipal conservation strategies are expected to result in about 650,000 acre-feet of supply by 2060, with irrigation and other conservation strategies totaling another 1.5 million acre-feet per year.
- The planning groups recommended 26 new major reservoirs projected to generate approximately 1.5 million acre-feet per year by 2060. Other surface water strategies would result in about 3 million acre-feet per year.
- Recommended strategies relying on groundwater are projected to result in about 800,000 additional acre-feet per year by 2060.

Utah:
Lake Powell Pipeline: Utah is planning, buying up the right of way, and has financing in place for construction of the Lake Powell Pipeline, to deliver water from the Colorado River (from Utah's unused allocation) to the St. George area in Southwest Utah. Utah's Board of Water Resources, under the Lake Powell Pipeline Development Act passed by the Utah State Legislature in 2006, is authorized to build the Lake Powell Pipeline. The legislation authorizes a pipeline to take water from Lake Powell, and transport it to Washington, Kane and Iron counties. The water diverted into the pipeline will be a portion of Utah's Upper Colorado River Compact allocation, and will consist of water rights to be held or acquired by the three water districts and the Board of Water Resources. The state will build the project and the districts will repay the costs through water sales.

Quick Facts

- The pipeline will total 177 miles from Lake Powell to Iron County
- The project will deliver 100,000 acre-feet
- Deliveries are planned to begin in 2020
- The project will cost over $1billion in capital costs

West Desert Pumping Project: The Utah legislature authorized a major pumping project to protect the risk of flooding out of the Great Salt Lake.

Bear River Development: Bear River is often referred to as Utah's last untapped river. In the Bear River Development Act, passed by the Legislature in 1991, the Division of Water Resources is directed to develop the surface waters of the Bear River and its tributaries. The act also allocates water among various counties and provides for the protection of existing water rights. The act allocates a total of 220,000 acre-feet of water annually. The total cost of the project is estimated to be between $130 million and $260 million, depending upon which dam site is chosen. Most of the required conveyance and treatment systems will be the responsibility of the contracting entities. An article in the Utah Environmental Law Review states "According to several administrative documents, the state intends to make Bear water available within the next two decades, and it appears that the state will finally push forward to realize their 60 year old desire to tap the Bear." This article can be accessed here: http://epubs.utah.edu/index.php/jlrel/article/viewArticle/103. It is unclear in this initial review what the state intends to do with this project in the near future.

Central Utah Project: The Central Utah Project (CUP) is a state supported federal project. CUP is being constructed by the U.S. Bureau of Reclamation and the Central Utah Water Conservancy District (CUWCD) took over construction of some of the final water distribution components. The project is explicitly listed in the Utah's State Water Plan as being necessary. It is located in the central and east central part of Utah. CUP is the largest water resources development program ever undertaken in the State. The project provides Utah with the opportunity to beneficially use a sizable portion of its allotted share of the Colorado River water. Project irrigation water will be provided to Utah's rural areas in the Uintah and Bonneville Basins. Water will also be provided to meet the M&I requirements of the most highly developed part of the State along the Wasatch Front where population growth and industrial development are continuing at a rapid rate. Water developed by the Central Utah Project will be used for municipal, industrial, irrigation, hydroelectric power, fish, wildlife, conservation, and recreation. The project will improve flood control capability and assist in water quality control

One key component of the project is the Bonneville Unit - This complex unit is currently being constructed and includes 10 new reservoirs, more than 200 miles of aqueducts, tunnels, and canals; a power plant, pumping plants, and 300 miles of drains. Starvation Reservoir, constructed on the Strawberry River about three miles above Duchesne, has a capacity of 167,000 acre-feet and Soldier Creek Dam has nearly quadrupled the capacity of Strawberry Reservoir from 283,000 to 1,106,500 acre-feet.

Other States:

Wyoming: The Wyoming Water Development Commission has financed many projects, including the State's share of the cost of raising Reclamation's Buffalo Bill Dam.

Kansas: Kansas purchased storage in Corps reservoirs for water supply uses.

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cowaterplan@state.co.us
Direct: 303-866-3441

Appendix C

Instream flow and natural lake level examples

Following are specific examples of instream flow and natural lake level water rights that were appropriated or acquired to preserve, and in some cases to improve, the natural environment to a reasonable degree.

Black Hollow Creek
In 2010, based upon a recommendation from Colorado Parks and Wildlife, the CWCB appropriated an instream flow water right on approximately 5.5 miles of Black Hollow Creek in Larimer County from the stream's headwaters down to the confluence with the Cache La Poudre River. This appropriation protects flows in three different seasons: 2.2 cubic feet per second from May 1 to September 30; 1.4 cubic feet per second from October 1 to November 15; and 0.75 cubic feet per second from November 16 to April 30. The natural environment in this segment of stream consists of a healthy population of greenback cutthroat trout.

Deadhorse Creek and Hanging Lake
In 1996, the CWCB appropriated water rights on both Hanging Lake and Dead Horse Creek and determined that all of the unappropriated water in this stream and lake system was required to preserve the natural environment to a reasonable degree. The CWCB took this approach based upon the fact that the natural environments on the lake and creek are unique, consisting of distinct assemblages of riparian vegetation, endemic hanging garden communities and globally imperiled species.

Big Dominguez and Little Dominguez Creeks
In 2011, the CWCB appropriated all of the unappropriated water on both Big Dominguez and Little Dominguez Creeks to preserve aquatic and riparian aspects of the natural environment. These instream flow appropriations not only preserve distinct fish populations, but also protect amphibians, aquatic insects and increasingly rare and distinctive communities of cottonwood trees and other associated riparian vegetation. Another important objective for these appropriations was to maintain the creeks in their natural pristine condition because their location in a designated Wilderness Area.

Colorado River Instream Flow Reaches from the Blue River to the Confluence with the Eagle River
In 2011, the CWCB appropriated water rights on three segments of the mainstem of the Colorado River: 1) Blue River to the Piney River; 2) Piney River to the confluence with Cabin Creek; and 3) Cabin Creek to a point immediately upstream from the Eagle River. These reaches, which appropriated between 500 and 900 cubic feet per second at various times throughout the year, were recommended by the Upper Colorado River Wild and Scenic Stakeholder Group as part of a comprehensive plan to manage these reaches of the River that includes a suite of protective measures as an alternative to a finding of suitability for Wild and Scenic designation.

Acquisition to Implement a Portion of the Colorado River Cooperative Agreement on the Fraser River and its Tributaries, Williams Fork River and its Tributaries, and the Colorado River

Under a Water Delivery Agreement and water court decree, Denver Water will provide annually 1000 acre-feet of water to Grand County for instream flow use by the CWCB. The instream flow use will consist of: 1) preserving the natural environment to a reasonable degree by maintaining flows in stream reaches where the CWCB has decreed instream flow water rights when those rights are not satisfied; 2) improving the natural environment to a reasonable degree by increasing flows in existing instream flow reaches above the CWCB's decreed amounts up to recommended flow rates; and 3) improving the natural environment to a reasonable degree on streams with no existing instream flow water rights.

Acquisition of Breem Ditch Water Right for Instream Flow Use on Washington Gulch and Slate River

Under a Water Conservation Use Right and water court decree, CWCB may use the senior Breem Ditch water right that once swept the stream dry to re-water the stream. This water will be used to preserve and improve the natural environment to a reasonable degree on Washington Gulch and to preserve the natural environment to a reasonable degree on the Slate River. The historical consumptive portion of the water right may be diverted downstream of the instream flow reaches for municipal use by Skyland Metropolitan District, thus making multiple uses of the changed irrigation right for consumptive (municipal) and nonconsumptive (environmental) uses.

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coloradowaterplan.com
cowaterplan@state.co.us
Direct: 303-866-3441

Appendix D

IBCC Conceptual Framework

The IBCC will review a new version of the Conceptual Framework on July 13, 2015.

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

1313 Sherman Street
Denver, CO 80203

P (303) 866-3441
F (303) 866-4474

John Hickenlooper, Governor

Mike King, DNR Executive Director

James Eklund, CWCB Director

TO: Colorado Water Conservation Board Members

FROM: Jacob Bornstein, IBCC and Basin Roundtable Program Manager, Water Supply Planning Section

DATE: July 16, 2014

AGENDA ITEM: 13 - IBCC Conceptual Agreement

Staff recommendation: This is an informational item only. No Board action is required.

Background

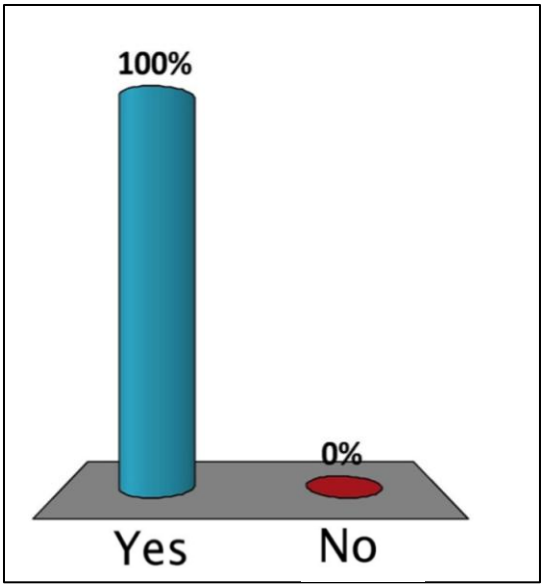
The Interbasin Compact Committee (IBCC) completed initial discussion of the Draft Conceptual Agreement on June 24th, 2014 and agreed to submit it to the CWCB Board for inclusion in the first draft of Colorado's Water Plan. The attached document incorporates the IBCC's requested changes from their the June meeting.

To demonstrate their level of agreement, the IBCC polled on the following question:
I agree that the Draft Conceptual Agreement is ready to go to the Board for consideration while we continue to get feedback from our roundtables, our constituencies, and the public.

All members of the IBCC polled "yes" to this question (see figure).

The IBCC anticipates additional revisions to the Draft Conceptual Agreement based on feedback from the Board, the Basin Roundtables, other water community stakeholders, and the public. IBCC members will work with staff to discuss and receive feedback on the Draft Conceptual Agreement with the Basin Roundtables. Individuals with suggestions for improvement to the Draft Conceptual Agreement should share them with a member of the IBCC or sumbit comments using the coloradowaterplan.com website. IBCC membership is available here.

There are still several topics the IBCC would like to further discuss. This work may begin as early as this fall.



All members of the IBCC polled "yes" to the following statement: *I agree that the draft Conceptual agreement is ready to go to the Board for consideration while we continue to get feedback from our roundtables, our constituencies, and the public.*

Discussion

The Director of Compact Negotiations, several board members that were in attendance, and staff will provide an update on the IBCC discussion and progress to this point.

Interbasin Compact Committee

DRAFT Conceptual Agreement

The *IBCC Conceptual Agreement* sets the framework for future detailed negotiations on a potential new transmountain diversion (TMD). It reflects major statewide areas of concern that should be discussed and negotiated between project proponent(s) and affected communities. The *IBCC Conceptual Agreement* was generated by the diverse stakeholders that make up the IBCC and represents a thorough exploration of the difficult issues that often surround a new TMD. As such, this framework may be helpful in accelerating future negotiations. However, the agreement is not meant to take the place of any specific negotiations and agreements that will surround any future transmountain project.

The IBCC acknowledges that overdevelopment of limited Colorado River System water is a serious risk that could result in a Compact deficit, and all planning has to recognize that risk. The purpose of this document is to provide an initial conceptual agreement about how a future increment of Colorado River water could be developed under the right circumstances.

IBCC Summary Points

1) The East 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 East Slope interruptible supply agreements, Denver Basin Aquifer resources, carry-over storage, terminal storage, drought restriction savings, and other non-West 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 West 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.

1) The East Slope is not looking for firm yield from a new[1] TMD project and would accept hydrologic risk for that project.

See Section 5 for background information and concepts related to future West Slope needs.

2) A new TMD project would be used conjunctively with East Slope interruptible supply agreements, Denver Basin Aquifer resources, carry-over storage, terminal storage, drought restriction savings, and other non-West Slope water sources.

It is important for East Slope parties to demonstrate to the West Slope that agreements and frameworks are in place for East Slope backup water supplies during dry years. Interruptible supply agreements (ISAs), Denver Basin Aquifer resources, carry-over and terminal storage, and drought restriction savings are the key options for backup water supplies that can be drawn on by East Slope entities during years that water cannot be diverted from a TMD. The IBCC envisions that any entity interested in participating in a new TMD would prepare and share a detailed plan for firming the yield of a new TMD in dry years using some or all of these options. The firming plan should include steps to firm up not only the amount of water diverted in the project, but the full amount of water used to meet demands, including the additional yield generated through reuse. Each entity's firming plan should be tailored to the unique strengths and constraints of each system, with the tools listed below serving as options that could be employed in any plan but not requirements that must be incorporated into each plan.

Background: Both the 2010 IBCC "Letter to the Governors" and the East Slope Basin Roundtables White Paper discuss a "dual system," where transmountain water would be used conjunctively with storage and local basin supplies, such as groundwater and agricultural sources.

Alternative Transfer Methods (ATMs): Colorado is one of the leaders in the West when it comes to ATMs. The grant program of the Colorado Water Conservation Board (CWCB) has funded many pilot studies, including the Northeast Colorado Water Cooperative Project. In 2013, the Colorado Legislature passed H.B. 1248, which was signed by the Governor. This legislation further allows ATM pilots to move forward. The Super Ditch is an

Resources for Item 2:

- Alternative Agricultural Water Transfer Methods (ATM) Projects
- Previous ATM Grant Summary Reports
- Upper Black Squirrel Creek Study (December 2008)
- The Poudre Runs Through It: Northern Colorado's Water Future (Launched 2011)
- House Bill 13-1248
- Northeast Colorado Water Cooperative
- SB06-193 Underground Water Storage Study (March 2007)
- Aquifer Recharge of Ground Water in Colorado – A Statewide Assessment (2004)
- Regional Aquifer Supply Assessment (December 2008)
- South Metro Water Supply Authority Aquifer Recharge Pilot Study (Ongoing)
- South Metro Water Supply Authority Regional Water Master Plan (June 2007)
- Metro Roundtable Water Supply Paper (2012)
- Interbasin Compact Committee Letter to Governor Ritter and Governor-Elect Hickenlooper (2010)
- South Metro Water Supply Study (2003)

[1] A "new" TMD means a transmountain diversion project that is not considered an identified project or process in SWSI 2010.

example of an ATM project in the Arkansas Basin. During the February IBCC meeting, the IBCC reviewed language on the agricultural and nonconsumptive gap, which stated that "Agricultural water has a role to play with regard to adding flexibility and reliability to meet future water needs." In addition, the IBCC polled on language regarding multi-purpose projects, which stated: "In addition to meeting East Slope needs, a new supply project should have significant operational flexibility (such as the ability to be used conjunctively with alternative agricultural transfers and nontributary groundwater when water supply is not available) (October Polling Results: 86% agree /14% needs further discussion/0% disagree)."

For the purposes of this component, ISAs will be the primary ATM tool employed in conjunction with a TMD. Additionally, alternative agricultural transfers that are operated on a rotating annual basis regardless of whether it is a wet or dry year could be carried out with farmers willing to fallow a percentage of their land on a more permanent basis. This strategy could play an important role in establishing East Slope drought reserves. It is possible that that many farmers will be glad to fallow a percentage of their land on a more permanent basis in return for a reliable cash-flow.

Denver Basin Aquifer Resources: Through interviews with water providers in the South Metro region, SWSI 2010 determined that water providers were hoping to replace approximately 30,000 acre-feet (AF) of nonrenewable Denver Basin Aquifer water with renewable sources. A new TMD project will change the conversation about nontributary groundwater resources. If new water supplies are brought to the East Slope, it may be appropriate to get away from the 30,000 AF concept and to speak generally about the different possibilities of conjunctive use of Denver Basin Aquifer resources.

The Denver Basin Aquifer can be conceptualized in two ways: 1) as a savings account in which available water is stored during years with more than sufficient water and then utilized during years without sufficient water through aquifer storage and recharge (ASR), or 2) as an equity line of credit when the limited and original aquifer water resources are drawn upon. ASR could be used as carry-over storage of TMD water for use in dry periods. Colorado's State Legislature commissioned a study on Underground Water Storage completed in 2007, which examined both alluvial and bedrock aquifer storage potential. In addition, WSRA grants have funded ASR pilots in the Black Squirrel, Lost Creek, and Denver Basin aquifers. Centennial Water and Sanitation District has an active ASR program, and other entities, such as Castle Rock and the East Cherry Creek Valley Water and Sanitation District are conducting ASR pilot projects. The 2007 Underground Water Storage report states: "Currently, rules only exist for implementing underground water storage projects in the non-designated portions of the Denver Basin bedrock aquifers…. A dialogue on developing rules and regulations for underground water storage aquifers throughout the state" should be considered (5-4).

Important questions remain about the use of Denver Basin Aquifer resources, including how much water can be stored and withdrawn, the timing requirements for storage and withdrawal, costs, and conceptual designs.

Carry-Over and Terminal Storage: Utilizing carry-over storage between wet and dry cycles is an important component of maximizing and timing the delivery of water supplies on the East Slope. Additionally, terminal storage can be used at the point of diversion as well as downstream to optimize the timing of conveying the water resources. Carry-over storage facilities and terminal storage facilities can be the same or different structures, depending on the design.

Drought restriction savings and drought reserves: Drought restrictions reduce demand and put less pressure on other East Slope water resources. Most communities have methods for handling a water-short year. However, a balance must be struck between how much the Front Range can commit to in terms of conservation measures and the variability of a TMD without firm yield. If a commitment to conservation measures is too great, flexibility for managing drought is reduced.

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Drought reserves are utilized by several water providers. These reserves would store East Slope water, such as ATM water, for use during times of drought.

Hypothetical Table: How TMD water in wet years is used conjunctively with water saved through drought restrictions, carry-over storage, ISA water, Denver Basin Aquifer resources, and reuse supplies is difficult to envision. Below is a hypothetical example developed for discussion to understand the interplay between the differing systems. This hypothetical example uses the "Winner Rule," where an average one AF diversion is illustrative:

	20 yr. period	Year Type	Potential TMD Withdrawals (AF)	TMD Use	Drought Restrictions / Reserve*	Stored TMD Water (ASR & Other)	Interruptible Supply Agreement Water	Denver Basin Aquifer Water	Reuse	Total Yield
Wet Period	1	Water Available	1.75	1.00	-	-	-	-	0.60	1.60
	2	Some Water Available	1.00	1.00	-	-	-	-	0.60	1.60
	3	Some Water Available	1.00	1.00	-	-	-	-	0.60	1.60
	4	No Water Available	-	-	0.24	0.40	0.15	0.30	0.51	1.60
	5	Water Available	1.75	1.00	-	-	-	-	0.60	1.60
	6	Water Available	1.75	1.00	-	-	-	-	0.60	1.60
	7	Some Water Available	1.00	1.00	-	-	-	-	0.60	1.60
	8	Water Available	1.75	1.00	-	-	-	-	0.60	1.60
	9	Some Water Available	1.00	1.00	-	-	-	-	0.60	1.60
	10	Water Available	1.75	1.00	-	-	-	-	0.60	1.60
Dry Period	11	No Water Available	-	-	0.24	0.40	0.15	0.30	0.51	1.60
	12	No Water Available	-	-	0.24	0.40	0.15	0.30	0.51	1.60
	13	No Water Available	-	-	0.24	0.40	0.15	0.30	0.51	1.60
	14	Some Water Available	1.00	0.75	0.24		0.05	0.05	0.51	1.60
	15	No Water Available	-	-	0.24	0.40	0.15	0.30	0.51	1.60
	16	No Water Available	-	-	0.30	0.30	0.21	0.30	0.49	1.60
	17	Some Water Available	1.00	0.75	0.24	-	-	0.10	0.51	1.60
	18	Water Available	1.75	1.00	-	-	-	-	0.60	1.60
	19	No Water Available	-	-	0.32	0.20	0.30	0.30	0.48	1.60
	20	No Water Available	-	-	0.32	0.20	0.30	0.30	0.48	1.60
Average Annual Yield (AF)			**0.83**	**0.58**	**0.13**	**0.14**	**0.08**	**0.13**	**0.55**	**1.60**
Total 20 Year Use (AF)			**16.50**	**11.50**	**2.62**	**2.70**	**1.61**	**2.55**	**11.02**	**32.00**
Average Annual TMD Water Usage						**0.71**				
Net Stored TMD Water Still Available (AF)						**2.30**				

* Drought Reserves may include water from alternative agricultural transfers that are operated on a rotating annual basis.

3) In order to manage when a new TMD will be able to divert, triggers are needed.

Triggers in the context of this component refer to when East Slope backup supplies will be needed to supplement a TMD. They do not refer to a mechanism to protect existing users (e.g., a West Slope water bank). It will be up to a project proponent to line up East Slope backup supplies and to demonstrate what they are.

Continuing conversations and negotiations between Colorado, other Colorado River Basin States, and the federal government regarding the continuation of the 2007 Interim Guidelines, 1944 Mexican Water Treaty and related Minutes, and similar basin-wide operations are sensitive. Colorado does not want to pre-judge the outcome of these discussions, and these conversations should occur at the appropriate level.

The triggers contemplated in this current IBCC effort only pertain to operations of a TMD within Colorado, distinct from those in the Interim Guidelines or the Treaty and its Minutes, which are applied to the Colorado River Basin as a whole. Any triggers to be discussed at the IBCC level cannot presuppose the outcome of these conversations, nor negatively impact Colorado's position in such conversations.

For the purposes of Colorado's Water Plan, it should be sufficient to: 1) include language indicating that the IBCC encourages the Upper Basin states to continue discussion on this subject, and that triggers should be finalized after the Interim Guidelines are renegotiated in 2026, but no later than 2030, and 2) draft a brief memo outlining components and variables of triggers that could be used for managing a new TMD (e.g., 10-year rolling averages, Colorado River Storage Project (CRSP) reservoir levels, hydrologic variability, climate change).

Triggers to manage when a TMD can divert will rely on contractual agreements between parties and not on changes to the Colorado Constitution. It is the hope and expectation that the IBCC-recommended process for further development of Colorado River supplies will be more attractive to project proponents than the status quo.

Resources for Item 3:

- Colorado River Basin Water Supply and Demand Study & continued work
- IBCC Scenario Development
- Colorado River Compact
- Upper Colorado River Basin Compact
- Minute 319
- 2007 Interim Guidelines
- Endangered fish PBOs
- Colorado River Water Availability Study
- Gunnison Basin Risk Assessment Scenario for Portfolio Tool Document
- IBCC Report to the Governors
- WISE Partnership
- Colorado River Cooperative Agreement

Background: The trigger concept has been utilized or proposed in several disparate situations. The Interim Guidelines, which expire in 2026, provide triggers for coordinating operations of Lakes Powell and Mead. Further, Minute 319 to the Mexican Water Treaty identifies triggers for increasing and decreasing release of Colorado River water for use in Mexico. While these and other work related to triggers/signposts in the Colorado River Basin Supply and Demand Study and through the IBCC scenarios are not intended to be applied to a new transmountain project, they serve as examples of triggers established in legal agreements for specific, interim operations in the Colorado River Basin.

There is also some precedent for linking project operations to hydrological triggers through contractual agreements within Colorado, such as is the case with the Water, Infrastructure, and Supply Efficiency (WISE) partnership and the Shoshone relaxation described in the Colorado River Cooperative Agreement (CRCA). In addition, the programmatic biological opinions (PBOs) on the Yampa, Green, and Colorado Rivers provide specific flow targets for endangered fish species that may be helpful to further examine as examples. Finally, the Gunnison Basin's "Risk Assessment Scenario for Portfolio Tool" document, primarily authored by Bill Trampe, discusses two hypothetical examples of potential trigger use. Lastly, the IBCC 2010 "Letter to the Governors" laid out the need to examine triggers to prevent a Compact curtailment and explored some ways to do this.

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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 transmountain diversion.

Resources for Item 4:

- Basin Implementation Plans
- Identified Projects and Processes (IPPs)
- Colorado BRT white paper
- East Slope white paper
- Yampa/White/Green White Paper
- Western Slope Water Banking
- Risk Management Strategies for the Upper Colorado River Basin (Kuhn, 2012)

Defining "Insurance Policy": The insurance policy refers to proactive protection against involuntary curtailment of Colorado River water uses in Colorado. The seven Colorado River Basin States' contingency planning has the potential to be the model for an insurance policy, and the insurance policy must be inextricably linked to and coordinated with contingency planning. Contingency planning is described in more detail below, but it can most simply be described as an operational strategy to minimize or avoid the risk of Lake Powell dropping below the minimum levels required to generate power ("minimum power pool"). It is therefore protective against the possibility of Compact compliance issues arising. The insurance policy will apply to existing uses, "agreed-to" projects, and some additional increment of future development on the West Slope. A new TMD will not be included in the insurance policy; it will be considered junior and "self-insured" through backup supplies such as alternative transfer method (ATM) water, Denver Basin Aquifer resources, and other water supplies described in Item 2.

Ongoing conversations between Colorado, other Basin States, and the federal government concerning current and future operation of the Colorado River Basin are sensitive. Colorado does not want to pre-judge the outcome of these discussions, and these conversations should occur at the appropriate level. While significant technical work could be done that combines consideration of the endangered fish protection, levels in Lake Powell, and the status of the Upper Basin's rolling 10-year non-depletion obligation under the Colorado River Compact with physical and legal water availability, this is work that must be done among the Upper Basin states as part of contingency planning for the Colorado River Basin. For the purposes of Colorado's Water Plan, it should be sufficient to include the language indicating that the IBCC encourages the Upper Basin states to continue discussion on this subject, and that triggers associated with contingency planning could be finalized to inform, or as part of the discussions for, renegotiating the Interim Guidelines. In addition, Colorado should continue existing work on the Water Bank Feasibility Study, Aspinall Water Bank Study, scenario planning and adaptive management.

In addition to encouraging the Upper Basin to continue contingency planning and compliance work, the IBCC also encourages the Upper Basin to clarify the amount of water contingency planning could cover through demand management. It is assumed that the volume should at least cover existing users, but it is not yet clear how much additional insurance, if any, demand management can provide for future diversions. Once the amount of potential demand management is determined, additional consideration of how much future development of Colorado River water can be covered by the insurance plan can be considered. The State of Colorado will bring information from the Basin Implementation Plans (BIPs) to contingency planning discussions to inform their examination of how much water can be covered through the insurance policy and will confer with the basin roundtables and other stakeholders throughout the negotiations.

The IBCC believes that the insurance policy as described above is critical for Colorado's water future and recommends that it be included in other sections of Colorado's Water Plan as appropriate, as it will be needed with or without a new TMD.

Background: The Basin States are evaluating possible contingency plans for operating the Colorado River system to meet minimum power pool in Lake Powell under extreme dry conditions. These plans are not directly related to Compact compliance issues. However, developing contingency plans to forestall the identified concerns would also help ensure that no Compact compliance issues would arise.

The Upper Basin representatives are currently evaluating options that could be deployed in the near term to address Lake Powell elevations, and have concluded at the proof of concept level that the Upper Basin can respond to a contingency condition on the River by taking three actions:

1) **Augmentation**: Continuing augmentation operations like cloud seeding;
2) **Extending CRSP Operations**: Extend operations of CRSP reservoirs to release increased amounts of water on an as needed basis to shore up storage levels at Lake Powell; and
3) **Demand Management:** Demand management is the term used to describe the process for compensating existing users across the Upper Basin to voluntarily reduce demand and thereby bolster reservoir storage. The Upper Basin states are exploring demand management with the understanding that any water generated as a result would be "system water" and would be carefully managed so that critical storage levels are maintained without triggering greater releases to the Lower Basin. These conversations are sensitive, and they are occurring among the sovereign states. Because of the structural deficit in the Lower Basin, demand management through conservation and other measures is also critical.

The contingency planning evaluations are still in their nascent form but are expected to progress through current and future water years. Several Colorado stakeholders serve as advisors to the State and there will be opportunity for broader stakeholder feedback in the future.

Colorado is also continuing its work through two water bank grants, which could inform demand management as it relates to contingency planning. The first is examining how the Aspinall reservoirs could be used in a water bank, and the second is a broader look at the feasibility of a water bank on the West Slope. Water banks, especially if developed and used across the whole Upper Basin, could support both existing users of West Slope water (both in-basin and out-of-basin users), and potentially some additional increment of "agreed to" projects.

Item 1 through Item 3 in the *IBCC Conceptual Agreement* also provide protection to existing users, as a new TMD would be curtailed in advance of a Compact compliance issue arising. A junior water right paired with Item1 through Item 3 would make a new TMD designed to "do no harm" to existing uses. These points are not intended to make existing uses better off than before a new TMD is developed. Contingency planning would make existing users better off but is not the new TMD project proponent's responsibility.

Future consumptive use on the Colorado River is difficult to predict. However, between identified projects and processes (IPPs) and development of additional supplies by West Slope entities, it is expected that at a minimum 100,000 acre-feet of consumptive use will be needed for municipal and industrial (M&I) needs.

In addition to traditional M&I needs, the needs of energy, agriculture, the environment, and recreation could also be taken into consideration. Pairing all of these projects and needs with an insurance policy may not be realistic. For instance, since a water bank would heavily rely on agricultural water to meet critical needs, it may not be appropriate for the insurance policy to cover new agricultural water uses. Instead, such increased use could be part of an insurance policy for meeting critical needs. By doing so, infrastructure costs could potentially be shared between

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the agricultural users and those with critical needs who would want to buy into an insurance policy.

5) Future West Slope needs should be accommodated as part of a new TMD project.

A new TMD will need to provide benefits to the West Slope. The focus should be on pairing the new TMD described above with one or more of the following:

- Compensatory projects and methods (meeting both consumptive and nonconsumptive needs),
- A socio-economic compensation fund (as described in the 2010 IBCC "Letter to the Governors"), and
- Other requirements of conservation and conservancy districts.

Resources for Item 5:

- Basin Implementation Plans
- Identified Projects and Processes
- Colorado River Basin Water Supply and Demand Study
- Colorado River Compact Water Development Projection
- Water Supplies of the Colorado River
- Development Potential in Yampa River Basin
- The Yampa Doctrine
- Reconnaissance Level Cost Estimates for Strategy Concepts

The new TMD project and compensatory West Slope project(s) need to move together conjunctively in order to ensure that both the funding and hydrology are available. Such an arrangement would provide the necessary mutual assurance that the new TMD described above and compensatory project(s) move forward as a package of projects that benefit both East and West Slopes.

Some portion of future West Slope needs will be met through the increment of additional development discussed in Item 4. The purpose of Item 5 is to indicate that a new TMD should include West Slope consumptive or nonconsumptive projects and methods that require East Slope support in the form of either financial or infrastructure resources. Discussion of future West Slope needs in relation to a new TMD is not meant to imply that West Slope entities should not move forward with additional projects and methods in the absence of a TMD.

Background: In 2009, each West Slope roundtable was asked what types of in-basin benefits would need to be on the table for them to consider an additional TMD project. This is summarized in the *Reconnaissance Level Cost Estimates for Strategy Concepts - Water-Related Benefits for West Slope Subbasins,* which is an appendix in SWSI and is included in the annotated bibliography below. These types of considerations are important when considering how future West Slope needs will be accommodated. These range from compensatory projects to other considerations that would benefit the West Slope.

In recent years, several projects have demonstrated the ability to meet the needs of both sides of the Divide, while also taking into account environmental needs. For example, the Windy Gap Firming Project included improvements to the Colorado River, providing water to West Slope water providers, and longer-term commitments to Grand Lake. In 2012, Grand County approved a 1041 permit for this project, based on the many benefits afforded West Slope local entities, through negotiation of the parties.

The CRCA also serves as an example of East and West Slope interests working together to achieve mutually beneficial outcomes. Under the terms of this agreement, Denver Water entered into a partnership with 42 West Slope entities, making steps toward the implementation of the Moffat Project while agreeing to many beneficial obligations on the West Slope. While firming supply for Denver, the agreement also provides many environmental protections for Colorado headwater communities and streams. This process is also notable for the creation of the "Learning by Doing"

process, which establishes a stakeholder group and process for environmental improvements, utilizing funding from Denver Water and others.

The IBCC and roundtable process outlined in HB 1177 also provides several provisions by which these institutions may participate in voluntary negotiations. As delineated in the bill, the roundtables and IBCC would be a natural venue for working together for mutual benefits, under the terms of an interbasin compact charter.

6) Colorado will continue its commitment to improve conservation and reuse.

Part A. Municipal & Industrial Conservation and Reuse

Conservation actions defined in the No and Low Regrets Action Plan should be substantively completed prior to implementation of a new TMD project. Such actions include development of conservation standards for communities planning to use agricultural transfers or new supplies for future water needs, focusing as much as possible on incentives, legislative options and support for indoor water use, and legislative options and support for outdoor water efficiency standards.

Reuse actions defined in the No and Low Regrets Action Plan should also be substantively completed prior to the implementation of a new TMD project. Such actions include improved tracking and quantification, development of a statewide reuse goal, development of new incentives for reuse, and education and outreach efforts.

All proponents of new M&I water projects should meet high conservation standards. Water providers participating in a new TMD project should have active conservation plans and activities approved by the CWCB in place prior to implementation of the project. Additionally, water providers participating in a new TMD project who utilize other fully consumable water supplies should have a reuse program to recycle as much water as is technically and economically possible.

The active water conservation plans of providers participating in a new TMD should demonstrate a commitment to working toward enhanced conservation goals. These goals should have measurable outcomes. The IBCC discussed, but did not resolve, whether entities using water from a new TMD project should be held to a higher conservation standard than other water entities in the state. This topic requires further IBCC discussion, including refinement of the terms “high” or “higher” related to this issue, including how to measure and track progress. The resolution of this issue should recognize that opportunities for conservation may vary from one community to another.

Examples of measurable conservation goals include establishing target indoor/outdoor water use ratios, target gallons per capita per day, and best management practices (BMP) targets. Developing implementation targets for BMPs may be the simplest approach to a measurable outcome in the short term, as per capita targets and indoor/outdoor water use ratios may be more challenging or controversial in some communities than others and there is currently insufficient baseline data. However, new data on per capita use data is emerging through HB 1051 in June 2014 and could provide a baseline for a future per capita or indoor/outdoor ratio target. Additionally, the BIPs are due in July 2014 and are expected to include plans for implementation of BMPs. The BIPs could provide helpful insight into how many BMPs are likely to be implemented and by how many providers. This information should inform a future IBCC discussion about what the right BMP implementation targets are and what progression of desired implementation would push providers to do more over time without overwhelming them.

Land use practices that help reduce water consumption should be supported and encouraged, focusing as much as possible on incentives. Land use is an important component in water conservation; however, further work is needed to determine strategies and partners to tackle this issue. Additional discussions on this issue should be initiated by the IBCC and should include municipalities, counties, local planning agencies, and elected officials at all levels.

Background: The Arkansas, Metro, and South Platte Basins have put significant efforts into conservation, reuse, and cooperative infrastructure. Some water providers, like Aurora, have reduced their per capita water use by 30% since 2002. Many other areas in the state have also seen declines in per capita water use.

M&I Conservation: SWSI 2010 takes what are essentially current water usage numbers and determines low, medium, and high conservation levels. The No and Low Regrets Action Plan determined that a minimum of 165,000 acre-feet of active conservation would need to be applied to meet future demands. This is equivalent to 100% of low conservation levels or 50% of medium conservation levels being applied to the gap. In addition, about 150,000 acre feet of passive conservation is factored into the overall demands. Passive savings are those realized by the natural replacement of more efficient fixtures and appliances in homes and businesses. There has been some concern that the replacement rates and starting points in SWSI 2010 may not reflect the latest data. SWSI 2016 will reexamine passive conservation. Recently the Fixtures Bill (SB14-103) passed through the Colorado Legislature and is awaiting the Governor's signature. This bill will help yield passive conservation savings from shower heads, toilets, faucets, and other fixtures.

The Metro Basin Roundtable Conservation White Paper determined that achieving somewhere between low and medium conservation was reasonable under current conditions, but any additional levels would need statewide action. The East Slope White Paper in general agreed that enhanced levels of conservation are needed, and the Colorado Basin Roundtable White Paper, several other West Slope basin roundtable portfolios, and the *Filling the Gap* report indicated that Colorado should strive for high levels of conservation. More recently, the Southwest Basin Roundtable has put together a conservation goal and measurable outcome that links the percentage of outdoor conservation use to indoor conservation use, with new transmountain (and agricultural dry-up) diverters needing to use less outdoor irrigation.

Resources for Item 6:

- Colorado Basin Roundtable White Paper
- Filling the East Slope Municipal Water Supply Gap
- Metro Roundtable Selection of a Reuse Factor for the Portfolio Tool Planning Exercise
- Metro Roundtable Updated Conservation Strategy
- Metro Roundtable Water Supply Paper (2012)
- Basin Implementation Plans
- Southwest Basin Roundtable Municipal Water Conservation Goal and Measurable Outcome
- Guidebook of Best Practices for Municipal Water Conservation in Colorado
- Statewide Water Supply Initiative
- SWSI M&I Water Conservation Strategies
- Fixtures Legislation
- Filling the Gap Report Series
- Currier Memo on SWSI 2010
- CWCB Response to Currier Memo
- IBCC Letter to the Governors
- No and Low Regrets
- Green River Studies in Wyoming
- Senate Bill 23
- Colorado Demonstration Zero Liquid Discharge Processes
- Rotary Sprinkler Nozzle Retrofit
- Colorado Review: Water Management and Land Use Planning Integration
- Calculating Per Capita Water Demand Savings from Density Increases to Residential Housing for Portfolio and Trade-off Tool
- Colorado River Cooperative Agreement
- Windy Gap Firming – Reuse
- CAWA
- WISE

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The IBCC's No and Low Regrets Action Plan lists several possible options for how to move forward with enhanced levels of conservation. These items and other concepts were organized into four conceptual bullets related to demand management for the IBCC's polling exercise in October 2013 in order to explore the intersection of conservation, reuse, and land use with TMDs.

Reuse: Colorado water law defines what water supplies can be reused, and to the extent each source can be reused. Currently there are a limited number of sources that can legally be reused in Colorado:

- **Nonnative water:** 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. Reuse is applicable for water from traditional purchase of agricultural water rights and ATMs.
- **Nontributary groundwater:** Reuse of nontributary groundwater is allowable.
- **Other Diverted Water:** Any water right with a decreed reuse right may be reused to the extent described in the decreed reuse right.

There are two ways in which these different source types can be reclaimed for reuse:

1. **Direct Reuse:** This is the process in which the return flows from the various supplies are physically reclaimed either for potable or nonpotable uses. An example of this can be found in Aurora's Sand Creek Water Reuse Facility for potable water or Colorado Springs Utility's non-potable water system.
2. **Indirect Reuse:** This process entails the exchange or substitution of the return flows from a reusable source. The most common form of Indirect Reuse is through river exchanges, where a utility lets the reusable water flow downstream, and diverts an equal amount of water from an upstream source.

In addition, municipal wastewater is usually used by agricultural producers downstream. In some cases, this water is directly leased to agricultural producers. In other cases, the water becomes part of the stream flow and used downstream.

Further reuse recommendations and descriptions can be found in the No and Low Regrets Action Plan, Metro Reuse White Paper, and the East Slope White Paper. The CRCA and Windy Gap firming agreements specifically deal with reuse. West Slope basin roundtables have expressed concern that current and planned reuse on the East Slope does not sufficiently utilize fully consumable waters.

Other Demand Management Strategies: In addition to conservation and reuse, the IBCC recommends regional and cooperative strategies and land use measures as important factors in the efforts of Colorado's various regions to "up their games."

Regional cooperative projects, like WISE and the Chatfield Reallocation Project, are becoming more common. According to the Metro Reuse Paper, reuse by exchange has nearly been exhausted, and more and more direct reuse (both potable and nonpotable) is being planned. Grand Junction, Ute Water, Clifton, and Palisade have interconnected their systems to provide reliability in the face of drought and emergencies. The No and Low Regrets Action Plan makes the following recommendation:

> **Encourage cooperative projects through BIPs:** CWCB should encourage Basin Roundtables to work with water providers and communities that anticipate having a water supply gap in the future (or that have one now) to partner with neighboring providers and communities to find creative solutions to

their water needs. In particular, water-short communities should work with their surrounding communities to examine whether they can be integrated into current systems or upcoming IPPs. Expanding the number of water users served by IPPs that are already planned or underway can help limit or delay the need for new supply or agricultural transfer projects.

Urban land use has also been a major discussion point. Both the 2009 Land Use and Water conference and associated report and the memo on water demand savings from density described several options, as did the No and Low Regrets Action Plan:

Support and encourage land use practices that help reduce water consumption, focusing as much as possible on incentives: In 2010, CWCB produced a report titled Colorado Review: Water Management and Land Use Planning Integration. Several local actions that could be used more broadly stemmed out of that report. These include:

Expedited permitting: Permitting for buildings and developments could be expedited if the project incorporates certain water efficiency measures or high levels of density.

Tax incentives: There could be tax breaks if the project incorporates certain water efficiency measures or high levels density.

Structure impact (tap) fees: Use impact fees to promote water-wise developments and in-fill. These fees could be structured to penalize water inefficient or sprawling developments and/or to reward sustainable/dense developments.

Regional collaborative planning: Localized solutions are often not effective, since water demand may be transferred from one jurisdiction to one or many others. Therefore, regional solutions are critical and should be further explored. Some opportunities exist, such as engaging Council of Governments in water/land use discussions, identification of related regional planning efforts that are underway and including water issues, and the use of intergovernmental agreements.

Integration: Many other efforts are currently underway that could reduce regional water demand, but are not specifically aimed at achieving that purpose. There are many opportunities for developing partnerships with other water conservation efforts, sustainable/walkable neighborhood developments, energy conservation and CO2 reduction programs, water quality programs, food security programs, transportation projects, market drivers, comprehensive plans, and many others.

Part B. Agricultural Conservation

When considering agricultural conservation strategies, it will be important to take a site-specific perspective and to consider the potentially negative consequences of altering the timing and amount of return flows. While some locations lend themselves well to agricultural conservation practices, others do not, and a clear understanding of the affected systems is necessary.

Current Agricultural Uses: Many of the BIPs are looking to find the explicit interconnections between agricultural and nonconsumptive uses. In addition, several are looking to decrease agricultural shortages. As part of this work, each basin should seek to reduce consumptive non-beneficial use by following the guidelines laid out in the Colorado Agricultural Water Alliance (CAWA) 2008 Agricultural Conservation Paper (e.g., reducing soil moisture loss where practical through drip irrigation or mulching). Lining of high-priority ditches is another important tool in reducing seepage losses in appropriate areas. Phreatophyte control presents one of the largest opportunities for reducing non-beneficial consumptive use and should be pursued aggressively, although balancing this with nonconsumptive needs can be challenging. Additional incentives should be developed to assist basins in implementing, where appropriate, agricultural efficiency and conservation practices, supporting the ecosystem services agriculture can provide, and changing crop types to lower water use crops.

Future Agricultural Uses: New irrigated agricultural lands (currently identified in the North Platte and Yampa basins) should be designed to either use best practices with regard to

agricultural conservation and efficiency, or, alternatively, be measurably and explicitly multi-purpose by meeting identified nonconsumptive needs.

Background: Communities around Colorado are working to improve the efficiency of water use in agricultural settings. Recent work in the Grand Valley serves as an excellent example of this. Many headgates have been modified, and orchards are now on drip irrigation. CWCB and others have supported many agricultural producers across the State who have put significant funds into decreasing ditch loss, diversion structures, and improving irrigation efficiencies. The Rio Grande and Republican River basins are working to maintain a sustainable agricultural community in the face of an imbalance between available water supplies and current levels of water use. The South Platte is still grappling with a Supreme Court decision that led to the shutdown of many agricultural producers who relied on wells. It is also important to take into consideration legal constraints such as the Arkansas River Compact or the decree in the North Platte Basin, under which greater efficiency measures can have complicated consequences for agricultural producers.

In addition, some irrigation practices, such as flood irrigation, often support riparian and wetland areas critical for migratory birds and other environmentally important species. Irrigation practices can also retime river flows, so that late summer and early fall flows are often better than they were under natural conditions. For instance, in high mountain meadows, high levels of irrigation early in the season benefit agricultural return flows and nonconsumptive values later in the year.

Agricultural conservation is aimed at reducing consumptive use and needs to be distinguished from agricultural efficiency. In some instances and for some crops, practices such as drip irrigation and mulching can reduce consumptive use. Agricultural efficiency measures, such as pivot sprinklers, may retime water, divert less, or otherwise modify operations to maximize the water delivery to the crop, but it is not aimed at reducing consumptive use. In fact, agricultural efficiencies often lead to increased consumptive use since most areas in the state already do not provide as much water as the crops could use under ideal conditions. When water is applied more efficiently to a crop, then it can more easily use and consume that water.

7) Environmental resiliency and recreational needs must be addressed both before and conjunctively with a new TMD.

Agriculture and Nonconsumptive Partnerships: Agricultural water has a role to play with regard to adding flexibility and reliability to meet future water needs. Agricultural partnerships with environmental, recreational, and municipal groups should be supported to help sustain Colorado's economic future and healthy environment. In addition, development of all new water projects should consider important agricultural and nonconsumptive gaps identified by the basin roundtables.

Environmental Resiliency: 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 TMD is built. This could create conditions under which future projects may be possible but would not be the responsibility of a new TMD project proponent since these issues were not

Resources for Item 7:

- CWCB Instream Flow Program
- Nonconsumptive Toolbox
- Programmatic Biological Opinions
- Colorado River Basin Water Supply and Demand Study
- Streamflow Evaluations for Whitewater Boating
- Watershed Flow Evaluation Tool: Yampa/White and Colorado Basins
- Colorado Parks and Wildlife Planning
- Wildlife Mitigation Agreements
- NEPA Documentation on Ongoing Processes
- Arkansas Voluntary Flow Management Program

caused by the new project proponent. These existing environmental and recreational gaps should be meaningfully addressed in the near term and in any new TMD-affected areas before a new TMD is built. Sources of funding will likely include federal, state, foundation, corporate, and private money. However, additional sources will likely be needed as well.

Environmental and recreational needs in relation to a new TMD: In addition, a new, multipurpose TMD could potentially fill remaining environmental and recreational gaps as part of a package of compensatory projects. Any new project should also include benefits and/or mitigation for environmental and recreational values. Environmental and recreational needs should be addressed proactively and voluntarily up-front in the project design, and proponents should include nonconsumptive partners to help the package of projects associated with the new TMD be truly multipurpose. Environmental impacts associated with a new TMD should be avoided, minimized or mitigated, and environmental restoration and enhancement opportunities should be provided. Project proponents will be responsible for mitigating impacts that result from the new TMD project, even if those impacts occur outside of Colorado. The above statements are not intended to create any new regulatory or permit requirements beyond those currently found in federal, state or local law.

Background: Since the 1970s, environmental and recreational needs have gained increasing recognition in Colorado's water law through instream flow and recreational in-channel diversion water rights. Colorado has become a destination state, with recreation-based tourism and activity contributing approximately $10 billion annually to the economy. Colorado's natural beauty and recreational opportunities are one reason why so many people move to and continue to live in Colorado.

The IBCC and basin roundtables have continued to acknowledge the importance of environmental and recreational needs. The Yampa/White and Colorado basin roundtables have conducted a flow analysis called the Watershed Flow Evaluation Tool, and many basins already have flow agreements or standards in place. For instance, the Arkansas Basin has the Arkansas Headwaters Recreation Area, the Gunnison Basin has flows through the Black Canyon, the Three States Agreement affects flows in the South Platte, and the Colorado, Yampa, and Green Rivers have PBOs that establish flows for the endangered species recovery program. In addition, all of the basin roundtables have identified where their important nonconsumptive values are located; these are called "focus areas." In 2009, CWCB conducted a survey to determine nonconsumptive IPPs, which have been put together with the focus areas in a nonconsumptive database. The BIPs will determine additional projects and methods to meet nonconsumptive needs. Additional efforts in Colorado include work by the Bureau of Reclamation as part of the ongoing efforts of the Colorado River Basin Supply & Demand Study, as well as other efforts by Colorado Parks and Wildlife, American Whitewater, The Nature Conservancy, Colorado Water Trust, and many other local, statewide, and national groups.

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Topics for Further IBCC Discussion Beginning in Fall 2014

- A discussion of quantifiable conservation targets, using HB 1051 reporting data and the BIPs to help inform the discussion
- A discussion of a socioeconomic compensation fund for a new TMD, above and beyond what is outlined in the IBCC 2010 "Letter to the Governors"
- Future use allocation (previously known as "equitable apportionment")
- Use of Denver Basin Aquifer resources (how much water can be stored and withdrawn, the timing requirements for storage and withdrawal, costs, and conceptual designs)
- How a new TMD could/should be structured (partnership structures, participants, financing, operational rules, proof of need, and project feasibility)
- Steps to preserve the option for a new TMD

Action Items

The following items are works in progress by CWCB staff and IBCC members. The IBCC believes that these steps will better inform the ongoing discussion of the seven points, while also keeping the roundtables up to date and informed about the IBCC process and key discussion items.

- **Basin Roundtable Outreach:** IBCC members will play a critical role in communicating about discussion items and updates contained in the *IBCC Conceptual Agreement* with their basin roundtables and constituents. IBCC members will also be responsible for bringing back feedback for discussion and integration into future drafts of the *IBCC Conceptual Agreement*.
- **Risk Management:** The concept of risk management is central to the discussion of this conceptual framework and in the ongoing conversations. Though not specifically designated as such, many elements proposed in the seven points will serve as risk management tools. As the documentation and dialogue continue, clarification should be made regarding which elements are advancing the concept of risk management. For example, the triggers concept in Item 3 and the "insurance policy" for existing uses of Item 4 are strategies by which the risk of Compact and other interstate related issues associated with a new TMD may be managed. This will also help reduce the risk that agriculture statewide will have to bear the full brunt of meeting a future water supply shortfall.
- **East Slope Incentives:** Incentives should be presented to East Slope entities in return for compliance with identified triggers. Further discussion is needed by the IBCC to determine what these incentives might include.
- **TMD Triggers Memo:** This action item will be an ongoing product of CWCB staff, as requested by the IBCC. The memo will address potential options available for triggers, as described in Item 3. These triggers only pertain to operation of a new TMD within the state of Colorado and are separate from any discussion of triggers at the interstate level.
- **Contingency Planning Updates:** A concern was raised by IBCC members regarding the ongoing contingency planning process occurring at the interstate level. This process, as described in Item 4, is obviously of great importance and concern to the entire state. IBCC members requested that updates on the process be provided or presented to basin roundtables to encourage greater understanding of the need and methods by which this planning is proceeding.
- **Review of Previous Streamflow Analyses:** The IBCC requested that a new study or review of previous analyses of streamflow in the Colorado River Basin be considered. Specifically, this work would utilize the Colorado Decision Support System or existing modeling under that

system to summarize estimates of natural flow, depletions, and pre-Compact depletions for each river in the Colorado River Basin. This work would conceivably better inform several different topics within the seven points.

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Appendix A. Annotated Bibliography

Item 2 References:

Alternative Agricultural Water Transfer Methods (ATM) Projects

Senate Bill 07-22 authorized the CWCB to develop a grant program to facilitate the development and implementation of ATMs in the state. Since its inception in 2007, the CWCB's Alternative Agricultural Water Transfer Methods Grant Program has awarded nearly $3 million to municipal water providers, ditch companies, conservancy and conservation districts, university research teams, nonprofit organizations, and other entities to pursue the goal of turning the conceptual idea of ATMs into a practical reality. At the request of the CWCB, the technical memorandum linked below was prepared to provide an update on the status of the ATM grant program and to summarize findings of the funded projects with regard to identifying solutions to the barriers to implementation. Section 1 identifies each of the ATM grant recipient projects and provides a series of targeted recommendations for moving forward with the ATM grant program and eventual implementation of ATMs as viable means to secure M&I water supplies in Colorado. Section 2 revisits the first round of grant recipients in more detail. Final reports for most of those projects were completed after the publication of the previous ATM grant program summary report, so this technical memorandum seeks to place the findings of those projects in context of the barriers to implementation. Section 3 summarizes the objectives of the projects receiving second round grant funding and also provides a status update on each project as of October 2012.

The Alternative Agricultural Water Transfer Methods Grant Program Summary and Status Update Technical Memorandum (November 2012) can be found here.

Previous ATM Grant Summary Reports

Colorado Water Conservation Board. 2011. Colorado's Water Supply Future – Alternative Agricultural Water Transfer Methods Grant Program Summary. Final Report. Prepared by CDM Smith.

Final (or most recent) deliverables for the first round of ATM Grant Program studies are as follows. *These documents are not presently available online*.

1. *Parker Water & Sanitation District and Colorado State University*
   Hansen, N., J. Pritchett, B. Lytle, T. Holtzer, J. Brummer, L. Garcia, J. Schneekloth, B. Bosley, and A. Helm. 2011. Final Report of The Lower South Platte Irrigation Research and Demonstration Project.
2. *Colorado Corn Growers Association*
   Colorado Corn Growers Association, Ducks Unlimited, Aurora Water, and Lower South Platte Water Cooperative. 2011. Completion Report: Development of Practical Alternative Agricultural Water Transfer Measures for Preservation of Colorado Irrigated Agriculture. Prepared by Brown and Caldwell, Colorado Water Resources Research Institute, Harvey Economics, and Lawrence Jones Custer Grasmick LLP.

3. *Lower Arkansas Valley Water Conservancy District Super Ditch Company*
   Lower Arkansas Valley Water Conservancy District. 2011. Development of Land Fallowing-Water Leasing in the Lower Arkansas Valley (2002 through mid-2011). Prepared by Trout, Raley, Montano, Witwer & Freeman, P.C.
4. *Farmers Reservoir & Irrigation Company*
   Farmers Reservoir and Irrigation Company. 2012. An Evaluation of Alternative Agricultural Water Transfer Methods in the South Platte Basin. Prepared by DiNatale Water Consultants, Inc. in association with CSU College of Agricultural Sciences, CSU Department of Agricultural and Resource Economics, and Ecological Resource Consultants, Inc.
5. *CSU Extension Office*
   Cabot, P., J. Valliant, J. Tranel, and M. Bartolo. 2012. 2012 Fall Annual Report to Colorado Water Conservation Board Alternative Agricultural Water Transfer Methods.

Final (or most recent) deliverables for the second round of ATM Grant Program studies are as follows. *These documents are not presently available online.*

1. The Nature Conservancy
   The Nature Conservancy and Trout Unlimited. 2014. Yampa Basin Alternative Agricultural Water Transfer Methods Study. Final Report. Prepared by CDM Smith.
2. *Colorado River Water Conservation District*
   MWH. 2012. Colorado River Water Bank Feasibility Study, Phase 1. Final Draft Report. Prepared for Colorado River Water Conservation District.
   MWH. 2013. Colorado River Water Bank Feasibility Study, Phase 2. Final Draft Report. Prepared for Colorado River Water Conservation District.
3. *Lower Arkansas Valley Water Conservancy District*
   Lower Arkansas Valley Water Conservancy District. 2012. Agricultural Water Lease Evaluation Tool (AgLET): Enhancements to Include Time and Uncertainties. Final Report. Prepared by Honey Creek Resources.
4. *Colorado Water Innovation Cluster*
   Colorado Water Innovation Cluster. 2013. Project Report: Lake Canal Alternative Agricultural Practices and In-Stream Flow Demonstration Project.
5. *East Cherry Creek Water & Sanitation District*
   East Cherry Creek Valley Water and Sanitation District. 2012. DRAFT Alternative Transfer Methods Status Report – October 2012. Submitted by DiNatale Water Consultants and N. Hansen, Troy Bauder, R. Flynn, and J. Deering (CSU).
6. *Parker Water & Sanitation District*
   Jaeger, F., B. Lytle, N. Hansen, J. Chavez, and L. Garcia. 2012. Lower South Platte Irrigation Research and Demonstration Project Status Report.
7. *Lower South Platte Water Conservancy District*
   Frank, J. M. Shimmin, J. Yahn, and Grant Review Committee. 2012. Memorandum – Lower South Platte Water Cooperative Interim Progress Report. Prepared by Matt Lindburg, Brown & Caldwell.
8. *Colorado Corn Growers Association*
   Sponsler, M, and the Flex Water Market Project Team. 2012. Memorandum – Flex Water Market Interim Project Report. Prepared by Matt Lindburg, Brown & Caldwell.
9. *Upper Arkansas Water Conservancy District*

Scanga, T. 2012. Memorandum – Building & Assessing Accounting and Administration Tools for Lease-Fallowing – Phases 1-3 Progress Report.
Walter, I. 2012. Memorandum – Update Lease Fallowing Accounting Tool (LFAT) Task Committee (TC).

10. *Colorado State University Agricultural Experiment Station*
Reich, D. 2012. Alternative Agricultural Water Transfer Methods: Progress Report – 1st Year.

A third round of ATM grants awarded more than $800,000 to six recipients in 2013, several of which are continuations of projects initiated and ongoing under the first and/or second round of ATM grants.

Upper Black Squirrel Creek Study (December 2008)

This study integrates new field data with information from previous studies and cooperating partners to refine our knowledge of the hydrogeology of the alluvial aquifer system in the Upper Black Squirrel Creek basin for the purposes of identifying potential sites for aquifer recharge and storage implementation. The final deliverable is available here.

The Poudre Runs Through It: Northern Colorado's Water Future (Launched 2011)

The Poudre Runs Through It is a diverse group of regional leaders brought together and facilitated by CSU's Colorado Water Institute to better understand both the operational and ecological needs of the Poudre River. By sharing their knowledge and experience, this work group learned together about many aspects of the Poudre River to identify opportunities for cooperative action. This group is trying instead to find broadly acceptable ways to meet multiple objectives: to have both a working Poudre and a healthier Poudre. Through a series of meetings in 2012 and 2013, the group identified a variety of innovative opportunities for voluntary, collaborative solutions that may help protect habitat and water quality while respecting private property rights. According to the group's website, they will continue meeting through June 2014 to put in action the "Flows, Funding, Forum" initiatives identified in the July 2013 progress report. Also visit their website at:
http://www.cwi.colostate.edu/thepoudrerunsthroughit/index.shtml

House Bill 13-1248: Concerning an Authorization of Pilot Projects for the Leasing of Water for Municipal Use

This bill authorizes the Colorado Water Conservation Board (CWCB), after the State Engineer determines the issue of injury, to approve up to ten pilot projects to test fallowing-leasing, with each project lasting up to ten years and no more than three pilot projects to be located in any one of the major river basins, namely: The South Platte river basin; the Arkansas river basin; the Rio Grande river basin; and the Colorado river basin, except as further limited by board. The CWCB may provide financial, technical, or other assistance to a pilot project pursuant to the Board's other activities and programs. The purposes of the pilot programs are to demonstrate cooperation, evaluate feasibility, provide sufficient data, and demonstrate how to operate, administer and account for the prac tice of fallowing irrigated agricultural land for leasing water for temporary munciipla use without causing material injury to other vested water rights, decreed conditional water rights or contract rights to water. The bill can be found here.

Northeast Colorado Water Cooperative

Several years ago, a small group of water users and water professionals began discussing the possibility of organizing a water cooperative in the area of Water Districts 1 and 64 in the lower South Platte River. The water cooperative would create a mechanism for moving augmentation credits from plans with unused credits into plans that need additional credits.

The steering committee applied for and was awarded two grants to research organizational and operational aspects of the water cooperative. Work under a grant through the Water Supply Reserve Account (WSRA) focuses primarily on research and development of an organizational structure for the Water Cooperative. An Alternative Transfer Methods grant was awarded to the Lower South Platte Water Conservancy District (the lead applicant) and numerous supporting augmentation plans, ditch companies and water organizations to research operational aspects of the cooperative.

The Cooperative is currently working towards implementation using funding from an additional ATM grant that was awarded in 2013. The Lower South Platte Water Conservancy District is the lead applicant for this grant, and it is being supported by numerous augmentation plans, ditch companies and other water organizations. The goal of the project is to implement the Cooperative in 2014. Implementation of the cooperative will be primarily in Districts 1 and 64. In the future, it is possible the cooperative could expand upstream of those two districts.

SB06-193 Underground Water Storage Study (March 2007)

Senate Bill 06-193 (SB06-193) directed the Colorado Water Conservation Board (CWCB) to conduct a study of potential underground water storage areas in the South Platte and Arkansas River Basins. In 2004 the Colorado Geological Survey (CGS) completed their report "Artificial Recharge of Ground Water in Colorado – A Statewide Assessment." In that study, large aquifer regions were identified statewide for recharge potential. This SB06-193 study uses the CGS study as a beginning point and goes a step further in the South Platte and Arkansas River Basins. More information on the study is available here.

Aquifer Recharge of Ground Water in Colorado – A Statewide Assessment (2004)

In 2003, the director of the Colorado Department of Natural Resources requested that the Colorado Geological Survey conduct a statewide assessment study of artificial recharge potential. This study assessed the opportunities for using artificial recharge to meet water storage needs statewide, focusing primarily on the hydrogeologic properties of aquifers and other underground storage options.

This study assesses the best aquifers in Colorado for their artificial recharge potential of ground water based primarily on their hydrogeological suitability. Implementation of an AR project must also consider several other factors, including (1) project objectives; (2) site-specific hydrogeologic conditions; (3) source water availability; (4) water law and water rights; (5) available land surface area and compatible land-use activities; (6) governing water-management districts or entities; (7) facility design criteria; (8) capital costs to construct; (9) operation and maintenance costs; and (10) general storage efficiency, recovery, and deliverability. An Executive Summary of the Study can be found here. Further information can be found here.

Regional Aquifer Supply Assessment (December 2008)

This study is an assessment of the regional data relevant to groundwater supply in the south Metro area undertaken with the support of a Water Supply Reserve Grant from the Colorado Water Conservation Board (CWCB). The purpose of this assessment is to compile recent regional aquifer data to support the South Metro Water Supply Authority (SMWSA) evaluation of aquifer storage and recovery (ASR) pilot test locations. As part of this regional aquifer supply assessment, a dataset of

aquifer characteristics, recent water levels, and well production was compiled and evaluated to gain a better understanding of the Denver Basin bedrock aquifers in the south Metro area. These aquifers are a key component of water supply for many of the SMWSA entities.

Based upon the findings of this assessment SMWSA would like to further explore the potential for implementing ASR in the south Metro area by conducting an ASR pilot study. This study would evaluate several long-term renewable water sources candidates for supplying ASR wells in the area, water quality compatibility, and the potential for regional integration of ASR operations to better manage the groundwater resources of the SMWSA entities. The Technical Report is available here.

South Metro Water Supply Authority Aquifer Recharge Pilot Study (Ongoing)

The SMWSA received a grant of $550,000 from the Colorado Water Conservation Board (CWCB) via a Water Supply Reserve Account (WSRA) Grant to implement an ASR Pilot Study. This study was originally scoped to identify two SMWSA member wells (Denver Basin wells) that could be retrofitted to implement ASR using water of similar water quality SMWSA members would receive from the WISE project.

A recent review of the financial feasibility of completing the South Metro Water Supply Authority (SMWSA) Aquifer Storage and Recovery (ASR) Pilot Project at an alternative site was completed and it was determined that the project, as currently defined, cannot be completed within the allocated grant funds. The primary reason for this is the ability to incorporate the cost of completing a monitoring well at a cost of $292,000, which was not part of the original scope. There are a few options for how the project can still proceed but will require coordination and input from SMWSA staff, SMWSA Groundwater Group and SMWSA members not represented in the groundwater group. The Scope of Work is available here.

South Metro Water Supply Authority Regional Water Master Plan (June 2007)

This Master Plan serves as a guidance document in developing renewable water supplies for the South Metro area. Development of the plan was based on the following approach:

- Identify goals for additional renewable water supply for each SMWSA provider in 2010 (interim), 2020 (mid-term), 2030 (long-term), and at buildout
- Develop alternatives and associated costs to convey, treat, and store renewable water from specific sources to the South Metro area
- Develop alternatives and associated costs to locally distribute renewable water supplies to SMWSA providers
- Develop an implementation plan that provides a general timeline and an outline of methodologies to follow when pursuing and evaluating renewable water supplies

The 2003 South Metro Water Supply Study recommended further investigation of a conjunctive use program, including use of imported water from the South Platte River and the Blue River in wet years, and exclusive reliance on local groundwater in drier years. Imported water would be stored locally, with an average of 19,000 to 26,000 acre-feet per year (AFY) of renewable water delivered to the South Metro area under the various conjunctive use scenarios studied.

Aquifer storage/recovery (ASR) is a potential alternative to surface water terminal storage. Depending on hydrogeologic conditions and other technical and institutional constraints, SMWSA providers could retrofit existing wells or install new wells for injection of surface water into the Denver Basin aquifer. Treated water in the potable distribution system exceeding demands would be directed to ASR, and withdrawals would be used to meet peak demands in excess of available Northern system supplies. The Regional Master Plan is available here.

Metro Roundtable Water Supply Paper (2012)

This paper describes how the Metro Roundtable conducted the Portfolio Tool planning exercise. The outcome of the exercise was the development of the Metro Roundtable's vision for meeting the projected future gap in municipal supply needs which is also described in this paper. The paper can be found here.

The Metro Roundtable prepared companion papers titled "Metro Roundtable Conservation Strategy" and "Selection of a Reuse Factor for the Portfolio Tool Planning Exercise." Together, these papers on filling the supply gap, conservation and reuse explain how the Roundtable performed its Portfolio Tool planning exercise.

Interbasin Compact Committee Letter to Governor Ritter and Governor-Elect Hickenlooper (2010)

This letter was presented to Governor Ritter and Governor-Elect Hickenlooper as a summary report related to the IBCC's discussion and accomplishments over the previous four years (2007-2010) and the proposed work plan for 2011. A "Comprehensive Framework to Meet Water Supply Gap" by the IBCC's New Supply Subcommittee (working document only, not consensus or decision document) is included starting on page 15 of the letter. It can be found here.

South Metro Water Supply Study (2003)

This study was undertaken by a number of partners to investigate water supply alternatives for the South Metro area through the year 2050. Of special interest was whether the Denver Basin Aquifer would meet the demands of the population in 2003, with the expected demands of population growth. Another issue addressed that of "conjunctive use", augmenting wet year flows from the South Platte and Blue River with groundwater. The study is available here.

Item 3 References:

Colorado River Basin Water Supply and Demand Study

This study, released in December of 2012, was a collaborative effort between the Bureau of Reclamation and the seven Colorado River Basin States. The study examined the Colorado River basin as a whole, along with peripheral areas reliant on Colorado River water, such as Denver and Los Angeles. The study evaluates reliability of the Colorado River system to meet increasing demands and outlines potential strategies for dealing with projected imbalances are outlined. The future demands of the system are analyzed under six hypothetical situations, which include varying factors that will affect the system over the next few decades, such as: population growth in the basin states, potential savings from conservation, and economic conditions in the watershed. Under these projected situations, the demand for consumptive uses in the Colorado River system is projected to range between 18.1 and 20.4 MAF by 2060. Four supply scenarios are utilized, taking into account historical hydrology and potential effects of climate change. The study team also reviewed 160 options for dealing with the potential imbalances, submitted by participants and stakeholders.

The study is available here. Actions identified as "Next Steps" in the study have begun with the formation of workgroups composed of experts and stakeholders. One Coordination Team and three Workgroups have been formed, on the matters of: Municipal and Industrial Conservation and Water Reuse; Agricultural Conservation and Water Transfers; and Healthy Flows. More information on the Moving Forward process can be found here.

IBCC Scenario Development

The Basin Roundtables and IBCC have chosen to utilize a scenario planning approach for addressing Colorado's water supply future. Based on the work of the roundtables, the IBCC identified five scenarios that represent a broad range of possible futures, taking into account drivers that will affect the direction of Colorado's water future. These scenarios will be utilized in SWSI 2016 to inform an adaptive management framework. The scenarios are described in greater detail in this draft chapter of Colorado's Water Plan: 5.1: Scenario Planning & Adaptive Water Strategy.

Colorado River Compact (1922)

This interstate compact is considered the cornerstone of the "Law of the River," which is the legal framework under which the Colorado River is operated. Key provisions of the Compact divide the river basin into the Upper and Lower Basins and Divisions and recognize the potential for right of use by Mexico. Of great import to the Upper Division States as it relates to work with the IBCC is Article III(d), which outlines the non-depletion obligation of 75 MAF over a ten-year rolling average. The full text of the Compact can be found here.

Upper Colorado River Basin Compact

The Upper Colorado Basin Compact was signed in 1948 by Arizona, Colorado, New Mexico, Utah, and Wyoming. Subject to the provisions of the 1922 Compact, the Upper Division states, which includes all the Upper Basin States but Arizona, are apportioned a percentage of consumptive use of the Upper Colorado River System. Colorado is apportioned 51.75% of the consumptive use available in the basin per year, less the 50,000 acre-feet (af) apportioned to Arizona. This Compact also establishes the Upper Colorado River Commission as the authority to, among other things, determine the quantity and timing of delivery by Upper Division states in a curtailment situation under the 1922 Compact. The full text of the 1948 Compact can be found here.

Minute 319

In November 2012, representatives from the Colorado River Basin states, the United States government, and the government of Mexico entered into Minute 319, which furthers the commitments of both countries to the 1944 Water Treaty between the U.S. and Mexico, while adapting to the increasing demands and drought conditions on the Colorado River. The Minute is a five-year agreement, under which Mexico committed to accept voluntary shortages when Lake Mead reaches certain levels, while gaining opportunities to receive increased releases under certain conditions. Also included is potential for a one-time environmental flow, which culminated recently in a pulse flow to the Mexican Delta, the opportunity for Mexico to delay delivery of Treaty allocation until subsequent years, and the opportunity for binational investment in Mexico infrastructure for mutual benefit of water users in the United States and Mexico. The full text of the Minute can be found here.

2007 Interim Guidelines

The Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead were signed in 2007, with affirmation and input from the seven Basin States' representatives. These guidelines, effective until 2026, are a collaborative effort to manage the risk of an increasingly variable water supply, while avoiding compact conflicts on the River. Under the guidelines, shortages are imposed upon the Lower Basin when certain elevations occur at Lake Mead, and guidelines for releases for Lake Powell are based on the elevations of the two lakes, as well as other specific criteria. The Guidelines also allow the Lower Basin states to store "Intentionally Created Surplus" and use that water under the terms of certain agreements and the guidelines. More information about the Guidelines, such as the full text and Basin States' affirming documents can be found here.

Endangered Fish PBOs

The programmatic biological opinions (PBOs) for sections of river within the Colorado River system provide specific flow targets for the endangered species of fish within those reaches. Under the Upper Colorado River Endangered Fish Recovery Program, these PBOs are a result of cooperation between federal agencies and other interested parties. More information about the Recovery Program is available here, and the PBOs are available here.

Colorado River Water Availability Study

The Colorado River Water Availability Study (CRWAS) was undertaken by CWCB to evaluate how much water from the Colorado River Basin System is available to meet Colorado's future water needs under alternate hydrologies. CRWAS utilizes many ongoing programs and processes directed by CWCB, in collaboration with other State, federal, and local agencies, as well as the IBCC and the BRTs. Phase I of the Study was released in March 2012, and Phase II is ongoing. More information about CRWAS, such as the final report from Phase I, Board meeting presentations, and the draft scope of work for Phase II can be found here.

Gunnison Basin Risk Assessment Scenario for Portfolio Tool Document (2013)

As quoted in the document, the Gunnison BRT is concerned with the following two points:

1. How do we manage development and use of Colorado River water to prevent a Compact curtailment, while allowing for full development of Colorado's entitlement?
2. If we fail, how do we deal with a Compact curtailment under full development of Colorado's Compact entitlement?

As part of this document the Gunnison BRT laid out two hypothetical examples of triggers, largely based on Colorado River Storage Project (CRSP) reservoir storage and hydrological predictions. These triggers could indicate when to use interruptible water supply agreements (IWSAs) on the East Slope and could reduce the reliance of East Slope water providers on West Slope water.

The document can be found here.

IBCC Report to Governor Ritter & Governor-Elect Hickenlooper (2010)

"Therefore, we are recommending a two-pronged approach. The first would be to put in place an "early warning" system that shuts down, curtails, or offsets new water development supply projects on the Colorado River in advance of a Compact curtailment. The early warning system would be based on hydrologic triggers." The complete IBCC Letter to the Governors can be found here.

WISE Partnership

The WISE (Water Infrastructure Supply Efficiency) Partnership is a regional water supply project between Aurora Water, Denver Water, and the South Metro Water Supply Authority, which seeks to create a sustainable water supply for the South Metro area. This supply will be provided by combining the unused capacity of Aurora's Prairie Waters project with unused water supply from Aurora and Denver. More information on the WISE Partnership is available here and here.

Colorado River Cooperative Agreement

The Colorado River Cooperative Agreement (CRCA) gained signatures of all 18 partners in the fall of 2013. The agreement is the culmination of years of negotiations between Denver Water and West Slope entities, aimed at protection of Colorado River watersheds, while allowing Denver Water to

develop future water supplies. More information about the agreement, parties, and specific provisions is available here.

Item 4 References:

Basin Implementation Plans

Every roundtable is currently engaged in the process of formulating Basin Implementation Plans (BIPs). These Plans, spearheaded by the Basin Roundtables, will establish goals and measurable outcomes for that Basin. Then, with guidance from roundtable members, basin stakeholders, and interested parties, the Plans will set forth projects and methods to meet their water needs. The BIPs are a way for basins to plan their way forward through 2050, with an eye to development and potential future uses. More information about the BIP process and the basin roundtables can be found here.

Identified Projects and Processes (IPPs)

Iterations of SWSI have updated lists of identified projects and processes (IPPs) for each basin, and it is expected that the BIP process will update and inform the IPPs for SWSI 2016. For a definition of a project that meets the requirements of an IPP, click this link. These projects and processes are the basins' means to meet the future needs established and outlined in SWSI and in the BIPs. For more information about IPPs and SWSI, click here.

Colorado Basin Roundtable White Paper

To inform the BIP process, the Colorado Basin Roundtable formulated a white paper to explain and delve into the issue of "Providing for Colorado's statewide and West Slope water needs." This document explains the background of water use in that particular basin, especially with regard to transmountain diversions, and the history of such diversions. The white paper sets forth the Roundtable's vision for the future of the basin with regard to water usage and future needs. Also, the white paper adopts a series of principles, focused on the Executive Order regarding Colorado's Water Plan. The Colorado Basin white paper in available in its entirety here.

Filling the East Slope Municipal Water Supply Gap

Similar to the Colorado River Basin Roundtable, the East Slope roundtables coordinated on a white paper to address a vision for the water supply future of their representative portion of Colorado. "Filling the East Slope Municipal Water Supply Gap" was released in draft form in July of 2013, intended to inform the BIPs of the East Slope roundtables. This paper addresses the various gaps in the basins and also provided a vision for filling the municipal supply gap. This paper provided recommendations for Colorado's Water Plan, addressing conservation, reuse, IPPs, and other ways to address the water supply future of the East Slope. The draft white paper is available here.

Yampa/White/Green Basin Roundtable Paper

The Yampa/White/Green Basin also authored a white paper to explain the issues facing their basin, and propose management solutions that would protect the basin's potential future uses. This white paper was approved by the roundtable in March of 2014 and explains the basin's view on future depletions in the Colorado River basin. The white paper is available here.

West Slope Water Banking

Efforts are ongoing amongst West Slope entities and interested parties regarding the potential for a water banking effort. The concept is spearheaded by the Colorado River Water Conservation District and involves utilizing pre-Compact water rights to meet post-Compact needs in a situation in which curtailment of rights is necessary. The goal of the proposal is to increase certainty for Upper Basin usage and reduce the increasing impacts of drought on existing uses. Outreach meetings are ongoing,

engaging with agricultural users to gage interest in participation, and potential costs and compensation for involvement in the bank. A report entitled "Colorado River Water Bank Feasibility Study" was released in March 2012, and is available here. In May 2013, a grant was approved for further study of the concept; references are here and here.

Risk Management Strategies for the Upper Colorado River Basin (Eric Kuhn, 2012)

Eric Kuhn authored this paper in 2012, explaining the challenges facing the Upper Basin and explains the history of the Colorado River Compact and the Upper Colorado River Basin Compact. The risk of a curtailment is examined, associated with three factors: the non-depletion obligation at Lee Ferry, the level of water use among Upper Basin states, and hydrology. The paper also examines potential Upper Basin strategies to minimize the risk of a curtailment. The paper is available in its entirety here.

Item 5 References:

Basin Implementation Plans

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Colorado River Basin Water Supply and Demand Study

This study, released in December of 2012, was a collaborative effort between the Bureau of Reclamation and the seven Colorado River basin states. The study examined the Colorado River basin as a whole, along with peripheral areas reliant on Colorado River water, such as Denver and Los Angeles. The reliability of the Colorado River system to meet increasing demands is evaluated, and potential strategies for dealing with projected imbalances are outlined. The future demands of the system are analyzed under six hypothetical situations, which include varying factors that will affect the system over the next few decades, such as: population growth in the basin states, potential savings from conservation, and economic conditions in the watershed.
Under these projected situations, the demand for consumptive uses in the Colorado River system is projected to range between 18.1 and 20.4 MAF by 2060. Four supply scenarios are utilized, taking into account historical hydrology and potential effects of climate change. The study team also reviewed 160 options for dealing with the potential imbalances, submitted by participants and stakeholders.

The study is available here. Actions identified as "Next Steps" in the study have begun with the formation of workgroups composed of experts and stakeholders. One Coordination Team and three Workgroups have been formed, on the matters of: Municipal and Industrial Conservation and Water Reuse; Agricultural Conservation and Water Transfers; and Healthy Flows. More information on the Moving Forward process can be found here.

Colorado River Compact Water Development Projection

This report was a product of the "Endangered Fish Flow and Colorado River Compact Water Development Workgroup." The Workgroup was convened by the CWCB in 1995 to estimate and formulate a way to protect the future uses of Colorado's Compact apportionment in the Colorado River Basin. The purpose for this task was to estimate how much water could be appropriated for endangered fish recovery instream flow purposes, without impairing the state's ability to fully develop apportioned water under the Compact. The final report of the Workgroup is available here. The CWCB planned an instream flow appropriation to meet these needs, which was later withdrawn. More information is available here.

Water Supplies of the Colorado River

This report was written in 1965 as a product of the Upper Colorado River Commission. The purpose of the report was to assess the supplies available from the Colorado River for use in the Lower Basin and the sufficiency of those supplies to meet the needs of the Lower Basin under Supreme Court decisions. This report is one of several examples that provide an examination of hydrology and usage in 1965 and determines that the river will not support the usage at that time. The report is available here.

Development Potential in Yampa River Basin

This 1993 memo contemplates the Upper Colorado River Basin Compact and provides points of consideration for development of water in the Yampa River Basin. Included are minutes and engineering reports from the 1948 Compact negotiations, as well as a consideration of proportional distribution of the development of Colorado's Compact entitlement among subbasins. The memo and associated references are available here.

The Yampa Doctrine

The Yampa Doctrine asserts that if the Yampa River is meeting the obligation of 5 million AF over 10 years under Article XIII of the Upper Colorado River Basin Compact, water uses in the Yampa Basin are not subject to curtailment under the Colorado River Compact of 1922. There has been much discussion of this Article at the Yampa/White/Green Basin Roundtable level. A CRWCD memo from 2010 discussing the Yampa Doctrine, with a memo from Tom Sharp outlining the Doctrine itself is available here.

Reconnaissance Level Cost Estimates for Strategy Concepts – Water Related Benefits for West Slope Subbasins

This appendix from SWSI 2010 examines some suggested water-related benefits that could be realized in West Slope basins as a result of a transmountain diversion. These suggestions include additional infrastructure, financial support for ongoing projects, and potential cooperative agreements. The document is available here.

Item 6 References:

Colorado Basin Roundtable White Paper

To inform the BIP process, the Colorado Basin Roundtable formulated a white paper to explain and delve into the issue of "Providing for Colorado's Statewide and West Slope water needs." This document explains the background of water use in that particular basin, especially with regard to transmountain diversions, and the history of such diversions. The white paper sets forth the Roundtable's vision for the future of the basin, with regard to water usage and future needs. Also, the white paper adopts a series of Principles, focused on the Executive Order regarding Colorado's Water Plan. The Colorado Basin white paper in available in its entirety here.

Filling the East Slope Municipal Water Supply Gap

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Metro Roundtable Selection of a Reuse Factor for the Portfolio Tool Planning Exercise

This paper provides background information on municipal water reuse, examples of water reuse by Metro Roundtable member utilities, and describes how the Metro Roundtable's reuse factor was selected for the Portfolio Tool planning exercise. This paper can be found here.

Metro Roundtable Updated Conservation Strategy

The purpose of this memo is to present an estimation of potential future water demand reductions that the Metro Basin Roundtable can reasonably expect by 2050 based on current and future water conservation programs and improved water use efficiencies. In keeping with the Statewide Water Supply Initiative (SWSI) and other state water conservation policy efforts, estimated demand reductions relate to three basic processes or influences on water use:

- Passive saving reductions related to the natural replacement of customer water using fixtures and appliances;
- Other changes in water use behaviors (e.g., state legislation, changes in land use, drought impacts, etc.); and
- Active water conservation program impacts related to implementation of water conservation programs sponsored by water utilities and special districts.

Noteworthy is that current water demand is trending downward due to a combination of these three influences. Similarly, future demand reductions will require that water utilities, nongovernmental organizations (NGOs), water customers, and state and local officials work together to support and ensure that meaningful, permanent water conservation programs are developed and implemented. This shared responsibility for future water conservation does not dismiss the important role of water utilities to act as good stewards of the state's water resources. But the work of managing water in Colorado is not solely the responsibility of our water utilities. It requires the cooperation and collaboration between all members of the water community.

Metro Roundtable Water Supply Paper (2012)

This paper describes how the Metro Roundtable conducted the Portfolio Tool planning exercise. The outcome of the exercise was the development of the Metro Roundtable's vision for meeting the projected future gap in municipal supply needs, which is also described in this paper. The paper can be found here.

The Metro Roundtable prepared companion papers titled "Metro Roundtable Conservation Strategy" and "Selection of a Reuse Factor for the Portfolio Tool Planning Exercise." Together, these papers on filling the supply gap, conservation, and reuse explain how the Roundtable performed its Portfolio Tool planning exercise.

Basin Implementation Plans

Basin Implementation Plans (BIPs) are being prepared in order to support Colorado's Water Plan and will be a fundamental component to its development. Each BIP will focus on strategies to meet roundtables' consumptive and nonconsumptive water supply needs. The Colorado Water for 21st

Century Act established the Basin Roundtables and tasked them to develop a water supply needs assessment, conduct a water supply analysis and propose projects and methods to meet those needs. BIPs will provide a more detailed analysis and be geared towards implementing projects to meet those needs to address the gap in a meaningful way. The BIP effort will be a foundational component of the update to SWSI and provide critical inputs into the Colorado Water Plan. Additional information on BIPs and Colorado's Water Plan can be found here. Draft BIPs will be available in July 2014.

Southwest Basin Roundtable Municipal Water Conservation Goal and Measurable Outcome

In support of the Basin Implementation Planning process the Southwest Basin Roundtable has developed draft municipal water conservation goals and measurable outcomes. A document detailing these goals is available here, and a summary is provided as follows:

- The SWBRT first conservation goal is to 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 50/50 to 60/40 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 west slope to east slope diversion project) shall have a higher standard of conservation. The goal for these water providers is a ratio of 70/30.
- Water providers proposing a new TMD shall achieve a 60/40 ratio by 2020 and 70/30 by 2030 (high conservation) as a prerequisite for the SWBRT to consider support of a new TMD.

Guidebook of Best Practices for Municipal Water Conservation in Colorado (Colorado WaterWise and Aquacraft, Inc., 2010)

From the Introduction

The Colorado WaterWise *Guidebook of Best Practices for Municipal Water Conservation in Colorado* (*Best Practices Guidebook* for short) is a planning tool prepared for the purpose of improving and enhancing water efficiency in Colorado. The *Best Practices Guidebook* offers a detailed description of specific water conservation measures, program elements, regulations, policies, and procedures that can be implemented by Colorado water providers to help ensure reliable and sustainable water supplies for future generations.

Colorado WaterWise envisions that the *Best Practices Guidebook* will be used by water professionals including water providers, local governments, consultants, building managers, design engineers, irrigation professionals, and others throughout the state to help select the most sensible and cost effective water conservation measures and programs. Utilities can use the *Best Practices Guidebook* to help select water conservation programs to include in their conservation plans to be submitted to the Colorado Water Conservation Board (CWCB). Building trade professionals may use the *Best Practices Guidebook* to determine the most sensible water efficiency practices to implement in new construction projects and existing buildings. Others may find the *Best Practices Guidebook* a useful tool to increase water efficiency in their local community.

The *Guidebook of Best Practices for Municipal Water Conservation in Colorado* is an essential companion to the water conservation planning resources developed by the CWCB[1] and can be used by water providers large and small to help select appropriate, cost effective water conservation program measures.

A copy of the *Guidebook* can be found here.

Statewide Water Supply Initiative (SWSI)

The Statewide Water Supply Initiative (SWSI) provides a comprehensive picture of Colorado's water needs, now and in the future. It incorporates and summarizes previously published work by CWCB and the Basin Roundtables. SWSI 2010 was adopted by the Board at its January 2011 meeting and includes the following:

- An analysis of nonconsumptive needs and nonconsumptive projects and methods
- An analysis of consumptive needs, including municipal, industrial, and agricultural water needs –*includes an analysis of passive conservation for municipal and industrial uses.*
- An analysis of water availability in each river basin
- An analysis of municipal and industrial identified projects and processes and a municipal and industrial gap analysis, and
- Strategies to fill the gap. – *includes an analysis of projected future conservation levels*.

Each of these sections is based on previous work which received significant input from the basin roundtables and the public. The SWSI 2010 website can be found here. Previous SWSI reports (i.e. SWSI 1 and SWSI 2) can found here. Information specifically related to municipal and industrial water conservation strategies can in Appendix L and is further described below.

SWSI 2010 Municipal and Industrial Water Conservation Strategies (Appendix L) – CWCB 2011

Municipal water conservation is an important component of Colorado's strategy to provide a safe, secure, and sustainable water supply for future generations. This document represents the latest effort by the Colorado Water Conservation Board (CWCB) to integrate water conservation into overall water supply planning and to estimate the statewide water conservation potential up to the year 2050.

The CWCB defines water conservation as those measures and programs that provide for measurable and verifiable permanent water savings (CWCB 2010b). This is separate and in addition to the temporary savings that may result from short-term drought restrictions and related programs. In support of SWSI, the Interbasin Compact Committee (IBCC), and other water conservation efforts throughout the State, the CWCB has developed several work products that provide technical detail related to water conservation planning. The purpose of this report is to:

- Incorporate recent water conservation-related efforts into the SWSI 2010 update,
- Update the range of potential future water conservation savings, and
- Provide water conservation strategies that may contribute toward meeting the projected 2050 municipal and industrial (M&I) water supply gap and help address Colorado's future M&I water needs.

Water conservation is assumed to be one of several water supply strategies that Colorado will need to rely on to meet future M&I water demands. Meeting Colorado's future water supply needs will require a mix of successful identified plans and processes (IPPs), agricultural transfers, reuse, and new water supply projects. The conservation savings forecasts presented here are intended for statewide planning purposes and are not intended to replace water conservation and water resources planning and projections prepared by local entities. This report estimates potential future water conservation for three distinct strategies, but has not determined the portion of those savings that could potentially be utilized toward meeting a future water supply gap. This reports can be found here.

Fixtures Legislation – SB 14-103 (originally SB14-0677)

The bill concerns the phase-out of the sale of certain low-efficiency plumbing fixture. A copy of the bill can be found here.

As specified in this bill, effective September 1, 2016, a person shall not sell a new low-efficiency plumbing fixture in Colorado.

As defined in the bill,

(1) "Low-efficiency plumbing fixture" means any of the following plumbing fixtures that is not a WaterSense-listed plumbing fixture:
   a. A lavatory faucet;
   b. A shower head;
   c. A flushing urinal; or
   d. A tank-type toilet or tank-type water closet.

(2) "WaterSense-listed plumbing fixture" means a plumbing fixture or plumbing fixture fitting that has been:
   a. Tested by an accredited third-party certifying body or laboratory in accordance with the federal Environmental Protection Agency's WaterSense Program or an analogous successor program;
   b. Certified by the body of laboratory as meeting the performance and efficiency requirements of the program; and
   c. Authorized by the program to use its label.

Filling the Gap Report Series

From Western Resource Advocates website.

Most of the population growth for the next 40 years in Colorado is expected to occur in the South Platte Basin and in the urban counties of the Arkansas Basin. The population in these areas is projected to grow by 70 percent from 2010 to 2050, and this growth will be the main driver for the increase of Colorado's water demand during the next four decades. The State of Colorado has projected that 85 percent of the population of the state (7.7 million Coloradans) will be living in these areas by 2050; and that an additional total water supply of 453,000 acre-feet per year (AFY) (147.6 billion gallons) will be required to meet the water demands of the residents and industries of the South Platte Basin and the urban counties of the Arkansas Basin by 2050.

Western Resource Advocates, Trout Unlimited, and the Colorado Environmental Coalition recognize the importance of preparing for our water future. However, we are concerned that many traditional water supply strategies have resulted in adverse impacts to rivers and streams and their associated environmental, recreational, and economic values. Rather than continuing old patterns, 21st century water development must account for instream flow needs, minimize the adverse environmental impacts of water supply strategies, and even improve stream flows or other environmental conditions on streams that are already depleted. These new challenges require new ways of thinking and new tools.

The Filling the Gap Series provides a proactive approach to meeting the future water needs of Colorado while protecting the state's economy, environment, and exceptional quality of life. Below you may find additional information on the reports of the Filling the Gap Series, including snapshots of their respective water management portfolios, which would more than fill the projected needs for the communities of the South Platte Basin and the urban counties of the Arkansas Basin.

Filling the Gap: Joint Executive Summary
   South Platte and Arkansas Basin Reports (2012)

Filling the Gap (I):
   Commonsense Solutions for Meeting Front Range Water Needs (2011)

Filling the Gap (II):
   Meeting Future Water Needs in the Arkansas Basin (2012)

Currier Memo on SWSI 2010

This memo is authored by John Currier, Chief Engineer at the Colorado River District, and was published in January 2014. The memo details observations made by Mr. Currier related to the most recent Statewide Water Supply Initiative (SWSI 2010). Specifically, Mr. Currier's memo observes that agricultural acreage loss was not calculated properly, conservative assumptions were made in determining the projected 2050 M&I gap, and that assumed reductions in per capita consumption in the South Platte Basin should be reconsidered so as to match those assumed in the Metro Basin. The memo concludes that these three factors, if revised per the memo's recommendations, would show that the need for a new, large transmountain diversion is nonexistent, or at best, remote. This memo can be found here. The CWCB prepared a response to Mr. Currier's memo, which can be found here and is described below.

Response to John Currier's Draft Memorandum Concerning SWSI 2010

This memo was prepared by CWCB in response to the concerns raised by Mr. Currier in his memo, SWSI 2010 Reality Check. The memo details the purpose and intent of SWSI 2010 being a reconnaissance level planning effort. Additionally, the memo goes into technical detail related to Mr. Currier's memo's three main points related to agricultural acreage loss, conservative assumptions made in determining the projected 2050 M&I gap, and the South Platte Basin's per capita consumption assumptions. Ultimately, the memo concludes that Mr. Currier's assumption on historical consumptive use from urbanized irrigated lands is incorrect and this water is not available to reduce the M&I gap. Also, Mr. Currier's reduction of the South Platte Basin per capita use to that of the Metro Basin cannot be assumed due to the differences in water use in the basins. The response memo also reminds the reader that while the success percentage of IPPs is critical to meeting the M&I gap, the outcome of many IPPs is still unknown. As SWSI 2016 and the Basin Implementation Plans (BIPs) are prepared, more information will be revealed on IPPs, and no and low regret strategies including conservation. The M&I gap will be adjusted appropriately. CWCB's intention is to continue in a transparent fashion using and developing the best data available and to partner with the basin roundtables and other stakeholder groups to update SWSI and other technical work as we move forward. Furthermore, CWCB expects and requests timely comment on its technical work and hopes that this memo will serve as an opportunity and reminder that CWCB will work with the Colorado River Water Conservation District to help Colorado be prepared for the future. This memo is available here.

Interbasin Compact Committee Letter to Governor Ritter and Governor-Elect Hickenlooper (2010)

This letter was presented to Governor Ritter and Governor-Elect Hickenlooper as a summary report related to the IBCC's discussion and accomplishments over the previous 4 years (2007-2010) and the proposed work plan for 2011. This letter contains many references to water conservation and reuse with a report from the IBCC's Water Conservation Sub-committee included starting on page 20 of the letter. It can be found here.

Draft No and Low Regrets: Agenda Item 24, September 24-25, 2013 Board Meeting

Based on the dialogue and direction from November 2012, March 2013, and June 2013 IBCC meetings, as well as numerous subcommittee meetings, a draft No and Low Regrets Action Plan has been developed. The No/Low Regrets Action Plan is based on the foundation of the Scenario Planning and Portfolio work conducted by the IBCC and the Basin Roundtables. This work indicates that the many strategies are necessary in preparation for any future scenario. Specifically, for conservation, the IBCC identified the following strategy:

Conservation: Implement strategies to achieve medium levels of conservation and apply half of that to meet the M&I gap.

Adaptive Capacities: Track the reliability of these conservation savings in meeting the gap. If conservation does not prove to be reliable, additional emphasis on other portfolio elements will be required.

The Draft No and Low Regrets can be found here.

Green River Studies in Wyoming

Based on conversation with Pat Tyrrell, Wyoming State Engineer, the following studies are being conducted in the Green River Basin of Wyoming:

- There is a study by Trout Unlimited (TU) and the Natural Resources Conservation Service (NRCS) on the Henry's Fork tributary within the basin on return flows and its impact on salinity control.
- There is a University of Wyoming study in the upper reaches of the Green River attempting to determine the economic benefits of irrigation return flows.
- Jeff Fassett, former State Engineer, is evaluating current statutes, regulations, and policies to determine if they can support demand management activities such as fallowing or deficit irrigation. If not, what additional authorities are needed? This is part of the Upper Colorado River Compact Commission's current discussions on demand management to increase inflow to Lake Powell.

Senate Bill 14-023 Transfer Water Efficiency Savings to Instream Use (SCHWARTZ—BECKER)

Concerning an authorization of the voluntary transfer of water efficiency savings to the CWCB for instream use purposes in water divisions that include lands west of the Continental Divide. This bill was vetoed by the Governor. A copy of the bill can be found here.

From the Bill Summary:

Section 1 of the bill defines "water efficiency savings" as that portion of a water right used solely for agricultural irrigation or stock watering purposes in water division 4, 5, 6, or 7 that is nonconsumptive under existing practices and that results from efficiency measures, determined as the difference between:

1. The lesser of the decreed diversion amount and the maximum amount that had been historically diverted using the existing facilities for a beneficial use under reasonably efficient practices to accomplish without waste the purpose for which the appropriation was lawfully made; and
2. The diverted amount needed to meet the decreed beneficial use after increased efficiency in the means of diversion, conveyance, storage, application, or use.

Section 2 allows water efficiency savings to be changed or loaned, pursuant to existing water court and water loan statutes, only to the CWCB, only for instream use, and only if:

1. The application was filed within 2 years after the diversions were decreased due to efficiency measures;
2. The change or loan will not materially injure decreed water rights; and
3. The change or loan will not adversely affect Colorado's interstate compact entitlements or obligations.

The change decree or loan approval must identify the amount of water efficiency savings and the stream reaches within which water efficiency savings, as changed or loaned, will be used. Water efficiency savings that have been changed or loaned are not subject to abandonment. The parties who enter into a change or loan of water efficiency savings may provide conditions by which the original decreed diversion rate may be preserved for a future use by the water right owner who implements the efficiency measures if use of the efficiency measures is discontinued.

Colorado Demonstration Zero Liquid Discharge Processes for Drinking Water Systems (Colorado State Grant No. C150456)

Study funded in part by CWCB Water Supply Reserve Account (WSRA) grants through the Arkansas and Metro Basin Roundtables and also interested utilities. In progress, anticipated to be published in June 2014.

From the Final Report Abstract:

Utilities within Colorado and throughout the western United States have been reluctant to build reverse osmosis plants due to the uncertainty surrounding the disposal of membrane concentrate (brine). Concentrate minimization and zero liquid discharge (ZLD) technologies can provide a means to solve the concentrate management problem. The purpose of this project was to pilot test concentrate minimization and ZLD techniques suitable for use in Colorado.

A new technology, Zero Discharge Desalination (ZDD), was selected for pilot testing. The ZDD technology is an integrated system combining electrodialysis metathesis with nanofiltration. The ZDD technology was pilot tested at two drinking water membrane plants in Colorado. The first pilot test obtained 96 percent recovery when treating brackish groundwater to levels suitable for human consumption. The second pilot test simulated increasing the recovery an existing membrane plant to 98 percent by treating its concentrate stream.

The ZDD technology did not obtain zero discharge as the name implies, but it demonstrated the ability to produce excellent water quality and obtain high recovery. The ZDD technology shows great potential, but further development of the technology to reduce cost, increase reliability, and simplify its operation is needed before the process is suitable for use in Colorado.

Rotary Sprinkler Nozzle Retrofit – Douglas County Water Resources Authority (WSRA Grant Completed Dec. 2013)

Retrofit of existing spray heads with rotary sprinkler nozzles could reduce water used in the project area by 15 percent, or approximately 6,305 AFY. High school students will be hired to perform the actual 1,000 retrofits as part of a summer jobs program in the Memorial Day to Labor Day timeframe over the summer of 2011. Not only will the rotary sprinkler nozzles be retrofitted, but they will also be aimed to avoid over-spraying and watering sidewalks. Irrigation controllers will be reset to reflect the proper application rates of the rotary sprinkler nozzles. WSRA funding will be used to purchase rotary sprinkler nozzles, pay high school students to perform retrofits, pay adults to schedule the retrofits and supervise the work of the high school students, collection of impact metrics, administrative oversight of the program, and public outreach to create excitement throughout the region for the retrofit program, and encourage widespread adoption over time of rotary sprinkler nozzles in the project area. A copy of the report can be found here.

Colorado Review: Water Management and Land Use Planning Integration – CWCB 2010

Adequate supplies of fresh water will be the number one resource scarcity issue of the 21st Century, globally and here at "home" in the western United States. To meet our consumptive and nonconsumptive water needs, both demand side and supply side strategies will be needed (CWCB 2009b). The integration of land use planning and water supply planning is, therefore, a key component of managing our society's future demand for water.

Colorado and the West have integrated land use and water supply in many areas and arenas. This is especially the case with ensuring adequate water supplies for new developments. The focus of this report, however, is on the water demand management components of land use planning and practices. Demand management is a broad strategy for meeting the water requirements of Colorado's growing population by reducing the water needed to sustain each household and person. Ways to reduce future

demand include building denser communities, infilling existing urban environments, following low impact development standards, and using water wisely. Many of these demand management strategies have a land use component that will be explored herein.

Understanding what has already been accomplished, where we might go, and how we can continue to move forward is the purpose of the report. The report does not set the course but rather sets the stage for communities, planners, and policymakers to move forward armed with information about policies, statutes, and strategies that exist in Colorado and the West. A copy of the report can be found here.

Calculating Per Capita Water Demand Savings from Density Increases to Residential Housing for Portfolio and Trade-off Tool – 2010 CWCB, CDM Smith

Increases in population density are inversely correlated with water use in gallons per capita per day (gpcd). Assuming that for single family homes 50 percent of the water is used indoors and 50 percent outdoors, water savings can be estimated with each increment of density increase. The general rule implies that a 20 percent increase in density would yield a 10 percent per capita water savings. Although significant savings can result from changes in density, these changes are usually outside of the control of water providers. CWCB proposes calculating water savings from available density data. This methodology was applied to the Denver Metro Area based off the Denver Regional Council of Government's (DRCOG) Metro Vision 2035, which predicts a 10 percent increase in density by 2035. The above methodology then indicates that a total savings of approximately 5 percent would result for current and existing uses. Applying this level of savings solely to the new population results in a savings off new demand of just over 10 percent for the Metro area. The portfolio tool now has the capacity to incorporate density data as available on a county by county basis, using this methodology. A copy of this report can be found here.

Colorado River Cooperative Agreement

The Colorado River Cooperative Agreement (CRCA) is the product of 5 years of mediated negotiations. The negotiations were triggered by several events. In 2003, Denver Water initiated the National Environmental Policy Act (NEPA) process with the U.S. Army Corps of Engineers to enlarge Gross Reservoir. In 2006, Denver Water filed a diligence application in federal court regarding some of its water rights under the Blue River Decree. These filings created the potential for significant litigation and political dispute between Colorado's East and West Slopes. In 2006, several West Slope entities met with then-Mayor Hickenlooper, who suggested that resolution of longstanding disputes over water would require the services of a mediator. John Bickerman began serving as the mediator for the negotiations in February 2007. The proposed agreement goes well beyond these triggering events, however. Its geographic scope is from the Front Range, across the Continental Divide, to the western state line. It directly involves 43 parties that are either signing the agreement or receiving benefits. The CRCA can found here.

The proposed agreement begins a long-term partnership between Denver Water and the West Slope. The agreement outlines many benefits and provisions; however, only those related specifically to conservations are presented below and were reproduced here from the CRCA 6-page summary.

Benefits to Colorado

- Reinforces the priority and increases the amount of conservation and reuse within Denver Water's service area.

Summary of Provisions

- Denver Water will complete construction of its 17,500 AFY recycled treatment plant and 30,000 acre-feet (AF) of gravel pit storage and will maximize exchanges. Denver Water will implement its existing water conservation plan to achieve 29,000 AF of savings.

- Denver Water will develop an additional 10,000 AFY of water supply through conservation or reuse.

Mutual Commitments

- The parties commit to promote best management practices for water conservation.

Windy Gap Firming Project – Reuse

Windy Gap Firming Project: Purpose and Need Report. Prepared for U.S. Bureau of Reclamation (September 2005).
A copy of this report can be found here.

From Section 6.0 Sources of Supply:

Under Colorado water law, transbasin imports such as Windy Gap water can be used to extinction, thus allowing this water to be captured and reused multiple times. Many of the Windy Gap Firming Project participants reuse or are planning to reuse available water supplies to minimize the acquisition of new supplies.

Water reuse may include either the capture and treatment of effluent for direct reuse or the use of an effluent supply to meet return flow obligations or augmentation requirements. Direct reuse typically involves diversion from the wastewater treatment plant and conveyance to storage or distribution as nonpotable reuse for irrigation of parks, golf courses, and landscaping. Water reuse allows a portion of outdoor water uses to be met without using raw water treated to drinking water standards (potable water). Several Project Participants, including Broomfield, Louisville, and Superior, have developed water reuse treatment facilities, including conveyance and storage. The Platte River Power Authority relies on reuse water to meet the cooling needs of the Rawhide Energy Station. Because consumptive use is less in the winter, reusable water is often captured and stored for summer irrigation. None of the Project Participants reclaim water for potable uses. For some Participants, effluent is reused to meet downstream augmentation or return flow obligations. Reuse for these purposes does not directly affect nonpotable demands identified for a Participant, but it helps meet other legal or contractual needs for the Participant.

Colorado Ag Water Alliance

Meeting Colorado's Future Water Supply Needs: Opportunities and Challenges Associated with Potential Agricultural Water Conservation Measures (September 2008).
A copy of the report can be found here.

From the Executive Summary:

The Colorado Agricultural Water Alliance is an association of agricultural organizations committed to the preservation of irrigated agriculture through the wise use of Colorado's water resources. Agriculture in Colorado currently owns and manages the majority of the state's water rights, putting this water to beneficial use for the production of the state's food, feed, fiber, and bioenergy crops. There is a public perception that agricultural water conservation measures such as canal lining and conversion to sprinklers can easily provide additional water supplies to meet growing demands for urban, industrial, recreation, and environmental water needs in Colorado. To address these perceptions, an analysis of the current scientific literature and the administrative precedents in Colorado was undertaken to identify the opportunities and challenges associated with irrigation water conservation.

Specifically, this document attempts to address the following questions:

- Can "agricultural water conservation" result in transferable yield for new uses?
- Does increasing irrigation efficiency result in transferable yield for new uses?
- Does increasing irrigation efficiency and other conservation practices benefit existing uses?

This document is not a legal brief; it is intended to help foster dialog and a greater understanding of the challenges facing irrigated agriculture in Colorado.

Water Infrastructure Supply Efficiency

The Water Infrastructure Supply Efficiency (WISE) Partnership is one of the first of its kind in the country and will bolster water supplies to the South Metro area while maximizing the use of existing water assets belonging to Aurora and Denver Water. Through WISE, Aurora Water and Denver Water will provide fully treated water to South Metro for distribution to participating members on a permanent basis (initial phase – 7,000 AFY). WISE will also provide a new back-up drought supply for Denver and offset costs and stabilize water rates for Aurora. Additional information on WISE can be found here.

Item 7 References

CWCB Instream Flow Program

Per Colorado water law, the CWCB is the sole entity that can hold instream flow water rights. These rights are nonconsumptive, in-channel or in-lake uses of water for minimum flows between specific points on a stream or levels in natural lakes. These rights are administered within the state's water right priority system to preserve or improve the natural environment to a reasonable degree. For more information about the state's Instream Flow Program, and for current and completed appropriations, click here.

Nonconsumptive Toolbox

The Nonconsumptive Toolbox was created by the CWCB to support efforts of the basin roundtables and other stakeholders to develop projects and methods to meet nonconsumptive needs, via two objectives. First, to serve as a guide for BRTs as they develop their BIPs. Also, the toolbox serves as a clearinghouse for data and information generated in Phases I and II of the nonconsumptive needs assessment process, by compiling the work of the roundtables in one place. The Nonconsumptive Needs Toolbox, with appendices, is available here.

Programmatic Biological Opinions

The programmatic biological opinions (PBOs) for sections of river within the Colorado River system provide specific flow targets for the endangered species of fish within those reaches. Under the Upper Colorado River Endangered Fish Recovery Program, these PBOs are a result of cooperation between federal agencies and other interested parties. More information about the Recovery Program is available here, and the PBOs are available here.

Colorado River Basin Water Supply and Demand Study

This study, released in December of 2012, was a collaborative effort between the Bureau of Reclamation and the seven Colorado River basin states. The study examined the Colorado River basin as a whole, along with peripheral areas reliant on Colorado River water, such as Denver and Los Angeles. The reliability of the Colorado River system to meet increasing demands is evaluated and potential strategies for dealing with projected imbalances are outlined. As a metric in the Basin Study, boating flows were used as a recreational indicator to assess the potential vulnerabilities of recreational attributes under different scenarios. The study is available here.

Stream-flow Evaluations for Whitewater Boating

In October 2013, American Whitewater released this report, summarizing the results of a Gunnison River Flow Survey conducted the previous summer. The survey asked respondents to identify

"minimum, acceptable, and optimal" flows for boating and to identify the difficulty of reaches. The report seeks to define the range of flow needs on seventeen sections of the river. The Gunnison Basin will be incorporating some data from this study into their Basin Implementation Plan. The full report is available here.

Watershed Flow Evaluation Tool: Yampa/White and Colorado Basins

The WFET is a newly developed approach that is being tested and evaluated. It is a desktop tool that uses existing information to provide a regional framework for examining the risk of ecological change related to stream flow alteration at a watershed or regional level. The WFET helps basin stakeholders assess the vulnerability of nonconsumptive attributes by associating the risk of ecological response with potential flow regime changes. The three major steps in the development of the WFET are: 1) use existing data and expert opinion to develop flow-ecology relationships by stream type, 2) develop a hydrologic foundation of daily natural and altered flows, and 3) combine flow-ecology relationships and the hydrologic foundation to assign risk status for specific attributes across entire watersheds at a reach or subbasin scale. Thus far, the Colorado and Yampa/White Basin Roundtables have developed the WFET. The Colorado WFET is available here, and the Yampa here.

Colorado Parks and Wildlife Planning

Colorado's Wildlife Action Plan and the Colorado Recovery and Conservation Plans are designed to take a strategic habitat conservation approach using an adaptive resource management framework composed of five key elements: biological planning, conservation design, conservation delivery, decision-based monitoring, and assumption-driven research. This approach establishes specific, measurable objectives and uses models relating populations to limiting factors to target management and assess its impacts. A "taxonomy of actions" was developed for species and for habitats to summarize this information in a consistent format. Conservation actions for species and key habitats were prioritized on a scale of high, medium, or low, based on expert input, existing recovery/ management plans, and staff experience/expertise (CWCS 2006). The process is designed to be iterative and focused on developing and refining a conservation strategy, making efficient management decisions, and using research and monitoring to assess accomplishments and inform future iterations of the conservation strategy. The Action Plan is not an Endangered Species Recovery Plan, nor is it a type of regulatory or "decision" document. Its purpose is to identify the state's wildlife conservation needs in order to foster greater consistency in conservation efforts among all members of Colorado's wildlife conservation community and others with a stake in Colorado wildlife conservation.

The CPW's Conservation and Recovery Plans target specific species and includes an extensive list of amphibians, birds, fish, and mammals. One example, the Greenback Cutthroat Trout Recovery Plan, established two central measurable outcomes. The first was to simply maintain existing populations of greenback trout populations. The second was more quantitative, setting out to restore the greenback cutthroat trout to non-threatened status within its native range and delist the species by the year 2000. These goals can be accomplished by maintaining at least 20 stable greenback populations occupying at least 50 hectares (124 acres) of lakes and ponds and 50 kilometers (31 miles) of streams. These measurable outcomes exemplify the quantitative targets that guide restoration and planning practices in the Conservation and Recovery Plans.

The Range-wide Conservation Agreement and Strategy is a collaborative effort across multiple states signed in 2006 to maintain roundtail chub (Gila robusta), bluehead sucker (Catostomus discobolus), and flannelmouth sucker (Catostomus latipinnis) populations to a degree sufficient to ensure persistence of each species within their ranges. The process established measurable criteria to evaluate the number of populations and individuals within each population required to maintain the three species throughout their respective ranges. These approaches or others can be used by

stakeholders to set goals for meeting nonconsumptive needs and to build long-term implementation plans that identify projects at the local scale while maintaining and integrating those projects into basinwide and statewide objectives.

Wildlife Mitigation Agreements

Colorado Parks and Wildlife worked with several energy companies to form wildlife mitigation agreements, which will protect over 354,000 acres on Colorado's Western Slope. Under these agreements, the companies will consult with CPW on how to prevent or mitigate impacts from resource extraction. This close relationship will protect wildlife habitat while allowing the companies a more assured planning process. More information about the Wildlife Mitigation Agreements is available here.

NEPA Documentation on Ongoing Processes

NEPA documentation is available on several processes throughout the state, assessing the impact that they may have on the environment. More information on the Moffat Collection System Project, including the Mitigation and Enhancement Coordination Plan, is available here. EIS documentation and other permits and supporting documentation on the Windy Gap Firming Project are available here. More information on the Chatfield Reservoir Storage Reallocation Study, including EIS documentation, is available here. Further information about the Arkansas Valley Conduit is available here.

Arkansas Voluntary Flow Management Program

The Upper Arkansas River benefits from a Voluntary Flow Management Program, a unique arrangement between state and federal agencies, non-profits, water management organizations, and rafting organizations. This voluntary program provides for increased recreational flow on the river, as well as serving as beneficial flow for wildlife. More information about the VFM is available here on a local rafting organization's homepage, and more information about the Upper Arkansas Headwaters area is available here on CPW's website.

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COLORADO'S WATER PLAN

coloradowaterplan.com
cowaterplan@state.co.us
Direct: 303-866-3441

Appendix E

Organizations the CWCB met with while developing the 2014 first draft and the 2015 second draft of Colorado's Water Plan

1. Accelerate Colorado
2. Action 22
3. American Council of Engineering Companies of Colorado
4. American Ground Water Trust
5. American Water Resources Association
6. American Whitewater
7. Arkansas River Compact Administration
8. Arkansas Valley Ditch Association
9. Arkansas Valley Farm/Ranch/Water Symposium and Trade Show
10. Association of Home Builders
11. Audubon Rockies
12. Boulder County Agriculture Forum 2015
13. Cavanaugh & Associates, P.A.
14. Center for a Sustainable WE2ST
15. Center for ReSource Conservation
16. CH2M
17. City of Aurora Youth Water Festival
18. City of Boulder Youth Water Festival
19. City of Greeley
20. City of Greeley Youth Water Festival
21. Clinton Global Initiative
22. Club 20
23. CoBank
24. Collins Cockrel & Cole
25. Colorado Agriculture Water Alliance
26. Colorado Association of Realtors
27. Colorado Bar Association
28. Colorado Business Roundtable
29. Colorado Cattlemen's Association
30. Colorado Cleantech Industry Association
31. Colorado Competitive Council
32. Colorado Counties Inc
33. Colorado Department of Local Affairs
34. Colorado Department of Public Health and Environment
35. Colorado Division of Water Resources
36. Colorado Energy Office
37. Colorado Forum
38. Colorado Foundation for Water Education
39. Colorado General Assembly, Joint Agriculture Committee
40. Colorado General Assembly, Water Resource Review Committee
41. Colorado Groundwater Association
42. Colorado Groundwater Commission
43. Colorado Mesa University
44. Colorado Municipal League
45. Colorado Natural Resource Group
46. Colorado Oil & Gas Association
47. Colorado Parks and Wildlife Commission
48. Colorado Public Radio
49. Colorado River Outfitters Association
50. Colorado River Water Conservation District
51. Colorado Rural Electric Association
52. Colorado School of Mines, Division of Economics & Business
53. Colorado Springs Utilities Leadership Team
54. Colorado Springs Utilities Water System Tour
55. Colorado State Fair
56. Colorado State University - Osher Lifelong Learning Institute
57. Colorado Water Congress
58. Colorado Water Institute
59. Colorado Water Quality Forum
60. Colorado Water Trust
61. Colorado Water Utility Council
62. Colorado Watershed Assembly
63. Conservation Colorado
64. Consolidated Mutual Water Company
65. Continuing Legal Education
66. Denver Inter-Neighborhood Cooperation
67. Denver Metro Chamber Leadership Foundation
68. Denver Metro Chamber of Commerce
69. Denver Metro Chamber Public Affairs Council
70. Denver Metro Youth Water Festival
71. Denver Museum of Nature and Science
72. Denver Post

73. Denver South Economic Development
74. Denver Water Citizens Advisory Committee
75. Ditch and Reservoir Company Alliance
76. Eagle River Water & Sanitation District
77. Earth Resources Institute
78. Environmental Defense Fund
79. Environmental Entrepreneurs
80. Faegre Baker Daniels
81. Family Farm Alliance
82. Farm Bureau
83. Fort Morgan Reservoir and Irrigation Company Board of Directors
84. Four States Irrigation Council
85. Front Range Water Council
86. Future Farmers of America
87. Garden Club of Denver
88. Garfield County Board of County Commissioners
89. Gates Family Foundation
90. Getches-Wilkinson Center for Natural Resources, Energy, and the Environment
91. Google
92. Hill & Robbins P.C.
93. Hydro Advisors, LLC
94. Lewis Roca Rothgerber LLP
95. Lower Arkansas Conservancy District
96. Metro Denver Economic Development Corporation
97. Metro Mayors Caucus
98. Metropolitan State University of Denver
99. Molson Coors
100. National Audubon Society
101. National Public Radio
102. National Renewable Energy Laboratory
103. National Young Farmers Coalition
104. Northern Colorado Economic Alliance
105. Northern Colorado Water Conservancy District
106. Northwest Colorado Council of Governments Water Quality/ Water Quantity Committee
107. Nuestro Rio
108. Open Water Foundation
109. Pikes Peak Water Authority
110. Protect the Flows
111. Pueblo Chamber of Commerce
112. Red Rocks Community College
113. Renew Strategies LLC
114. Rio Blanco Water Conservancy District
115. Rocky Mountain Farmers Union
116. Rotary Club - Westminster
117. Sierra Club Rocky Mountain Chapter
118. South Metro Denver Chamber
119. South Metro Water Supply Authority
120. Southeastern Colorado Water Conservancy District
121. Southern Colorado Business Partnership
122. Southwest Colorado Water Conservation District
123. Southwest Ute Tribal Council
124. Stanford University
125. Statewide Basin Roundtable Summit
126. Sustaining Colorado's Watersheds Conference
127. The Aspen Institute
128. The Keystone Center
129. The Nature Conservancy
130. The Rocky Mountain Climate Organization
131. Trout Unlimited
132. U.S. Army Corps of Engineers
133. U.S. Department of Agriculture, Forest Service
134. U.S. Department of the Interior, Bureau of Land Management
135. U.S. Department of the Interior, Bureau of Reclamation
136. U.S. Environmental Protection Agency
137. U.S. Geological Survey
138. University of Colorado - Denver, Business School
139. University of Colorado - Denver, College of Architecture and Planning

140. University of Colorado - Denver, School of Public Affairs
141. University of Denver, Josef Korbel School of International Studies
142. University of Denver, Sturm College of Law
143. University of Wyoming College of Law
144. Upper Eagle Regional Water Authority
145. Ute Mountain Ute Tribe
146. Ute Water Conservancy District Kid's Water Festival
147. Water Availability Task Force
148. Western Governor's Association
149. Western Resource Advocates
150. Western Slope Caucus
151. Western State Colorado University – Colorado Water Workshop
152. Western States' Water Council
153. Xcel Energy