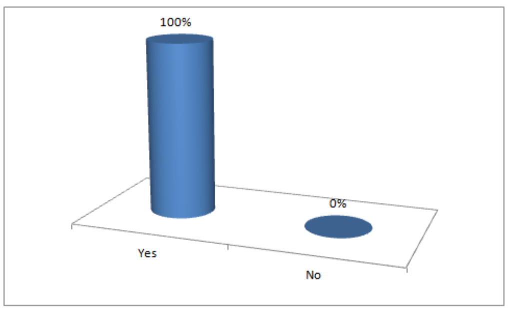
Greetings,

We are pleased to present to you the Draft South Platte Basin Implementation Plan.

This Draft Plan is a product of countless hours by the members of South Platte Basin and Metro Roundtables, its committees, and consulting teams. These efforts started in 2005 with the creation of the Roundtables pursuant to the *Colorado Water for the 21st Century Act*, and were re-energized by the Governor's May 2013 Executive Order to create Colorado's Water Plan. The individuals that participated in crafting this plan collectively represent diverse water interests including: environmental, water conservation, recreation, agriculture, industry, water suppliers, watershed groups, cities, counties, and water conservancy districts. Significant public input was received in person at one of the many public meetings, online through the Basin Implementation Plan website, and from emails to the Colorado Water Conservation Board.

The diversity of the South Platte Basin is what makes it home for the majority of Colorado's population, the State's strongest economic basin, its top agricultural producing basin, and a gateway to valued recreational opportunities and a cherished environment. This diversity is also what makes a holistic "basin" plan a tremendous challenge, and is why we are encouraging you to review the Draft Plan and once again provide your input.



All members of the South Platte Basin and Metro Roundtables unanimously voted "to submit this plan to the Colorado Water Conservation Board on July 31, 2014 for inclusion in the draft Colorado's Water Plan and for further public, stakeholder and Roundtable comment after July 31, 2014."

The South Platte Basin Implementation Plan is drafted using sound facts and grounded expertise. The members of the South Platte Basin and Metro Roundtables are confident that this Draft Plan presents solutions that are pragmatic, balanced, and consistent with Colorado law and property rights. However, it cannot be stressed enough that there is still much work that needs to be done to provide for the water needs of the South Platte Basin and the State as a whole. Although this Draft Plan provides solutions for meeting the South Platte Basin's future water supply needs, it is important to note that the Basin will purposefully continue to maintain a leadership role in efficient use and management of water.

Thank you for your interest in water and taking the time to review the details of this Draft Plan. The Roundtables will continue to work on the Draft Plan through April 2015, when a Final Basin Implementation Plan will be submitted to the Colorado Water Conservation Board.

We look forward to hearing your feedback and encourage you to attend the soon-to-be-scheduled public meetings, including the monthly Roundtable meetings. You will be able to find information on the public meetings, as well as provide feedback online, at www.southplattebasin.com or www.coloradowaterplan.com

Sincerely,

Sean T. Cronin
Chair, South Platte Basin Roundtable

Mark Koleber
Chair, Metro Roundtable

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Draft
South Platte Basin Implementation Plan

Metro Basin Roundtable

South Platte Basin Roundtable

July 31,
2014

HDR

West Sage
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July 31, 2014

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Dear Mr. Hecox, Mr. Kernohan, Mr. Koleber, Mr. Cronin, Mr. Streeter, and Members of the South Platte and Metro Roundtables:

On behalf of HDR Engineering and West Sage Water Consultants, we are pleased to provide you with the attached Draft South Platte Basin Implementation Plan (SP-BIP). The Draft SP-BIP was prepared under two separate contracts with project sponsors acting for the State of Colorado. HDR's work related to consumptive water uses was performed under contract to the South Metro Water Supply Authority and the West Sage Team's work on environmental and recreational water needs was performed under contract to Duck's Unlimited. The Draft SP-BIP was reviewed and approved by the Metro and South Platte Basin Roundtables at their joint meeting on July 14, 2014 for submission to the State of Colorado as part of the development of Colorado's Water Plan.

The Draft SP-BIP is the South Platte Basin's first step in a two-year effort towards creation of the Colorado's Water Plan. Following the submission of the Draft SP-BIP to the State, a second and final version of the report will be developed for submission in April 2015. This version will incorporate additional public input, supplementary technical assessments and Roundtable direction. In December 2015, the Final Colorado's Water Plan will be issued by the Colorado Water Conservation Board.

HDR and West Sage thank you for the opportunity to develop this draft plan and acknowledge that it would not have been possible without the generous commitment of time from each of you and also the continuous support of the South Platte's Rio Chato Committee, the Metro's Executive Committee, the Environmental and Recreational Subcommittee, and the entire South Platte and Metro Basin Roundtables. We also greatly appreciate the support of the State's team, especially John Stulp, Rebecca Mitchell, Jacob Bornstein, and Craig Godbout.

We look forward to your feedback on the DRAFT SP-BIP. Thank you for selecting HDR and West Sage for this timely and important project. We look forward to continuing our support you on the SP-BIP going forward.

Best Regards,

Blaine Dwyer, PE
Vice President
HDR Engineering

Laurel Stadjuhar, PE
Principal
West Sage Water Consultants

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Acknowledgements

This Draft South Platte Basin Implementation Plan (SP-BIP) could not have been developed over the past six months without the involvement and guidance of many individuals, committees and organizations with deep commitments to comprehensive water management in the South Platte and Republican River Basins. HDR Engineering and the West Sage Team are very grateful for the generous support provided to us. First, thank you to the South Platte and Metro Roundtables for entrusting the important work of developing this plan to us. Second, we especially appreciate the direction of the two committees (Metro's Executive Committee and the South Platte's Rio Chato Committee) who were assigned by the Roundtables to do the "heavy lifting" during the development, writing and editing of this Draft SP-BIP. The dedication and support of the people comprising this joint committee brought many important and diverse viewpoints to the Draft SP-BIP. In particular, we thank those individuals who routinely took time each week to coordinate with our teams to shape the approach, technical information, and tone presented in this Draft SP-BIP. We also owe significant thanks to the Environmental and Recreational Subcommittee, supporting West Sage in the development of the environmental and recreational portions of the Draft SP-BIP. The balance and thoughtful advice of the subcommittee members brought important perspectives into the report and helped to provide a well-rounded document. Please see the membership lists for these groups below

The Draft SP-BIP builds on a great deal of previous work prepared by the State of Colorado. We are very appreciative of the support provided to us by John Stulp, special water policy advisor to Colorado Governor John Hickenlooper, to the staff of the Colorado Water Conservation Board, especially Rebecca Mitchell, Jacob Bornstein and Craig Godbout and to the State's consulting team on the Statewide Water Supply Investigation, led by CDM-Smith.

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List of Acronyms

AF	Acre-feet
AFY	Acre-feet per year
ASR	Aquifer Storage and Recovery
ATMs	Alternative Transfer Methods
AWWA	American Water Works Association
BIP	Basin Implementation Plan
BMP	Best Management Practices
BRTs	Basin Roundtables
CAWS	Collaborative Approach to Water Supply Permit Evaluation
CBEF	Center for Business and Economic Forecasting
C-BT	Colorado Big Thompson
CCGA	Colorado Corn Growers Association
CDPHE	Colorado Department of Public Health and Environment
CDSS	Colorado Decision Support System
CDWR	Colorado Division of Water resources
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
CGWC	Colorado Ground Water Commission
Corps	United States Army Corps of Engineers
CRCA	Colorado River Cooperative Agreement
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Resource Program
CRSPA	Colorado River Storage Project Act
CRWAS	Colorado River Water Availability Study
CSA	Combined Service Area
CU	Consumptive Use
CU&L	Consumptive uses and Losses
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board
CWP	Colorado Water Plan
CWRPDA	Colorado Water Resources and Power Development Authority
DBA	Denver Basin Aquifer
DCWRA	Douglas County Water Resource Authority
DNR	Colorado Department of Natural Resources
DPR	Direct Potable Reuse
ECCV	East Cherry Creek Valley
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentive Program
ERMOU	Eagle River Memorandum of Understanding
ESA	Endangered Species Act
FRICO	Farmers Reservoir & Irrigation Company

FSA	Farm Service Agency
G&MOs	Goals and Measureable Outcomes
GIS	Geographic Information System
gpcd	gallons per capita per day
GW	Groundwater
GWMD	Ground Water Management Districts
HB	House Bill
IBCC	Interbasin Compact Committee
IPP	Identified Projects and Processes
IPR	Indirect Potable Reuse
ISA	Interruptible Service Agreement
ISF	Instream flow
IWR	Irrigation Water Requirement
LEDPA	Least Environmentally Damaging Practicable Alternative
LIRF	Lawn Irrigation Return Flows
M&I	Municipal and Industrial
MO	Measurable Outcome
MOA	Memorandum of Agreement
MODFLOW	Modular Finite-difference groundwater flow computer program
MPB	Mountain Pine Beetles
NAWQA	National Water Quality Assessment Program
NC	Nonconsumptive
NCNA	Nonconsumptive Needs Assessments
NEPA	National Environmental Policy Act
NGOs	Non-governmental organizations
NISP	Northern Integrated Supply Project
Northern Water	Northern Colorado Water Conservancy District
NPIC	North Poudre Irrigation Company
PACSM	Platte and Colorado Simulation Model
PEPO	Public Education, Participation, and Outreach
POR	Period of Record
PPCD	Pharmaceuticals and Personal Care Products
PRRIP	Platte River Recovery Implementation Program
RICD	Recreational in-channel Diversions
RO	Reverse Osmosis
ROD	Record of Decision
RRWCD	Republican River Water Conservation District
SB	Senate Bill
SDO	State Demographer's Office
SMWSA	South Metro Water Supply Authority
SP - BIP	South Platte Basin Implementation Program
SPDSS	South Platte Decision Support System
SRGAP	Southwest regional Gap Analysis Project
SSI	Self Supplied Industrial
SW	Surface Water

SWP	Surveyed Water Providers
SWSI	Statewide Water Supply Initiative
TDS	Total Dissolved Solids
TMD	Transmountain Diversion
USDA	United States Department of Agriculture
USGS	United States Geological Study
WEF	Water Environment Foundation
WERF	Water Environment Research Foundation
WISE	Water Infrastructure and Supply Efficiency
WQCD	Water Quality Control Division
WSL	Water Supply Limited
WSRA	Water Supply Reserve Account
WSSC	Water Supply Storage Company
ZLD	Zero Liquid Discharge

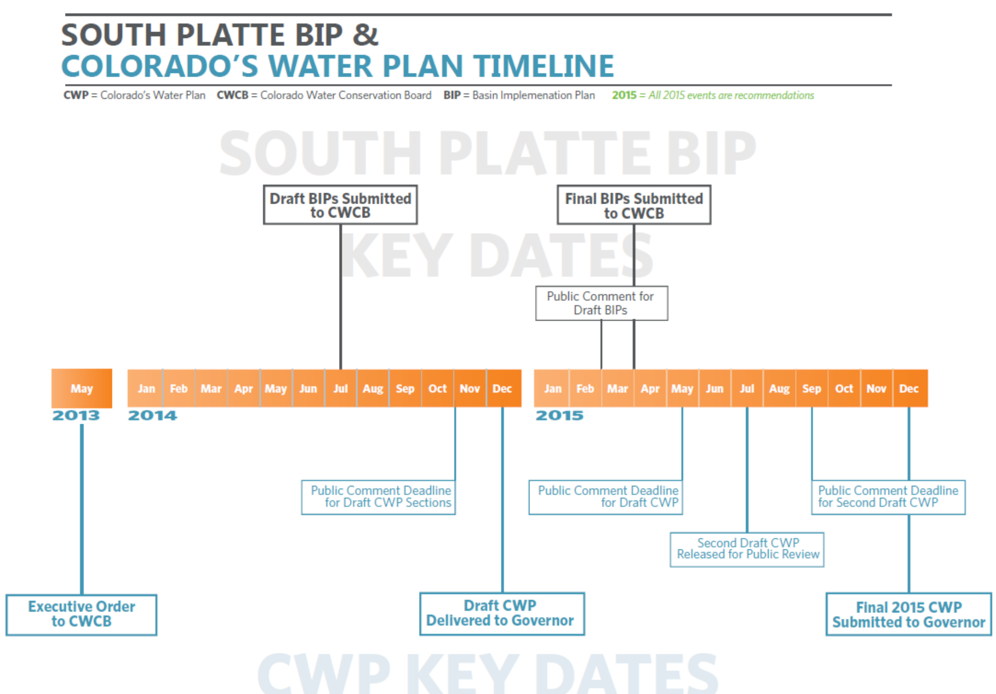
Foreword

At the request of Governor John Hickenlooper, the State of Colorado has begun to develop “Colorado’s Water Plan”. As part of the plan, “Roundtables” across the state are developing Basin Implementation Plans (BIPs) which will be incorporated in Colorado’s Water Plan as appendices. Colorado’s Water Plan is intended to set a course for water planning on a statewide level in Colorado, utilizing a grassroots approach that incorporates local knowledge from each river basin. It is the hope of the South Platte and the Metro Basin Roundtables that the South Platte Basin Implementation Plan (SP-BIP) will serve as a first step towards decisive action to address Colorado’s water needs now and in the future. The timeline for creation of Colorado’s Water Plan, including the deadlines for creating each BIP, and public comment periods is pictured below.

The SP-BIP, as a piece of this larger project, has been developed in a collaborative effort by the South Platte and Metro Basin Roundtables (BRT). As a Joint BRT, they engaged two consulting teams to develop the SP-BIP. HDR Engineering, supported by MWH Americas, Inc., was tasked by the BRTs with developing the portions of the SP-BIP related to consumptive water uses including municipal, industrial, and agricultural uses. The West Sage Water Consultants Team was tasked with developing the information related to environmental and recreational uses. The work of HDR and West Sage has been integrated in this document to form the Draft SP-BIP. Key members of the consulting teams are listed on the following page.

Public input from all categories of water interests in Colorado is critical to formulate a balanced SP-BIP and a successful CWP. To engage the public in the development of the SP-BIP, the Metro and South Platte BRTs are using multi-faceted communications and outreach tools. This approach seeks to reach diverse stakeholders. ***To participate in the SP-BIP development, please use one or more of the following public engagement tools:***

1. Attend a Basin Roundtable meetings (www.coloradowaterplan.com)
2. Attend at SP-BIP Open House Events (TBD, 2014-2015)
3. Visit the South Platte BIP Website (www.southplattebasin.com)
4. Request a presentation by BRT member



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Executive Summary

1 Executive Summary

1.1 Colorado's Water Resources

Over the last decade Colorado has faced substantial and increasingly complex water-related challenges. The sources of these challenges are as diverse as the state itself. They range from competing economic needs including agriculture, oil and gas, tourism, recreational, industrial, and municipal use, to differing regional outlooks about water allocation based on the State's geography and demographics. It was this coalescing of challenges facing Colorado that demanded stronger action. Taken together these and other issues presented a call for executive-level action to align competing interests and outlooks under a unified vision for the future of Colorado water planning.

Because Colorado has a long and proactive water planning history, the state has a very well-established water planning regime. The complex challenges facing Colorado in recent years, however, meant that State-level action to align water planning across the many basins was deemed appropriate. On May 14, 2013 Colorado's Governor, John Hickenlooper, responded to this situation by issuing an Executive Order directing the Colorado Water Conservation Board to commence work on Colorado's Water Plan (CWP). As specified in the Executive Order, the CWP must integrate 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.

The Colorado Water plan seeks to take up the many water challenges faced by the state including:

- Addressing the projected water supply gap that experts believe may reach 500,000 acre feet per year by 2050
- Addressing the largest regional supply gap in the South Platte Basin – the most populous and agriculturally productive Basin in the state
- Addressing how drought conditions can and may worsen this projected supply gap
- Reducing the state's trend toward "buy and dry" transfers of water rights from agriculture to municipal use as demand increases
- Incorporating environmental and recreational values so important to the economy and quality of life in each of the state's river basins
- Addressing the long standing interbasin and intrabasin challenges through cooperative dialogue and cooperative action, including the basin roundtables and IBCC
- Recognizing that water quantity and quality issues in the state are integrally linked
- Addressing interstate water obligations for the nine compacts and two equitable apportionment decrees applicable to Colorado

In developing the Plan, the Governor directed the Colorado Water Conservation Board to utilize the existing system of Basin Roundtables, established by the *Colorado Water for the 21st Century Act* in 2005. The Basin Roundtables were created to encourage locally-driven, collaborative solutions to the increasingly complex and controversial water questions facing the State.

Additionally, the Governor directed that the Colorado Water Plan should work to align state water projects, studies, funding opportunities, and other efforts. It should improve the State's role in facilitating and permitting water projects, utilize the knowledge and resource of relevant State agencies, as well as assemble and include working groups and ad-hoc panels developed to address specific issues that come to light in the process of making the plan.

The first draft of Colorado's Water Plan will be developed and submitted to the Governor in December 2014, and the work of the Basin Roundtables will form the foundation of the plan.

1.2 Basin Roundtables

As mentioned above, nine Basin Roundtables were established in 2005 to help manage and develop the State's water resources. This occurred in part as a response to the increasingly controversial and contentious water issues facing the state and in part to help proactively manage the changing water demands associated with the State's unprecedented population growth and the growing need for multiple uses for water in Colorado.

The nine basin roundtables, as shown in Figure 1-1, predominantly represent the major river basins of the State with one important exception: the South Platte Basin, which includes two roundtables, the Metro Roundtable and the South Platte Basin Roundtable. The South Platte River Basin covers a large portion of Northern Colorado which includes several major agricultural regions of the Front Range as well as the metropolis of Denver and its surrounding area. As a result, the South Platte Basin and Metro Roundtables decided to develop a single Basin Implementation Plan for the South Platte Basin.

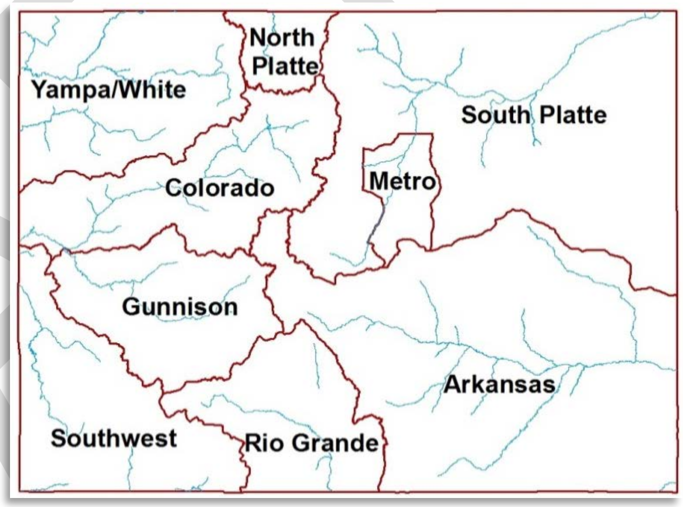


Figure ES-1. Colorado River Basins

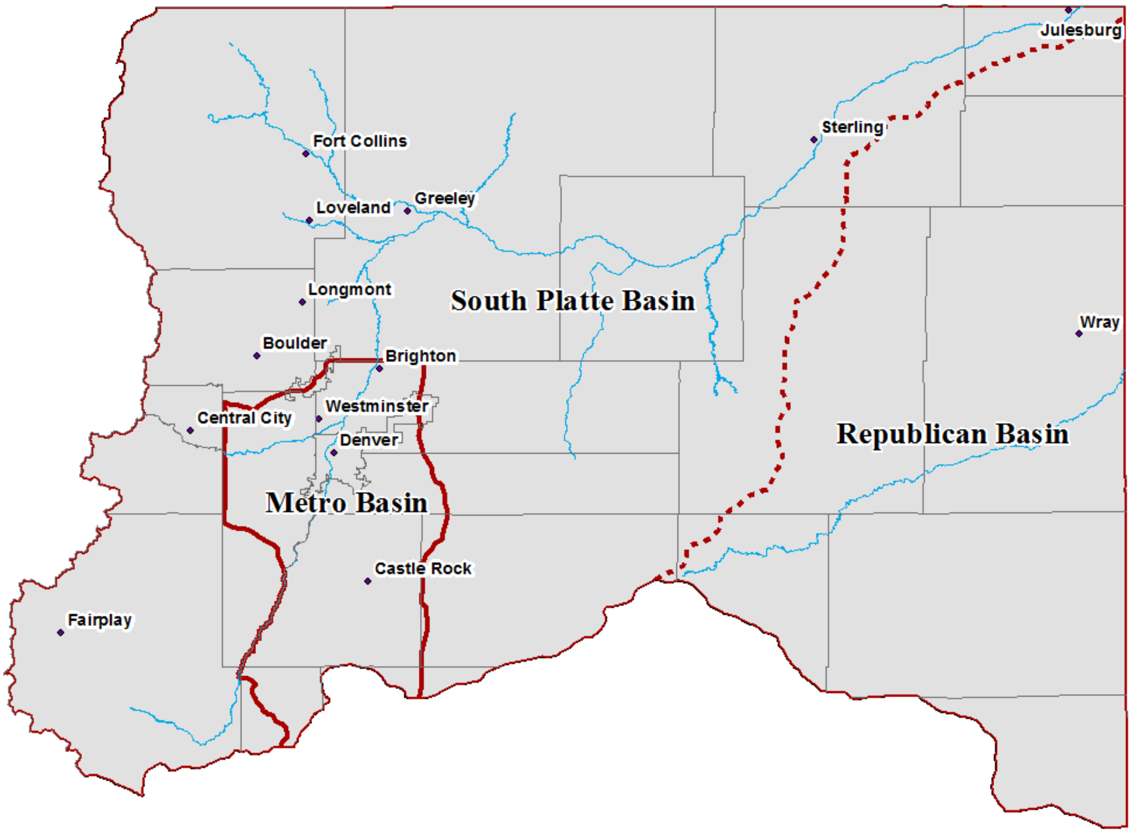


Figure ES-2. The South Platte Basin

The factors affecting water in the South Platte including the diversity of demographics and water uses for the urban portion of the Basin, versus the very different needs of agricultural users in other portions of the basin were deemed significant enough that the Basin was divided into two separate Basin Roundtables, one representing the Metro region of the South Platte and the other representing the remainder of the Basin including the portion of the Republican River Basin in far Eastern Colorado.

2 South Platte Basin Water Supply Challenges

The South Platte Basin supports a wide range of water needs including municipal, industrial, agricultural as well as important water-dependent ecological and recreational attributes. Coloradoans and tourists regularly enjoy the South Platte's recreational opportunities provided by the many environmental features of the basin. Based on State Demographers Office population projections, the South Platte and Metro Basins are projected to grow from approximately 3.5 million people in the year 2008 to about 6 million people by the year 2050. Population growth will significantly increase the future municipal and industrial water needs.

There are many water supply challenges and opportunities specific to the South Platte Basin which set the stage for analysis of water demand and implementation of satisfactory solutions. Familiarity with the

South Platte's water issues by water managers, regulatory agencies, elected officials, the business community, and the general public both will bolster Colorado's ability to maintain and improve sustainable water supplies. This will help promote economic growth, public safety, and environmental diversity both within the South Platte Basin and across the state. A good Colorado solution depends on a good South Platte solution.

Several water supply challenges specific to the South Platte Basin shape the ways that solutions for water availability in the basin are identified, analyzed and implemented. Below, these challenges are described in greater detail.

Limited Native Supply in the South Platte

The Basin, in a typical year, has little unappropriated water from either the South Platte or Republican Rivers available for new uses. This means that any new population or new economic activity requires a transfer of water away from another use, or the importation of new Colorado River water supplies. In recent years, these transfers have predominantly been from agriculture to municipal use – a system known as "buy and dry" where agricultural water rights are willingly sold to municipalities to supplement their supplies, resulting in the dry up of agricultural lands. Extensive continuation of this process is not in the best interest of the Basin nor is it in the best interest of the State.

Conservation, Reuse, and Successive Use

To answer some of this need, efficiencies in water use have been improved substantially along the South Platte, including successive use of water. On average, South Platte Basin water is used 7 times successively before it leaves the state at the Nebraska border. While this amount of successive use by downstream users is commendable, it either constrains the ability of water agencies to exchange water or to convey it back upstream or reduces the amount of water that has been previously available to downstream water users. Every drop in the South Platte River is used and reused many times over in meeting multiple needs.

A key premise in Colorado water law is the concept of "beneficial use." Further, under Colorado water law, the specific water uses must be identified to receive a decree. The water right decree also indicates whether that water right is limited to a single use and, in many cases, specifies the degree it can be reused. Frequently such rights constrain or prevent water from being reused. While some opportunities for additional reuse still exist in the South Platte, there is limited ability to expand reuse to cover our growing water demand.

Water providers in the South Platte Basin continue to seek expansion of their existing conservation programs for several reasons. Though these agencies have already implemented significant water conservation measures that are known nationally for their rigor, they plan to pursue even more aggressive conservation levels in the future. Some factors that limit the amount of conservation which can be implemented include the type of industry seeking water savings. Several industries within the Basin including livestock operations, food processing, beverage production, oil and gas extraction, as well as mineral development have significant water requirements which cannot be reduced indefinitely. And finally, the wide range of cultures, community settings, and backgrounds within the Basin affect lot sizing and landscaping and consequently result in a widely varying per capita water usage that cannot be approached with a one-size-fits-all conservation approach.

Groundwater and Aquifer Storage and Recovery

Two types of groundwater are recognized in Colorado water administration: 1) tributary (or alluvial aquifers hydrologically connected to rivers and streams) and 2) non-tributary (not hydrologically connected to rivers and streams). While groundwater and aquifer storage present some opportunities in the Basin, continuation of current rates of withdrawals and/or potential expansion of the use of the important regional asset of the non-tributary Denver Basin Aquifer are constrained by declining water levels and well productivity in large areas of the Aquifer. New technologies for Aquifer Storage and Recovery (ASR) offer the opportunity that the Denver Basin Aquifer could be used for future water storage; however this technology requires additional research on managing stored water and being able to reliably recover the water as needed.

Alluvial aquifers (aquifers hydrologically connected to rivers and streams) along the South Platte have been used historically by water users. However, in 2006, the State required that numerous wells be shut down in the central South Platte Basin whose owners had not yet developed augmentation plans to make up for out-of-priority water use and delayed effects of the groundwater pumping. This has significantly constrained the use of alluvial groundwater in the central South Platte Basin and has generated considerably controversy and state legislation to more fully consider potential solutions and management options.

Interstate Water Commitments

South Platte River management is constrained by both interstate compacts and other programmatic and regulatory issues. The South Platte River Compact divides the waters of the South Platte River between Colorado and Nebraska, giving Colorado the right to fully use the water between Oct. 15 and April 1. During the irrigation season, Colorado must deliver 120 cubic feet per second to Nebraska at Julesburg or it must curtail junior diversions. The State Engineer is authorized to administer the compact. In addition, compliance with federal programs for threatened and endangered species recovery also results in interstate water management commitments that are outlined on the following page.

The Republican River Compact between Colorado, Nebraska and Kansas places severe challenges on Colorado's residents living and working in this basin. The Republican River Basin is physically distinct from the South Platte Basin and the Rocky Mountain snowmelt feeding the South Platte River does not benefit the Republican River Basin. The Ogallala Aquifer that spans eight Great Plains states supplies the Basin's agricultural economy (Yuma, Kit Carson, Phillips, and Washington counties are ranked in the top ten agricultural producing counties in the State according to the 2012 USDA agricultural census). Irrigation with Ogallala Aquifer water contributes to superior crop yields but a declining groundwater table raises concerns about how much longer or to what degree the Basin will be able to benefit from this water source.

Environmental Permitting Processes and Threatened and Endangered Species Recovery

There are challenges in developing additional water supplies for the South Platte Basin related to important species protection plans, namely the Platte River Recovery Implementation Plan (PRRIP). This three-state program serves to protect the habitat of four endangered species that utilize the Platte River and riparian areas. The current program places specific constraints on approval of new water depletions and prevents certain types of new water storage facilities in the lower reaches of the South Platte River in Colorado.

In addition to the PPRIP, other regulatory and permitting issues constrain water planning in the South Platte to a large degree. A key constraint on the South Platte Basin is the ability to permit new reliable sources of future supply. Due to the unpredictable timeframes and requirements associated with federal (Clean Water Act, Endangered Species Act), state and local permitting requirements for major projects, some water supply projects have been 10 years or longer without clear resolution. These associated delays and the resulting extension of the permitting timeline for a water project result in significantly higher financial burdens to Colorado's residents. Given the immense need for water in the Basin, it is critical that permitting processes for major water projects in the state improve both in terms of turnaround times and the predictability of the process while still providing the needed environmental protections and mitigations.

Environmental and Recreational Uses

Preserving and enhancing the environmental and recreational aspects of the South Platte River is important to Colorado's economy and quality of life. Water is necessary to maintain aquatic, riparian and wetlands habitats that are essential for ecological diversity. In addition, flows in streams are essential to many recreational economies, including fishing, waterfowl hunting and boating, and for general aesthetics near waterways, including greenways, trails and wildlife viewing. The important environmental and recreational values in the South Platte Basin must be considered when planning for Colorado's water future. Many of these attributes currently suffer due to current water diversions and infrastructure operations.

Maintaining or enhancing environmental and recreational attributes can be a constraint on potential future water development, however many opportunities exist to maintain these opportunities while concurrently developing water supply projects. Multi-purpose projects or agreements for cooperative operation of existing projects to help benefit these important attributes should be considered when projects are planned to help meet water needs. Additional projects to address these needs should be considered including environmentally friendly diversion structures, restoration of habitat and stream channels, and environmental pools in reservoirs with release timing to benefit the environment.

Water Quality Issues

A major challenge in the South Platte Basin relates to adequacy of the water quality for domestic and municipal water uses. These water users and water supply agencies recognized as early as the late 1800s that higher quality water was found in the mountain tributaries of the South Platte River where they exit the foothills. Since then delivery systems bringing high quality, reliable water from the South Platte River tributaries have been a staple of South Platte Basin water planning. Today, however, these higher quality water sources are fully developed and municipal water suppliers are attempting to meet new supply demands with lower quality water sources often located within the lower portions of the Basin. Major technological innovations are needed for delivery, treatment, and disposal of the waste streams from currently available complex water treatment systems, which results in significant cost to customers, impacts to the environment, and uncertain regulatory permitting processes. Relying exclusively on South Platte River supplies in the face of decreasing water quality will be a major challenge in the South Platte Basin.

Summary of Challenges

Because of the diverse population and economic drivers in the basin, as well as a host of specific challenges on the water available for developing new supply, the South Platte Basin faces an enormous challenge in meeting its future water needs. As the Basin faces the greatest projected regional supply gap, it will need to continue to develop creative, multifaceted approaches to meet a growing demand. The challenges facing the South Platte are representative in many ways of the greater challenges facing Colorado as it looks to plan its water supply to 2050. ***Though the challenges loom, they are not insurmountable.*** The South Platte Basin Implementation Plan offers an integrated planning approach that will maximize the use of existing water supplies, develop new opportunities, and leverage technology and policy advancements that help to meet the Basin's diverse water supply needs.

3 Solutions for the South Platte

Making Choices

Finding solutions for the range of issues constraining water planning in the South Platte Basin is as much about determining how to balance the competing demands of Colorado and the South Platte Basin as it is about seeking technological and political solutions. To produce a viable and sustainable model to meet the projected water supply gap requires tradeoff within the Basin and the State concerning how we want to balance the utilization of our natural resources to support diverse economic, cultural, and environmental interests across the state.

Today's current de facto answer to our growing water demands has been the use of agricultural transfers. These transfers offer a mechanism to provide much-needed water to municipal suppliers and the environment through instream flows; however this water comes at the expense of the agricultural sector, which has a long and rich history in Colorado. The dry up of agricultural land in order to support growing municipal demands means that farmers and ranchers who have cultivated land, helped support small communities across the state, and contributed to Colorado's rich cultural heritage are making choices to leave agriculture – and, in the process, affecting surrounding rural economies and our State's historical identity. A key element of the South Platte solution is establishing systems where farmers can decide for themselves how to manage their water rights while concurrently offering potential new transactional methods to help lessen the associated impacts on others is a key element of the South Platte solution.

The current solutions for increasing water demands can also have tradeoffs for environmental and recreational values throughout the Basin. The South Platte's environmental and recreational attributes are important for the economy and resident's way of life, and these attributes should be proactively considered when planning for the Basin's future water needs. Colorado's residents appreciate Colorado's natural resources and want to maintain scenic and ecological values throughout the State, including in the South Platte Basin.

Strategic Overview

Although the roundtables support the free market and rights of water owners to sell their property, the roundtables have explored options to counter the "buy and dry" trend. The three major guidelines the Basin Roundtable has utilized in determining solutions to meeting the projected water supply shortfall are below:

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.

In Colorado water planning, a commonly understood, integrative approach to planning is known as the "Four Legs of the Stool." This approach recognizes that successful water planning in Colorado will need to utilize four specific tools; Conservation and Reuse, Identified Projects and Processes (IPPs), Agricultural Transfers, and new Colorado River supplies along with a supporting storage component. The South Platte Basin Implementation Plan employs this approach in its strategy to meet the water supply needs of the South Platte and Metro Basins.

The South Platte Basin's goal is to prepare for future water needs in a way that maximizes the state-wide beneficial use of our water resources while minimizing the impacts of additional water use on environmental and recreational resources. An integrated and managed approach to meeting the supply gap will include implementing a large percentage of the Basin's IPPs, a term used to describe the existing strategies and water projects which have been planned but not yet fully implemented. Additionally, the plan calls for enhancing water use efficiencies (conservation and reuse), integrating multi-purpose projects comprised of storage, conveyance via pipelines and other methods, and the integration of existing water infrastructure systems where possible. The plan intends to incorporate environmental and recreational protections and enhancements, utilize some degree of agricultural transfers using alternative methods to traditional "buy-and-dry," and simultaneously develop new unappropriated Colorado River supplies for the benefit and protection of all of Colorado, both now and in the future.

Ideally, projects within this strategy would be multi-purpose and address associated recreational and environmental benefits. New Colorado River supply would be developed in a manner that does not exacerbate compact obligations. Front Range storage would come from enlarging existing reservoirs; building off-river storage; and using underground storage to maintain aquifer levels, reduce evaporative losses and minimize riparian impacts. New Colorado River supplies and Front Range storage would form the base of the municipal and industrial supply while providing environmental and recreational benefits. Front Range agricultural transfers coordinated with use of the Denver Basin Aquifer would be used primarily for droughts and drought recovery. Alternative transfer methods including land and water conservation easements could be used to help maintain agricultural production and the local economic benefits of agriculture. Continued leadership in conservation and reuse will ensure that all of these resources are used efficiently, allowing the Basin to maximize the benefits and minimize costs of development.

The South Platte Basin's vision is to develop solutions that balance the use of new Colorado River supplies with South Platte agricultural transfers, conservation, reuse and environmental and recreational programs in a coordinated manner to reduce the size and effects of the Colorado River supply projects and equitably share project benefits between the east and west slopes. The South Platte Basin proposes the construction of projects that develop tandem, diverse sources of supply – from new Colorado River supplies and agricultural transfers – instead of building projects based on a single source, from either new Colorado River supplies or agricultural transfers.

4 Implementation

The graphic above represents the process used to write the South Platte Basin Implementation Plan. Arrows represent each stage of the development of the Plan sequentially. Specific lists or themes are identified that were established during each phase of the plan's development. These themes and lists helped to drive the evolution of the report, and to establish the strategies and portfolios recommended in Sections 5 and 6.

Implementation of the multipurpose solutions described in the South Platte Basin Plan will be where ideas meet reality. To meet the supply gap and achieve the goals and outcomes identified by both the Governor of Colorado and the Basin Roundtables, the South Platte Basin Implementation Plan has recognized ten areas of focus, whose successful completion will be integral to meeting the regional supply gap and ensuring that Colorado's future water needs are met. Current projections anticipate that in 2050 water demands will exceed water supplies for municipal and industrial uses as well as for irrigated agriculture. This water supply gap under a medium demand scenario, with current conditions, anticipates that by 2050 there will be a municipal and industrial water supply gap of 428,000 acre-feet and irrigated agriculture water supply gap of 422,000 acre-feet.

1) Maximize implementation of IPPs

Successfully implemented IPPs, both in-basin and transbasin, will be critical to meeting the projected supply gap. The extent of which IPPs are successful will relate directly to the magnitude of the M&I gap.

Successful IPPs will lead to a smaller M&I gap while unsuccessful IPPs will increase the gap even further. A summary of anticipated yields from each category of regional IPPs at a 60 percent success rate is given in Table ES-1 below.

Table ES-1. IPP Yield by South Platte Subbasin

Region	Agricultural Transfer	Reuse (AFY)	Growth into Existing Supplies (AFY)	Regional In-Basin Project (AFY)	Firming In-Basin Water Rights (AFY)	Firming Transbasin Rights (AFY)	New Transbasin Rights (AFY)	Total IPPs at 60% Yield
Denver Metro	3,000	12,600	20,000	10,000	900	4700	10,800	62,000
South Metro	3,000	20,700	8,100	13,800	0	500	6,000	55,200
Northern	10,200	6,200	16,600	28,100	8,200	12,000	0	81,300
Upper Mountain	0	0	2,200	25	2,200	0	0	4,400
Lower Platte	0	0	4,500	2,900	4,500	0	0	11,900
High Plains	0	0	2,100	0	0	0	0	2,100

2) Maintain leadership in conservation and reuse and implement additional measures to reduce water consumption rates (see Section 4.3)

Already, the Basin has reduced their water use by approximately 20 percent since 2000 and currently achieves one of the lowest per capita water uses in the state. Even so, both Roundtables anticipate implementation of additional conservation programs tailored to diverse types of water supply systems and conditions existing in the South Platte River Basin. The interplay between conservation programs and municipal and industrial water reuse will continue to be examined.

Currently there are a limited number of sources that can legally be reused in Colorado, but water providers are attempting to reuse every drop to which they are entitled. Water that isn't reused locally is reused within the basin through successive use. Reuse will continue to push the economic, technical, and legal limits in order to maximize South Platte supplies.

3) Maximize use and effectiveness of native South Platte supplies

To more effectively utilize native South Platte supplies, the Roundtables suggests the development of multipurpose water storage and conveyance infrastructure, as well as new methods to more effectively utilize tributary and non-tributary groundwater. Another critical aspect of utilizing existing supplies will be the exploration of integration of existing South Platte Water Supply Systems.

4) Minimize traditional agricultural buy-and-dry and maximize use of Alternative Transfer Methods (ATMs) to extent practical and reliable

Many water providers count planned agricultural transfers towards their Identified Projects and Processes. These transfers are in the planning stages and will proceed, barring hold ups in water right transactions, permitting of conveyance infrastructure or other unexpected circumstances. Ensuring that such projects proceed to the extent possible is an important piece of meeting the South Platte supply gap.

Additionally, it is recognized that Colorado's water right transfer process is heavily weighted towards dry-up of irrigated lands in order to transfer the historical consumptive use (CU) water. One alternative method to bolster water supply options is the use of alternative agricultural water transfer methods (ATMs). ATMs are meant to "minimize the impact on the local economy, provide other funding sources to the agricultural user, and optimize both the agricultural and nonagricultural benefits of the remaining lands." (SWSI 2010) Some of these alternative transfer methods include rotational fallowing, interruptible supply agreements (ISAs), water banks, purchase and leasebacks, deficit irrigation, and changing crop types. Through the implementation of ATMs, the agricultural producer can view their water rights as a "crop" and cities may view the cornfields as "reservoirs" holding water supplies for times of shortage. Much is still unknown about the feasibility of ATMs, but pilot projects in the basin are looking to find solutions to overcome the associated legal, technical, institutional, and financial issues associated with ATMs.

5) Protect and enhance environmental and recreation attributes

There are various important environmental and recreational attributes within the South Platte Basin that must be proactively considered when addressing water supply needs. Currently, there are some existing impairments to environmental and recreational needs within the Basin, and areas where habitat and streamflows must be enhanced or maintained to support these needs. The efforts being undertaken to meet the supply gap may potentially impact flows in streams, habitat, as well as water quality. Reduced stream flow in focus areas has the potential to create additional areas needing protection in order to sustain or enhance environmental and recreational attributes. Additional storage in the Basin has the potential to impact streamflows and to disturb wildlife habitat. However, opportunities to align environmental and recreational uses with the projects needed to meet the supply gap do exist. If cooperative operational agreements with cooperative operations or considerations can be put into place, there exists the potential to align environmental and recreational interests with the overarching goals of water suppliers. The strategies discussed regarding additional Colorado River supplies are intended to distribute impacts and benefits to environmental and recreational attributes to both the West and East slopes. Watershed management programs should also continue and be expanded to focus on additional high priority areas. Focused attention is needed to address threats associated with extensive tree mortality in the basin, increased fire hazards and water quality degradation associated with major recent floods.

6) Simultaneously advance the consideration and preservation of new Colorado River supply options

The Metro and South Platte Roundtables believe in strong consideration and preservation of the ability to use Colorado's entitlement under the Colorado River Compact as we also pursue other strategies to meet our water demands. Investigating, 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.

7) Manage the risk of increased demands and reduced supplies due to climate change

The effects of climate change on water resource availability are very difficult to assess and the exact ways it will affect Colorado are unknown. Many South Platte water providers consider it irresponsible not to consider the potential for climate change in making water supply and demand projections.

8) Facilitate effective South Platte communications and outreach programs that complement the State's overall program

A critical component in advancing the South Platte Basin Implementation Plan and Colorado's Water Plan will be a strategic focus on communication and education with stakeholders including water users, political leaders, and leaders of major businesses and industries throughout the State. Improving public understanding about the goals, needs, and plans of the State and the South Platte Basin will help to improve public acceptance of the need for innovative water rate structures, energetic conservation measures, and more integrated land use and water supply planning.

9) Research new technologies and strategies

Water quality is an ongoing issue for the South Platte Basin. A major concern is the ability to manage and treat lower quality water effectively, and then dispose of the waste products (brine) in a cost effective and environmentally sound way. One important component of the South Platte Basin Implementation Plan will be for the State to take a proactive role in investigating technologies capable of treating low quality water sources and disposing of waste products.

10) Advocate for improvements to federal and state permitting processes

Cities throughout the South Platte Basin are struggling with the time and cost to obtain permits for incremental expansions to their water systems despite the environmental mitigation and enhancements offered by the projects. To meet the near and long term supply gaps, improvements to the permitting processes for supply projects are needed while still maintaining full regulatory compliance and environmental protections. This begins with approvals for planned supply projects including IPPs for meeting the nearer term supply gaps as well as other supply projects expected in the medium and long range timeframes. It is recognized that not all of the projects currently engaged in federal permitting or planned in the near future may obtain permit approvals with conditions acceptable to the project sponsors. Regardless of permit success rates, an important component of the South Platte Basin Implementation Plan is development of specific and actionable steps to improve the federal and state permitting processes for major water projects both in terms of efficiency and the predictability of the process while still providing the needed environmental protections and mitigations. ***Broader political and financial support is essential if the state is to use integrated projects to meet the supply gap.***

5 Summary

The South Platte Basin faces a cadre of unique challenges in planning for its municipal, industrial and agricultural water needs. It hosts some of the largest population centers in the state as well as several of the leading economic drivers from business, industrial, recreational and agricultural producers. As such, the South Platte Basin faces the largest projected regional shortfall for municipal, industrial and agricultural water in the future.

The South Platte Basin Implementation Plan offers a strategy to combat this shortfall utilizing diverse, tandem-supply solutions to chart a course that meets the projected water needs of the South Platte Basin as it develops in the future. This plan acknowledges the unique challenges, opportunities and tradeoffs present in the South Platte Basin, then leverages these challenges into ten specific implementation strategies to address them. Because the solutions developed in the Plan are multifaceted, approaching the Basin's water challenges with an arsenal of tools to help improve supply, they may help to achieve the goal of bridging the projected supply gap while evenly distributing the impacts of the State's water development across the State's many regions as well as its diverse economic interests.

When executed with the support of the State, political leaders, business leaders, and the public, the implementation strategies outlined in the Plan has the potential to achieve the ambitious goal of supplying water to the South Platte Basin, and by extension help supply the water needs and sustain the economy of the State of Colorado through 2050.

1

Goals and Measurable Outcomes

1 Basin Goals and Measureable Outcomes

Key Points:

- The SP-BIP defines a framework for meeting the future water quantity and quality needs of agriculture, businesses, communities, the environment, and recreational uses in the South Platte Basin.
    - The South Platte Basin is Colorado's most economically diverse basin. Incorporates the areas for both the Metro and the South Platte Basin Roundtables, which includes Republican River Basin.
    - The majority of the state's population resides here and accounts for 80% of the state's economy and tax base.
    - Includes nine of the top ten agricultural producing counties, despite the curtailment of a significant number of wells in the South Platte Basin.
    - The State demographer forecasts that eighty percent of the state's population and job growth will be on the eastern slope through 2050.
    - The single biggest driver of the need for additional water supplies is population growth.
- These overarching themes drive the crafting of strategies to meet future water needs:
    - A good Colorado plan needs a good South Platte Plan
    - Solutions must be Pragmatic, Balanced and Consistent with Colorado Water Law and Property Rights
    - The South Platte River Basin will continue in its Leadership Role in Efficient Use and Management of Water
    - A Balanced Program is needed to Plan and Preserve Colorado River Options
- Goals and measurable outcomes in the following categories will also assist the State develop Colorado's Water Plan:
    - Agriculture
    - Municipal Water Conservation, Reuse and Efficiency
    - Identified Projects and Processes
    - South Platte Storage and Other Infrastructure
    - Water Quality
    - New Colorado River Supplies
    - Environmental and Recreational
    - Statewide Long-term

The South Platte Basin Implementation Plan (SP-BIP) begins with an overview of the important water resource attributes of the South Platte and Republican River Basins. This section is followed by sections covering the purpose of the SP-BIP and its relationship to statewide needs and programs, water-related values, water supply needs, overarching themes and potential solutions that all help guide the development of the Basin's goals and measureable outcomes.

1.1 Basin Overview

The combined South Platte and Republican River Basins comprise about 27,660 square miles in northeast Colorado. Because the South Platte and Republican River Basins have independent hydrology and water supply challenges, the description for each basin is separated below.

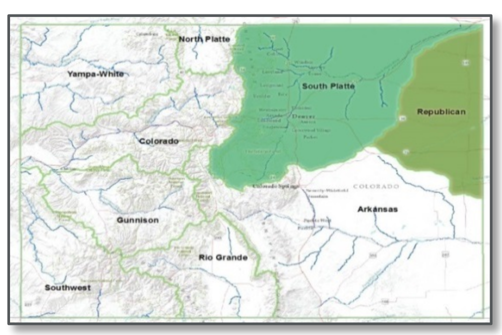


Figure 1-1. Colorado's River Basins

South Platte River Basin: The South Platte River Basin incorporates the areas for both the South Platte Basin Roundtable and Metro Roundtable. The South Platte River Basin is the most populous basin in the State. The population within the South Platte Basin is expected to double from approximately three and a half million people to six million people by 2050 (approximately 80% of Colorado's population resides in the South Platte Basin). The Front Range of the South Platte Basin is often characterized as Colorado's economic and social engines and also has the State's greatest concentration of irrigated agricultural lands. This irrigated agricultural land accounts for approximately 72% of the production of all of Colorado's agricultural output (SWSI 2010).

Figure 1-2. South Platte River

The topographic characteristics of the South Platte River Basin are diverse. The Basin's waters originate in the mountain streams along the Continental Divide in the northern portion of the Front Range. The South Platte River emerges from the mountains southwest of Denver and moves north through the Denver metropolitan area where it is joined by numerous tributaries such as Cherry Creek, Clear Creek, Coal Creek, Bear Creek, Boulder Creek, St.Vrain Creek, Big Thompson River and Cache La Poudre River. It then flows to the northeast across Colorado's High Plains. The western portions of the basin and its montane and subalpine areas are mostly forested in contrast to the High Plains region which is mainly grassland and planted/ cultivated land. Approximately one-third of the South Platte Basin land area is publicly owned, with the majority of these lands in the forested mountains. The South Platte River crosses the Colorado-Nebraska state line near Julesburg and merges with the North Platte River in southwestern Nebraska to form the Platte River.

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

Definition of Terms

The Metro Basin Roundtable is a subset of the South Platte Basin determined by population and geographic boundaries.

The South Platte Basin Roundtable represents the interests of the entire South Platte and Republican Basins excluding the subset that is the Metro Basin Roundtable (described above).

The Republican Basin is hydrologically separate from the South Platte Basin but is represented by the South Platte Basin Roundtable.

The South Platte Basin is the boundary including all areas of the South Platte, Metro, and Republican Basins.

The South Platte River Compact of 1923 (South Platte Compact) 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 South Platte Compact requires the Colorado State Engineer to curtail diversions east of the Washington County line that are junior to June 14, 1897 when flow in the river is less than 120 cubic feet per second from April 1 through October 15.

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

The South Platte Basin is Colorado's most economically diverse basin. Urban sector business and industries within the South Platte Basin provide for a majority of the state's overall economy. 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. Coloradoans 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 municipal/industrial (M&I) sector has proven reliable, though is viewed as unsustainable if the South Platte, and the State of Colorado, is to continue to have a diverse economy as the population continues to grow. The challenge of preserving the 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:

- **Agricultural Water Transfers**—Agriculture is the dominant water use in the Basin, accounting for 85% of total water diversions. Conversion of agricultural water to M&I uses ("Agricultural Transfers") will continue to be a significant option for meeting future M&I needs, especially in those areas where agricultural land will be urbanized. These Agricultural Transfers are likely to have negative impacts to rural communities, and to open spaces, wetlands and recreation that are tied to irrigated lands. Loss of irrigated agricultural lands will negatively impact the local economy and the State's economy, as well as the State's food security. Agricultural water transfers can be reduced if other solutions including the development of Colorado River supplies are more successful.
- **M&I competition for limited water supplies**—Competition for additional M&I water supplies is significant, and in some cases, multiple M&I suppliers have identified the same water supplies as future water supplies. Competition increases the costs to M&I customers, and competition for the same water supplies could result in some M&I suppliers not having enough water in the future.
- **Adherence to Colorado River Compact**— 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. Equally important is finding responsible ways to develop and use Colorado's remaining compact entitlements.
- **Water Supply Options**— Investigating, preserving, and developing additional supplies from the Colorado River Basin is critical to effectively plan for future water supplies. If additional Colorado River supplies are not available for future use, the "default" will include additional

Agricultural Transfers, greatly increasing the negative impacts of Agricultural Transfers, as identified above.

- **Reliance on Nonrenewable Tributary Groundwater**—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.
- **Planned surface storage projects**—Completion of planned storage projects, including Glade Reservoir, Halligan and Seaman Reservoir Enlargements, Gross Reservoir Enlargement, and the Chatfield Reallocation Project, is critical to meeting future water supply needs. These projects will supply much-needed water to project participants, and failure to complete these projects will result in water shortages, additional Agricultural Transfers, or additional water diversions from the Colorado River Basin.
- **Conjunctive Use**—Conjunctive use of surface water and alluvial groundwater, and use of alluvial aquifers for storage, offer opportunities to expand sustainable water use. Aquifer storage is generally considered to have lesser environmental impacts and water stored in alluvial aquifers is not subject to evaporation losses. Aquifer storage poses control and administrative issues that will need to be addressed to ensure that other water rights are not injured. Aquifer Storage and Recovery (ASR) programs have been successfully implemented in portions of the Denver Basin. Although ASR may not be a successful water management tool for all entities for all of their water supply needs, ASR can be an effective management tool for portions of supplies or for smaller entities without large demands.
- **Water Quality Considerations**—Water quality will continue to be a challenge as more water is diverted for use, and point and non-point sources discharge to the Basin's waters. Salt content of soil and water in the South Platte River Valley, and sedimentation/erosion in parts of the basin, are likely to continue to increase over time, which will negatively impact the ability to use the water for agricultural and M&I purposes. Other water quality concerns include naturally occurring and anthropogenically introduced substances including metals. Technological solutions are expensive and may result in increased energy demands and issues associated with disposal of concentrated treatment residuals.
- **Efficient Use of Existing Water Resources**—The South Platte Basin is leading the State with regard to M&I water use efficiency. Efficient use of the basin's resources, through water reuse and conservation, is a critical component of meeting future water needs. Increased M&I water use efficiency will reduce water availability for agriculture, ecological resources, and other uses as M&I return flows diminish.
- **Urban River Stretches**—The urban environment is an important component of quality of life for many South Platte Basin residents. Judgments about the value of the urban environment, including the need to provide water for irrigated landscape, make discussions about water supply development needs all the more difficult.
- **Environment and Recreation**— The South Platte Basin has diverse ecological and recreational opportunities, including amenities such as mountain streams and rivers (fishing, rafting, etc.), city green ways, flatwater reservoirs, wetlands and open space, are extremely

important to Colorado's tourism economy and residents' quality of life. Environmental and recreational based tourism is important in the basin, as the South Platte Basin is home to the State's top two most visited State Parks as well as the eastern half of Rocky Mountain National Park.

Republican River Basin: The Republican River Basin in Colorado is located on the Northeastern High Plains. The headwaters of the North Fork and South Fork of the Republican River and the Arikaree River originate in the Northeastern High Plains of Colorado near Wray, Cope and Seibert, respectively. The Republican River is formed by the confluence of the North Fork of the Republican River and the Arikaree River just north of Haigler, Nebraska, with the South Fork of the Republican joining just southeast of Benkelman, Nebraska. Other major drainages within the Republican River Basin include Frenchman Creek, Beaver Creek and Red Willow Creek. The Republican River Basin in Colorado encompasses approximately 7,760 square miles, which represents 31% of the total Republican River Basin located in Colorado, Nebraska and Kansas.

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

The Republican River Compact of 1942 (Republican River Compact) apportions the waters of the Republican River Basin between Colorado, Nebraska and Kansas. The Republican River 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.

The Republican River 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 Republican River Compact makes allocations for beneficial consumptive use in each state. Colorado was allocated 54,100 acre-feet, which was further allocated as follows: North Fork of the Republican River drainage basin – 10,000 acre-feet; Arikaree River drainage basin – 15,400 acre-feet; South Fork of the Republican River drainage basin – 25,400 acre-feet; Beaver Creek drainage basin – 3,300 acre-feet. In addition, Colorado is allocated the entire water supply of the Frenchman Creek and Red Willow Creek drainage basins in Colorado.

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

Administration of surface water in the Republican River Basin is separate from groundwater administration. The Water Courts have judicial authority regarding surface water rights, whereas the Colorado Ground Water Commission (CGWC) has regulatory and an adjudicatory authority regarding the management and control of Designated Ground Water. The CGWC 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 Ground Water Basin. The CGWC has established seven designated basins and 13 Ground Water Management Districts (GWMDs) within such basins.

Ground Water Management Districts are local districts that have additional administrative authority. Much of the Republican River Basin lies within the Northern High Plains Ground Water Management District.

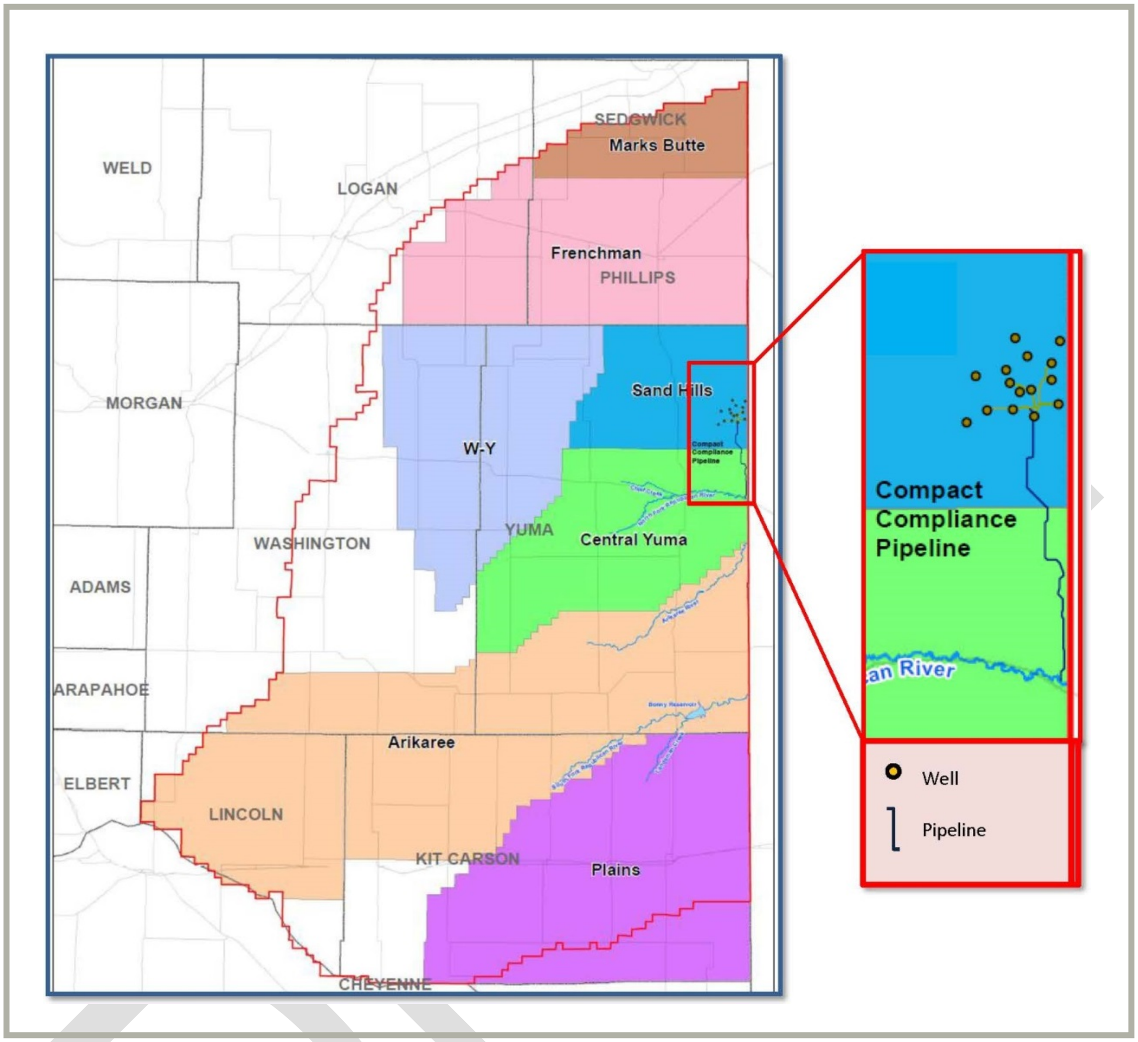


Figure 1-3. Republican Basin Ground Water Management Districts

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

- Continued Republican River Compact compliance.
- Projected depletions to the Ogallala Aquifer are anticipated to continue to reduce the amount of readily available water supplies for the agricultural economy in the Basin; in some cases presenting a feasibility issue of providing adequate water supplies for crop irrigation or in some cases no water supply.
- Continued detailed coordination and communication between multiple water rights and administrative authorities (CGWC, DWR, GWMD, Water Court, etc.).

1.2 The SP-BIP: Its Purpose, Authorization and Execution

The overall purpose of the SP-BIP is to define a framework for meeting the water quantity and quality needs of agriculture, businesses, communities, the environment and recreation through 2050 and beyond. To meet this purpose, the two South Platte Basin Roundtables (Metro Basin Roundtable and South Platte Basin Roundtable), formed in 2005 in response to legislation passed by the Colorado General Assembly (HB1177), recognized the value of collaboration and joined together to prepare a unified plan for the entire basin (including the Republican River Basin).

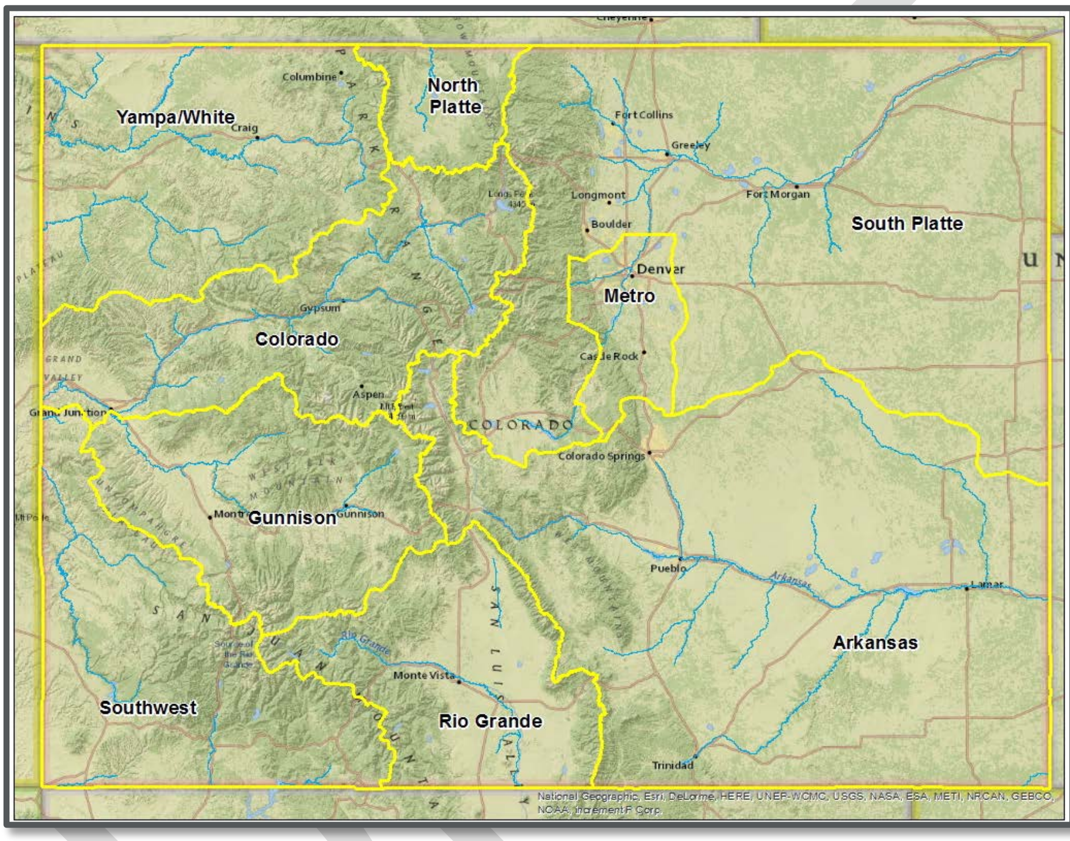


Figure 1-4. Colorado Map of Basin Roundtables

The Roundtables, working closely with the Colorado Water Conservation Board (CWCB), developed two "requests for proposals" from consultants and engineering firms to support the two Roundtables in developing the SP-BIP. HDR Engineering was selected to support the analysis of consumptive (agricultural, municipal and industrial) water needs and solutions. West Sage Water Consultants was selected for analysis of generally nonconsumptive (environmental and recreational) water needs and solutions. The two consulting teams began work in January 2014 and are collaborating closely with each other, the Roundtables and the CWCB. The two consulting teams are also coordinating public outreach programs to encourage broad input and to simplify the ways in which diverse interests may participate in the development of the SP-BIP.

Governor Hickenlooper's May 14, 2013 Executive Order calls on the State's agencies and citizenry to bring collaboration and innovation in addressing our water challenges in Colorado's Water Plan (CWP).

The order specifically cites: 1) the State's water supply gap as "real and looming" and 2) the important role played by the South Platte River Basin due to its population and agricultural production.

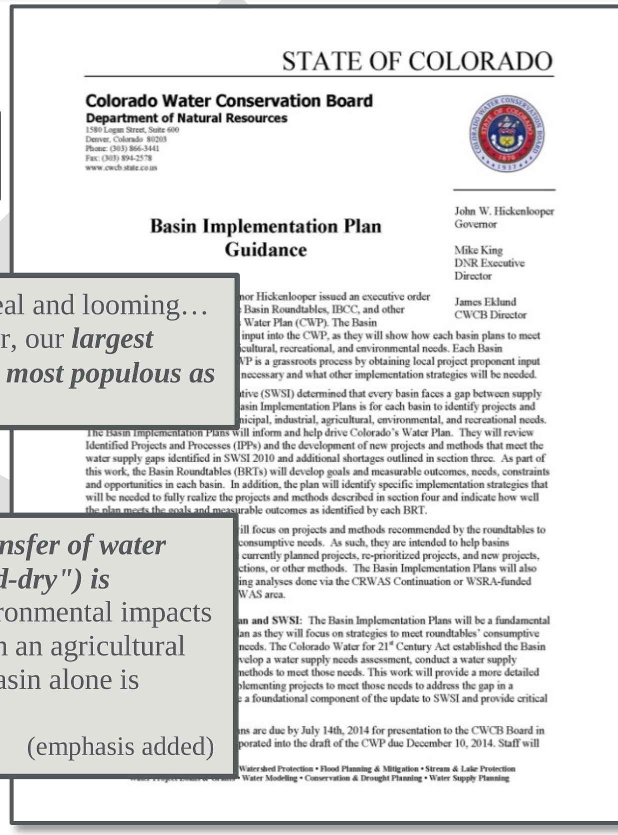
The Statewide Perspective:
The Executive Order calls for collaboration and specifically cites the water needs of the South Platte Basin

"… seek to tap Colorado collaboration and innovation in addressing our water challenges."

"The gap between our water supply and water demand is real and looming… 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***."

"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 … reduction in irrigated acreage in the South Platte Basin alone is currently estimated at 20% …"

(emphasis added)


STATE OF COLORADO

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Basin Implementation Plan Guidance

The Basin Implementation Plans will inform and help drive Colorado's Water Plan. They will review Identified Projects and Processes (IPPs) and the development of new projects and methods that meet the water supply gaps identified in SWSI 2010 and additional shortages outlined in section three. As part of this work, the Basin Roundtables (BRTs) will develop goals and measurable outcomes, needs, constraints and opportunities in each basin. In addition, the plan will identify specific implementation strategies that will be needed to fully realize the projects and methods described in section four and indicate how well the plan meets the goals and measurable outcomes as identified by each BRT.

Figure 1-5. Governor Hickenlooper's Executive Order

As the Roundtable's mobilize throughout the State to develop their Basin Implementation Plans they will be continually challenged to bring the collaboration and innovation called for in the Executive Order and to avoid inflexible positions that will constrain their ability to solve in-basin, inter-basin and inter-State water issues. All Coloradoans share concern over the potential for more variable hydrology in the future. They also share a concern that water supply limitations might not only affect future economic growth and prosperity but also our current uses of this precious resource.

As the facilitators of grassroots input to this statewide planning process, the South Platte and Metro Roundtables have recognized the limitations of what can be accomplished in the initial version of the SP-BIP. Although the term "implementation" is in the titles of the basin plans, the State has indicated many times in many forums that these plans will be living documents and that the version of the SP-BIP to be submitted on July 31, 2104 will be "version 1.0" in what may evolve into a series of updates and refinements. As the State's many water-related management and regulatory agencies engage to support the plans and potentially streamline their review and approval processes, effective "collaboration and innovation" will also be needed from them.

The schedule adopted by the CWCB in response to the dates in the Executive Order requires that the general results of the SP-BIP be presented at a mid-July CWCB Board meeting and that the SP-BIP be submitted by July 31, 2014. This timeframe generally limits the purpose of the SP-BIP and leads to a focus on compiling existing information rather than collecting new data and preparing new analyses. The State has indicated that public input and analyses may continue after July 31, but any new analyses or other information developed after this date may not be in time to be included in the Draft CWP to be submitted to the Governor on December 10, 2014 simply due to the time required to integrate all the basin plans into a coherent statewide document. Therefore, a key purpose of the SP-BIP is to identify important topics for further analysis and incorporation in future versions of the SP-BIP and CWP.

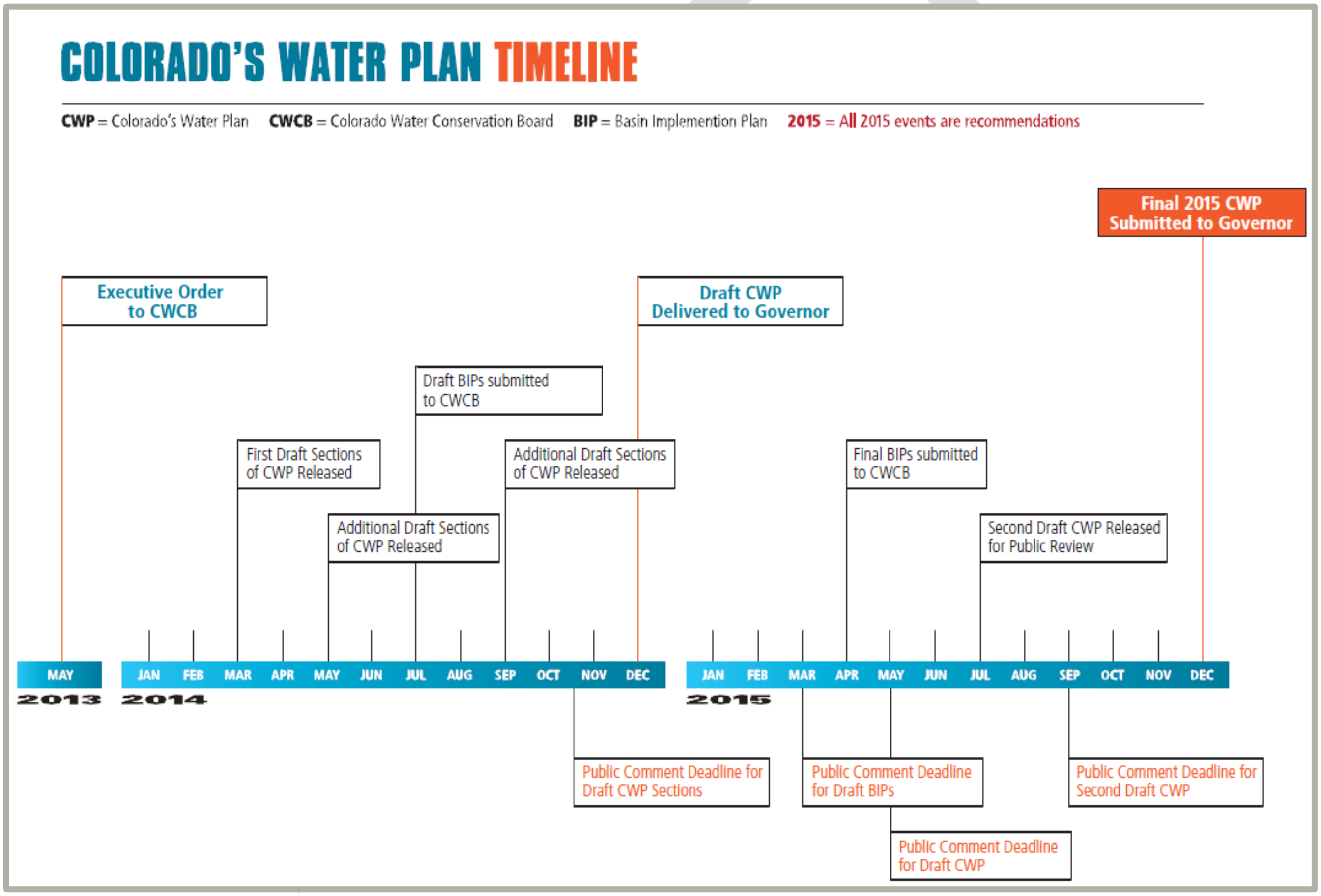

Figure 1-6. Colorado's Water Plan Timeline

1.3 Public Input Guides the South Platte Plan

An energetic and on-going outreach program provides input from all water use sectors and areas throughout the South Platte River Basin. Five sub-basin Stakeholder meetings were initiated soon after contracts where executed with the consulting teams in mid-January to identify issues, data sources and methodologies in time to make adjustments as needed. More than 26 meetings were conducted throughout the basin including SP-BIP presentations at each of the monthly Roundtable meetings.

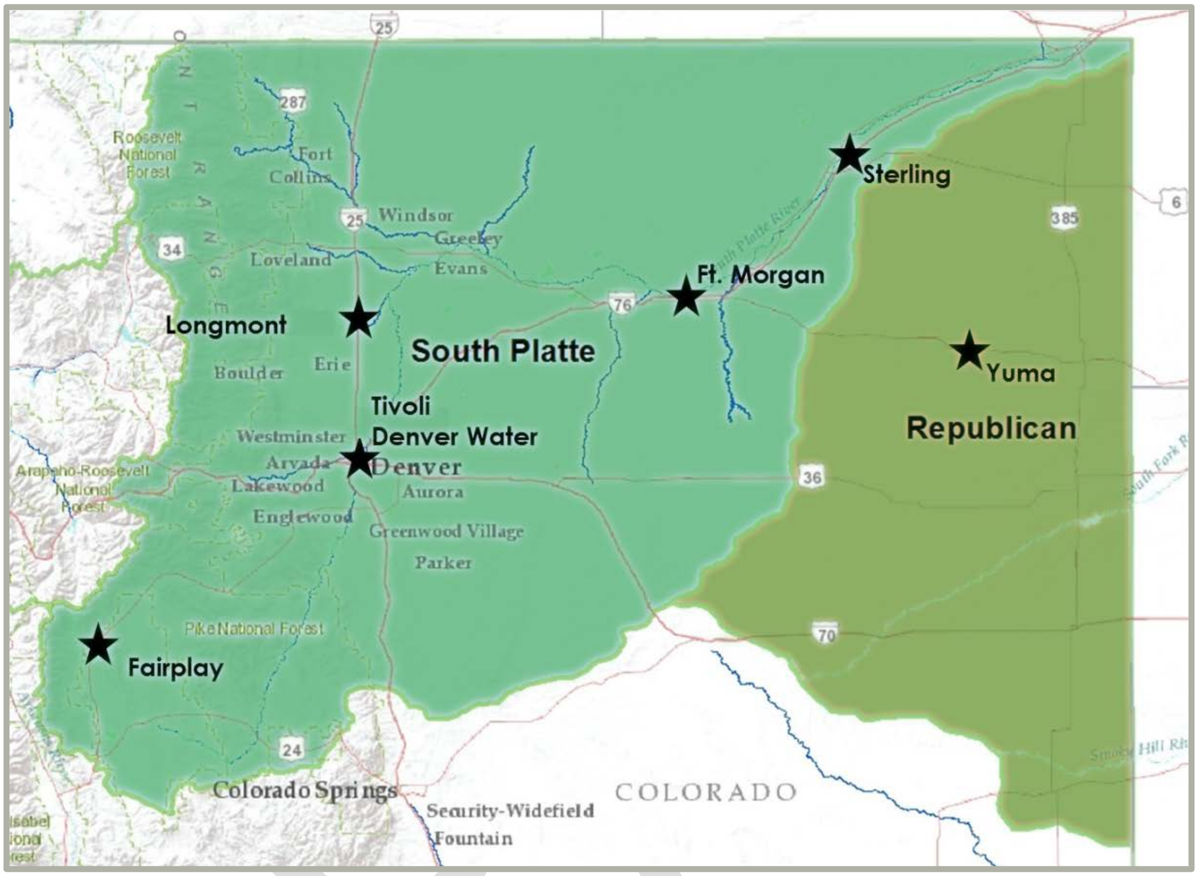

Figure 1-7. Stakeholder Meeting Locations for the South Platte and Republican River

In addition to the stakeholder meetings, public input was also facilitated through the following tools and methods:

- The SP-BIP Online Meeting – an interactive web-based presentation and public response program where the Chairs of the two Roundtables present overview information, direct the public to where more detailed information can be obtained and receive direct comments from the viewers.
- Online Survey for Comments and Input – a survey form soliciting public input on the overall SP-BIP program and key issues. Commenters can also provide any additional comments or suggestions not covered in the survey questions.
- Electronic database/mailing list – the general public was invited to join the SP-BIP mailing list to receive periodic updates and to provide continuing input to the process via online surveys and input forms.
- Basin Roundtable (BRT) member interaction/presentation to interested groups – the original and continuing intent of the legislation creating the Roundtables assures broad representation of water interests but also provides communication networks where Roundtable members

representatives provide direct links to all types of water uses including agriculture, municipal, industrial, environmental and recreational. Many Roundtable members are also members of special interest and civic groups and provide periodic input directly to their memberships.

- Collaboration with Environmental and Recreational Subcommittee – A “nonconsumptive” subcommittee (Environmental and Recreational) comprised of Roundtable members and additional representatives was established to help guide the identification of important natural or recreational resources. The Environmental and Recreational Subcommittee is also tasked with reviewing draft work products related to the characterization of other water needs and the potential projects and methods that could be used to satisfy future water demands in all water use sectors. The Environmental and Recreational Subcommittee met with the environmental and recreational consulting team approximately once every two weeks to review work progress.
- Weekly status calls – Each week, the two consulting teams jointly reviewed their work programs with representatives from the Metro Basin Roundtable’s Executive Committee and the South Platte Basin Roundtable’s Rio Chato Committee. These two subcommittees include outside environmental and recreational representatives, to promote transparency and obtain timely input and guidance considering the short duration schedule for developing the Draft SP-BIP.

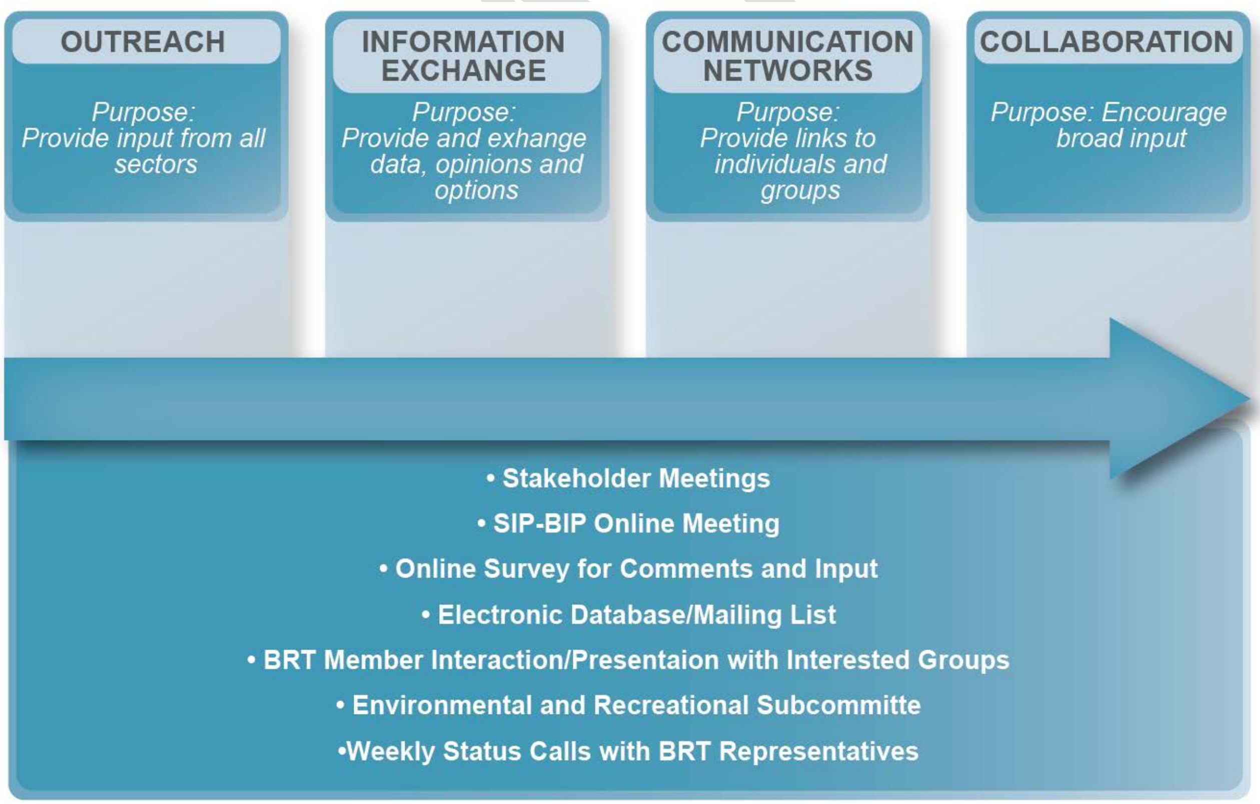

Figure 1-8. Public Involvement Mechanisms

1.4 The South Platte's Relationship to Statewide Water Needs and Programs

The eastern slope of Colorado is home to 80% of the state's population and accounts for 80% of the state's economy and tax base. It also represents a large portion of the agricultural, recreational, and tourism sectors of the state's economy. Eighty percent of the state's population and job growth is forecasted be on the eastern slope. With the regional interdependence of the state's economy, it is critical to Colorado's prosperity that the water supply gap be filled throughout the state.

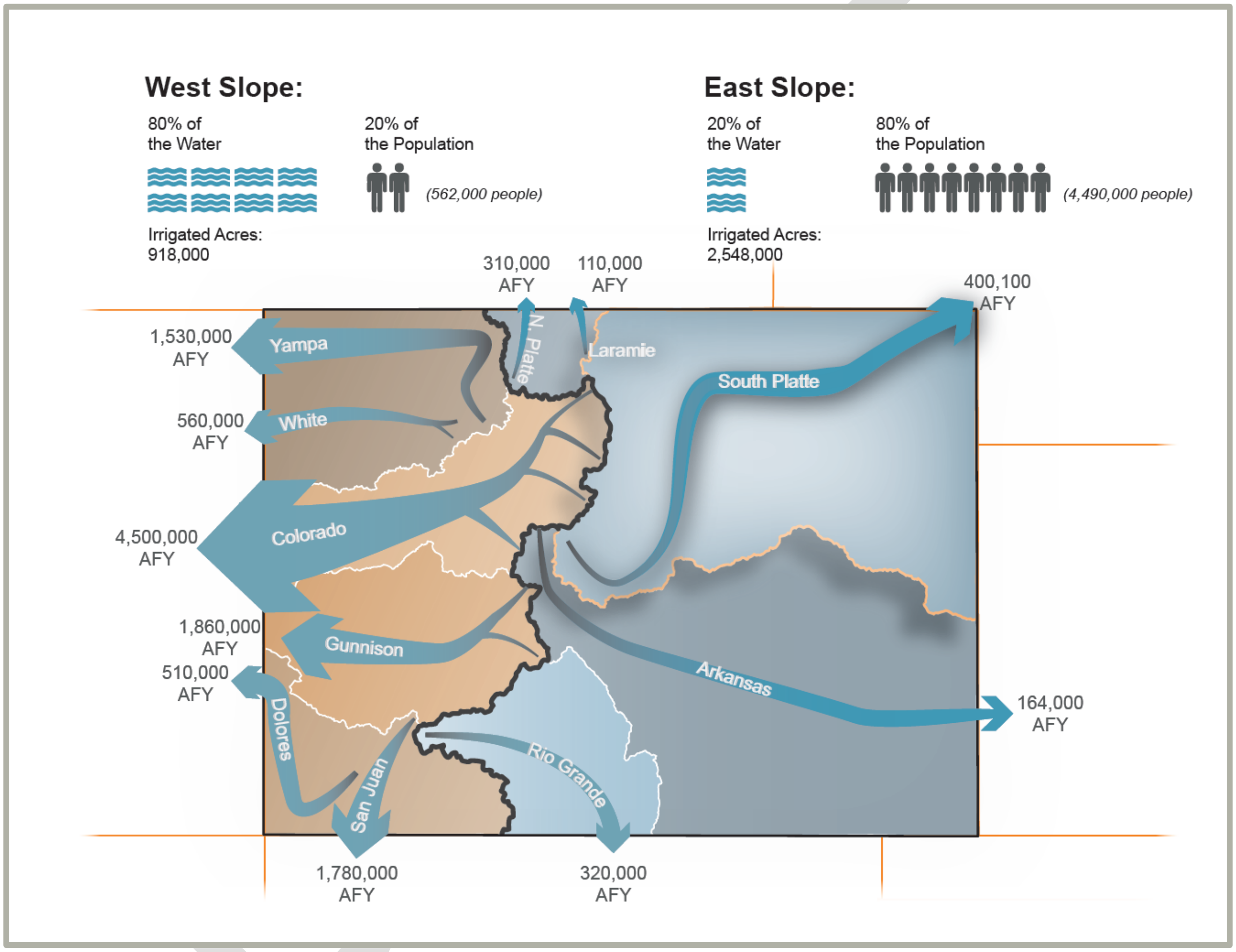

Figure 1-9. Colorado Population, Irrigated Acres and Flows

In addition to economic interdependency between the State's river basins, there are also many other important inter-relationships affecting our approaches to addressing our statewide water supply issues:

- Political inter-relationships – solving Colorado's long-term water supply problems will take collaborative political processes in the General Assembly and in the State's water and natural resource planning, regulatory and funding agencies. Many potential in-state approaches would require new legislation that would need to be applied uniformly and equitably across the State. Interaction with the nineteen states that receive water originating in Colorado must be lead by our State water managers. Interaction with federal water management and regulatory agencies needs to be handled consistently across river basins to maintain the State's water administration authorities. The degree to which the State can speak with a unified voice on potential future federal legislation and/or executive orders may also greatly affect our ability to implement water supply solutions. Hydrographic, environmental and recreational interconnections – The existing and potential future diversions of water from the Colorado to the South Platte and Arkansas Basins receives intense attention and scrutiny, but there are also many other water-related and environmental interconnections and co-dependencies that will benefit from continued collaborative statewide efforts. These include threatened and endangered species recovery programs, input on proposed changes to federal land and water management programs including designation of additional special use areas (e.g. wilderness areas, wild and scenic rivers, national recreation areas, etc.), forest management and fire response planning, invasive species migration and control and many other watershed and water quality programs that should be consistently applied across the State. The State and water users must consider the interdependency and interconnectedness of water diversions and uses with environmental and recreational flows and wetlands areas. Much of Colorado's economy and quality of life depends on these environmental and recreational attributes.

- Hydrographic, environmental and recreational interconnections – The existing and potential future diversions of water from the Colorado to the South Platte and Arkansas Basins receives intense attention and scrutiny, but there are also many other water-related and environmental interconnections and co-dependencies that will benefit from continued collaborative statewide efforts. These include threatened and endangered species recovery programs, input on proposed changes to federal land and water management programs including designation of additional special use areas (e.g. wilderness areas, wild and scenic rivers, national recreation areas, etc.), forest management and fire response planning, invasive species migration and control and many other watershed and water quality programs that should be consistently applied across the State. The State and water users must consider the interdependency and interconnectedness of water diversions and uses with environmental and recreational flows and wetlands areas. Much of Colorado's economy and quality of life depends on these environmental and recreational attributes. The South Platte Basin is home to many important environmental and recreational attributes that require thoughtful consideration during water planning processes.
- Cultural and social interconnections - Coloradoans typically show a great deal of pride in our State when interacting with each other as well as with people around the country and around the world. Our State is renowned worldwide for its natural beauty and the hospitality shown its visitors. We share a culturally rich heritage and generally seek collaborative solutions. We take pride in our western heritage, individualism and pragmatism, especially in federal legislative and executive agency interactions. These traits and traditions tend to unite us across river basins and help us relate to each other's challenges and potential solutions. As a trend (that is projected to continue), offspring of West Slope residents often find employment and raise families in new South Platte River Basin communities.

1.5 South Platte Water-Related Values

An important aspect of the State's previous water planning program was a comprehensive statewide "visioning" program. This work was the foundation for developing the values and long-term goals listed in the Governor Hickenlooper's May 2013 Executive Order for the development of Colorado's Water Plan. The South Platte and Metro Roundtables have reviewed and endorsed these water-related values and goals to help guide the development of the SP-BIP.

The South Platte Basin Implementation Plan is guided by Governor Hickenlooper's Executive Order and the State's "Long-Term Goals"

Governor Hickenlooper's Executive Order D2013-005 indicates that "*Colorado's water policy must reflect its 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." (Ref. 1, CWCB, 2013)

The following four "Long-Term Goals" were defined by the State to accomplish the directives in the executive order by meeting:

1. Community Water Needs throughout Colorado
2. Colorado's Agricultural Needs
3. Colorado's Environmental and Recreational Needs
4. Colorado's Water Quality Management Needs

Figure 1-10. Colorado's Long Term Goals

The South Platte and Metro Roundtables have also received public input supporting the following general concepts to help guide the development of the SP-BIP:

- Strong local planning and goal-setting processes (grassroots, bottom-up)
- Improving the efficiencies and timeliness of regulatory review and approval processes for water supply, environmental and recreational projects and programs
- Continued recognition of private property rights and compliance with Colorado's prior appropriation water administration doctrine
- Emphasis on voluntary and incentive-based programs; especially those involving temporary or permanent transfers of water from one water use sector to another
- Continued transparency, dialogue and information sharing among the interest parties (including the public; BRT members; other BRTs; elected officials; special interest groups and local, state and federal agencies)

1.6 South Platte Water Needs

The single biggest driver of the need for additional water supplies in the South Platte River Basin is population growth. The cities, towns, and rural communities on the eastern slope of Colorado are projected to have a water shortage by 2050 depending on many factors including future population growth rates, per capita water use rates and the degree to which currently planned water supply projects are successfully implemented. With high population growth and low project implementation rates, the water supply shortage could be even greater than 500,000 acre-feet per year. This east slope municipal water supply gap is about 75% of the projected statewide municipal supply gap (SWSI 2010).

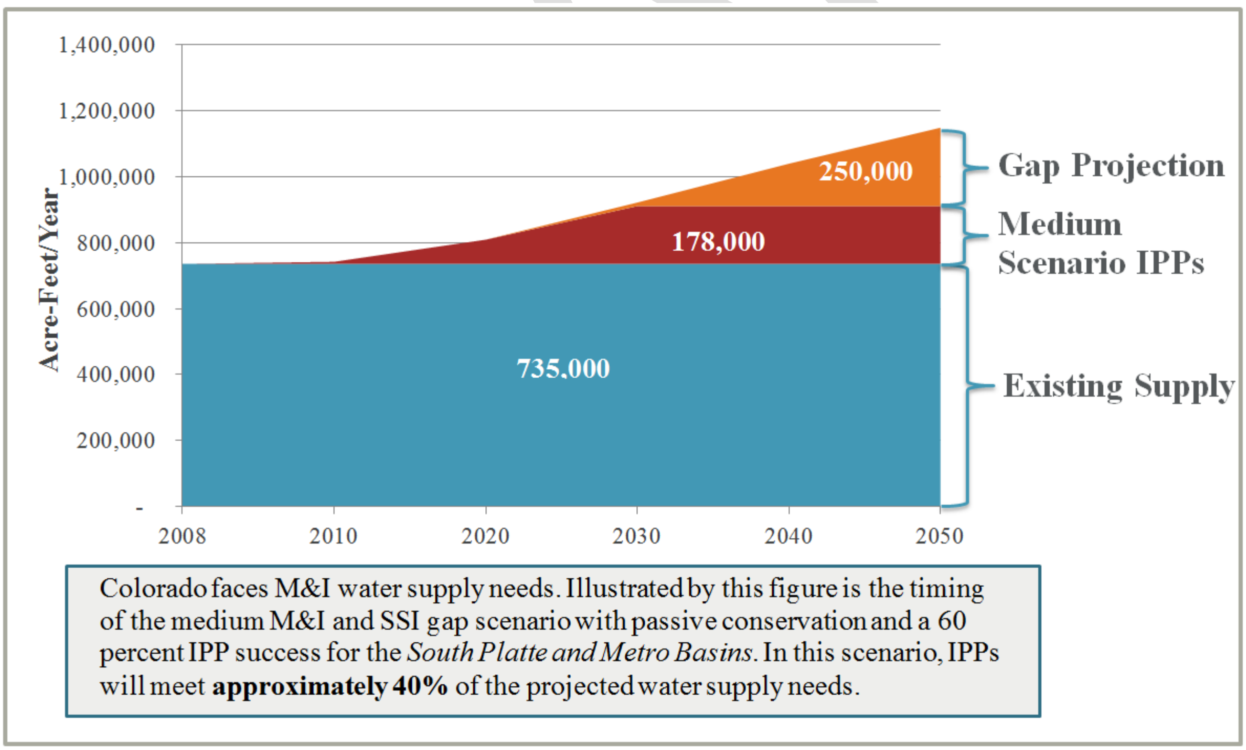

Figure 1-11. South Platte Metro Basin Medium Scenario M&I and Self Supplied Industrial (SSI) Gap Projection

Cities along the Front Range are national leaders in water conservation and reuse and will continue to make the most efficient use of their supplies. These cities have been struggling to obtain regulatory permits for incremental expansions to their water systems despite the environmental mitigation and enhancements these projects offer. As a result, municipal conservation programs have already been heavily implemented. Additional reuse of certain supply components including non-tributary groundwater and transbasin imports (with notable exceptions such as the Colorado-Big Thompson project for which subsequent use is not permitted) is possible but these projects can affect downstream water supply availability, water management flexibility and interstate water compact compliance.

In addition to these forecasted municipal and industrial water demands, there are also other major future water uses competing for limited water supplies including agricultural, environmental and recreational water needs.

Preserving agricultural production, rural communities and the environmental and aesthetic benefits from irrigated agriculture while also complying with the principles of private property rights will be key challenges in the South Platte River Basin. Voluntary and incentive-based programs will be needed to promote equity and to help maintain the most productive agricultural lands. According to Statewide Water Supply Initiative (SWSI) 2010, by 2050 the South Platte Basin is projected to experience a decrease in irrigated acres from 831,000 acres to 633,500 acres. Despite this decrease in irrigated acres a water shortage for agricultural uses is projected to continue. By 2050, the anticipated water shortage for agriculture in the South Platte Basin is projected to be 262,000 acre-feet per year (AFY).

Preserving and enhancing the environmental and recreational aspects of the South Platte River is important to Colorado's economy and quality of life. While these attributes do not typically consume as much water as other uses, water is necessary to maintain aquatic, riparian and wetlands habitats that are essential for ecological diversity. In addition, flows in streams are essential to many recreational economies, including fishing, skiing, whitewater and flatwater boating, waterfowl hunting and viewing, and for general aesthetics near waterways, including greenways, trails and wildlife viewing. These environmental and recreational aspects must be considered when planning for Colorado's water future. Many of these attributes currently suffer due to current water diversions and infrastructure operations. Multi-purpose projects or agreements for cooperative operation of existing projects to help benefit these important attributes should be considered when projects are planned to help meet water needs. Additional projects to address these needs may include environmentally friendly diversion structures, restoration of habitat and stream channels, and environmental pools in reservoirs with release timing to benefit the environment.

Because it is essentially fully appropriated, there is, unfortunately, extremely limited potential for additional development of supplies native to the South Platte River Basin. The Republican River Basin faces the same situation in addition to having to meet severe interstate compact compliance requirements.

With intense competition for limited water supplies, the SP-BIP must incorporate reasonable compromises among diverse interests and water uses based on careful consideration of the most critical water uses including agricultural, municipal, industrial, environmental and recreational needs.

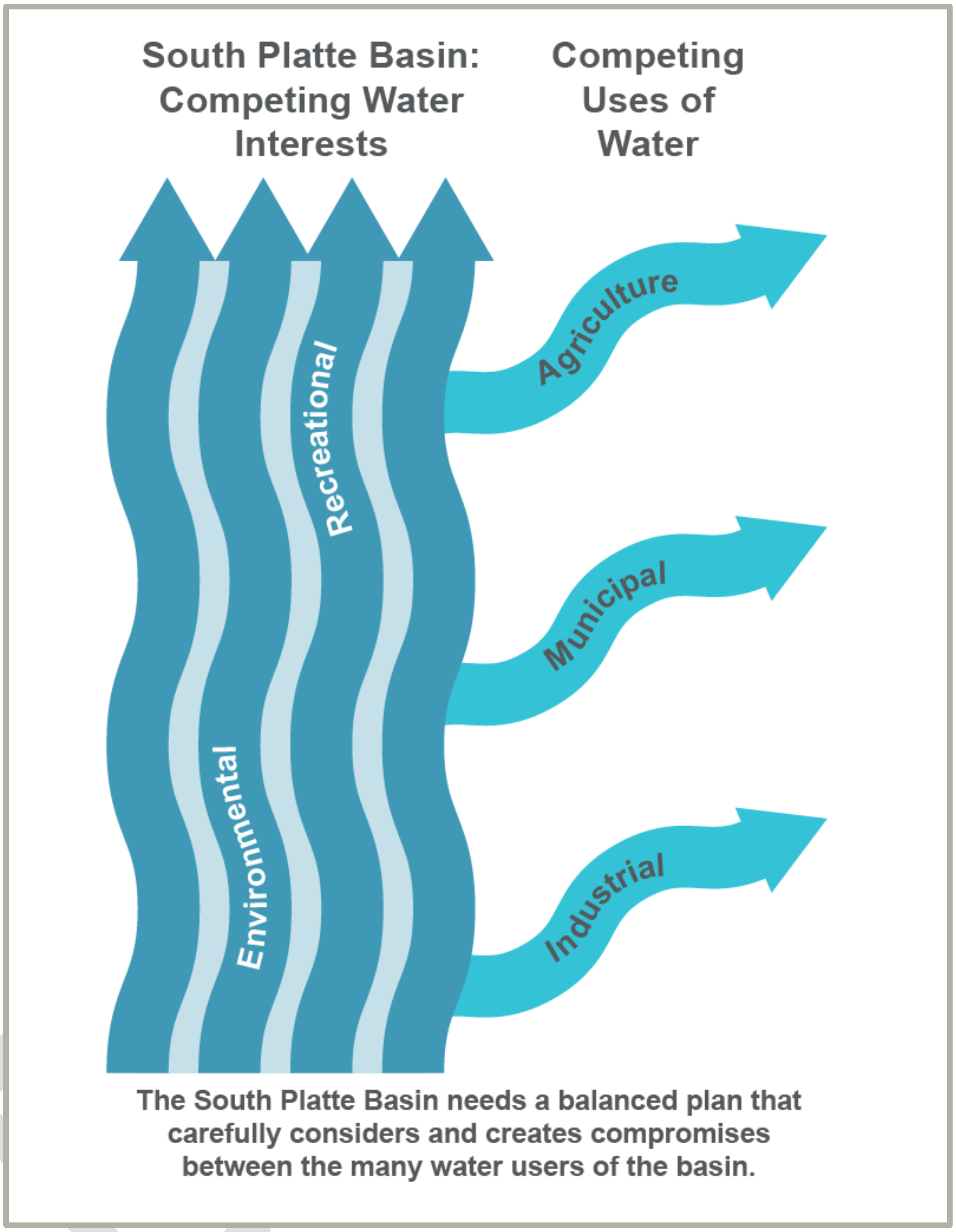

Figure 1-12. Creating a Balanced SP-BIP

In summary, there is no current comprehensive plan for South Platte River Basin water needs. Beyond conservation, reuse, and the system expansion projects incorporated in currently-listed identified projects and processes (IPPs), the default plan is the dry-up of hundreds of thousands of acres of agricultural land on the east slope, some of Colorado's most productive land. We reject this default plan and offer the following alternatives for inclusion into the upcoming Colorado Water Plan.

Our vision for meeting the east slope municipal supply gap is statewide support for:

1. Reaching enhanced levels of municipal conservation and reuse.
2. Successful permitting and development of planned municipal supply projects, considering environmental protections and benefits.
3. Continued research, testing, and use of agricultural and municipal water-sharing partnerships.
4. New water storage on the east slope using environmentally beneficial methods.
5. Investigating, preserving, and developing Colorado's allocation of Colorado River water.
6. When it is needed, development of state water project(s) using Colorado River water for municipal, agricultural and environmental uses on the east and west slopes.

The South Platte River Basin is committed to making the most of our locally available supplies to meet our water supply needs. This commitment includes reaching enhanced levels of conservation and reuse, developing new east slope storage, and using mutually beneficial water-sharing programs with agriculture. However, maximizing local supplies will require statewide political support and this has to be coupled with statewide political support for development of already planned supply projects and, potentially, a state water project(s).

1.7 Approach and Overarching Themes

Communication of complex and diverse goals is enhanced if these goals are organized to align with overall themes to support a unifying message. After reviewing the documents above and considering various conversations with South Platte Basin stakeholders, it seems that one of the key overarching messages that may need to be conveyed is that ***a good Colorado Plan needs a good South Platte Plan.*** The South Platte Basin Implementation Plan should recognize diversity in regional economies, cultural perspectives and values. The SP-BIP should also tend to unite the State in realizing the collective consumptive use and environmental and recreational benefits and the associated improvements in water supply security.

The economic and environmental inter-relationships across river basin boundaries are so strong that, as the South Platte Basin goes; so does the rest of the State. There are limitations to this, of course, but there are also other factors that argue for a broad, statewide approach to solving South Platte Basin water supply issues. This is especially true when considering Colorado's interstate water management and compact issues.

A theme expressed in many of the BRT documents and communication is that solutions for reducing the basin's water supply gaps need to be ***pragmatic, balanced and consistent with Colorado water law and property rights.*** For solutions to be pragmatic (implementable) they should be configured with an eye toward future permitting activities and regulatory approvals. Consistent with a goal of pragmatism is the concept that solutions should be balanced. When possible, 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

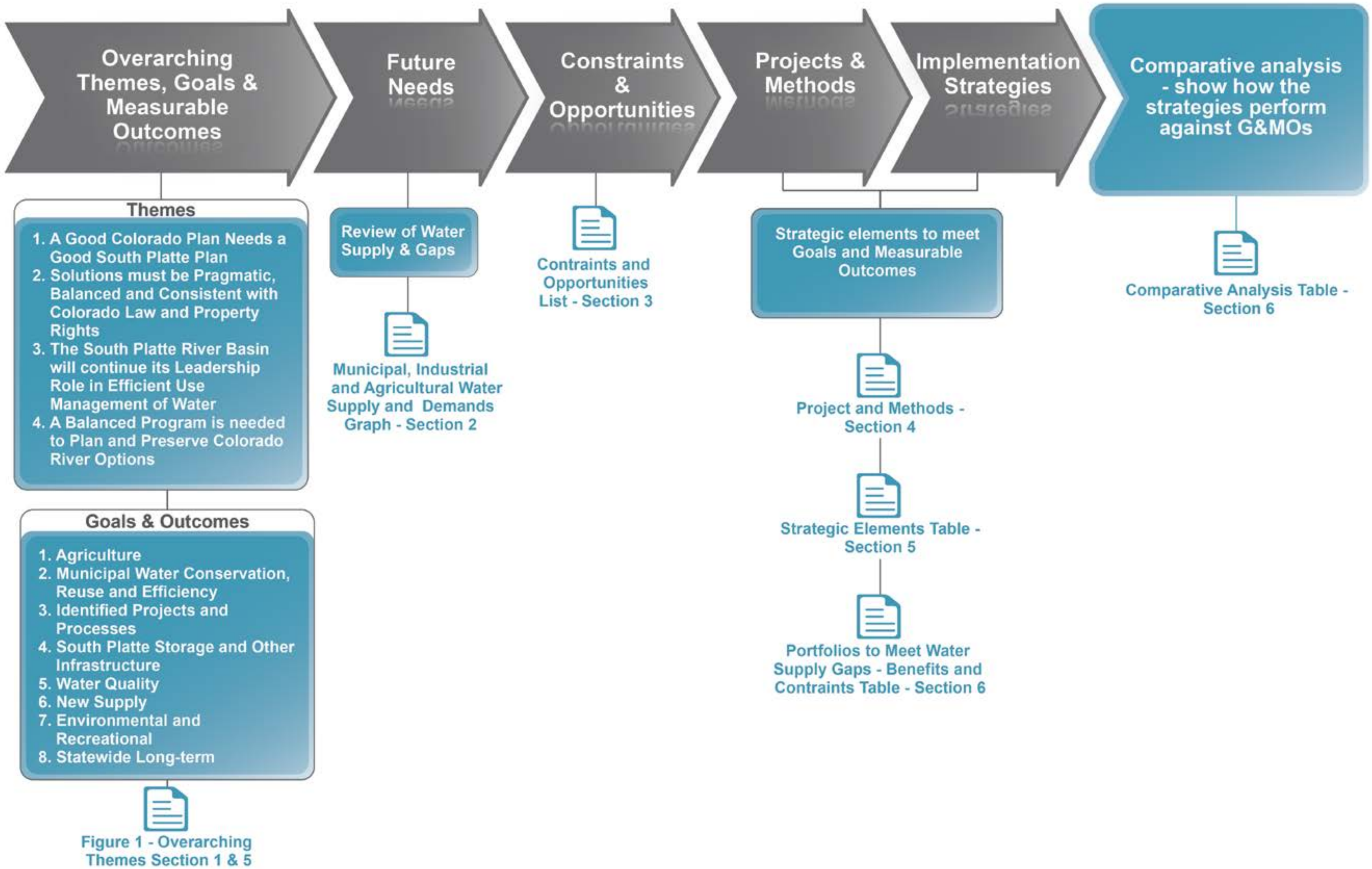

Figure 1-13. Basin Implementation Plan Development

Water supply solutions should also be capable of being integrated with multiple existing water supply systems and be consistent with Colorado water law and property rights. Implementation of currently defined IPPs is fundamental to the success of a South Platte Basin Implementation Plan and a high rate of approval is needed to allow a focus on longer term goals.

A commonly understood approach in Colorado water planning is the concept of the "Four Legs of the Stool." This approach uses an integrative strategy which recognizes that successful water planning in the State relies on four critical water supply tactics; IPPs, Conservation, New Supply and Agricultural Transfers. These tactics must also be supported through development of storage options. The SP-BIP employs this integrative approach to managing the Basin's resources for the future. This approach is consistent with Colorado law and property rights, and also has broad support and understanding among water professionals in the state.

To get broad in-basin and Statewide support, ***South Platte Basin water suppliers must continue to be cognizant and responsible in managing their water resources and supplies*** before support can be expected from each other and from other basins. If allowed to be viewed as promoters of poorly managed growth, the South Platte Basin can expect little support from many in-basin and transbasin neighbors. Fortunately, significant recent strides towards this theme can be cited (e.g. the Colorado River Cooperative Agreement and other project-related mitigation and enhancement plans). The State's water planning process can also be used to ***demonstrate that the South Platte and Arkansas Basins are leaders in sustainable water management practices that could be considered as guidelines, or possibly standards throughout the State.***

In summary, four overarching themes ***have been developed for the consideration of the South Platte Basin as a whole and not to bind any of its stakeholders to specific actions or requirements.*** The themes will help guide the development of Goals and Measurable Outcomes (G&MOs) in the SP-BIP and help communicate consistently with the State and other BRTs in the CWP development process:

APPROACH AND OVERARCHING THEMES

***A Good Colorado Plan Needs a Good South Platte Plan* -** The economies of the State's river basins are closely intertwined. A comprehensive South Platte Basin plan will need to be consistent with the values represented in Governor Hickenlooper's executive order. A comprehensive and reliable solution to meeting the South Platte Basin's consumptive, environmental and recreational water supply gaps benefits all of Colorado and all Coloradan's share the need for a viable South Platte plan. The "default" plan of continued and possibly extensive loss of agricultural production is not in Colorado's overall interest.

Solutions must be Pragmatic, Balanced and Consistent with Colorado Law and Property Rights – A useful basin implementation plan must deal with the realities of obtaining regulatory approvals.

***The South Platte River Basin will continue its Leadership Role in Efficient Use and Management of Water* -** No person, company or institution operates without risk/ perils of change. The State's future as a whole (and the future of each of its river basins) depends on efficient, sustainable and collaborative solutions.

***A Balanced Program is needed to Plan and Preserve Colorado River Options* -** A balanced program to plan and preserve options to responsibly develop Colorado River water to benefit both east slope and west slope consumptive, 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.

Figure 1-14. SP-BIP Overarching Themes

1.8 South Platte Solutions

Solutions to provide the water needed for the various consumptive (municipal, industrial, and agricultural) and nonconsumptive (environmental and recreational) water uses can be categorized in the following three groups:

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
3. Watershed health and water quality management

These types of solutions provide the foundation for identifying the Projects and Methods presented in later chapters that are configured to in relation the Goals and Measureable Objectives presented in the next section.

1.9 Goals and Measureable Outcomes

The CWCB has requested that each BRT prepare and submit G&MOs as part of their Basin Implementation Plans (BIP). These G&MOs will be used by the State to help inform and guide their development of CWP.

Guidance for developing the G&MOs is provided in the State's "DRAFT Supplemental Basin Implementation Plan Guidance for – Section 1: Goals and Measurable Outcomes, December 9, 2013". The State also provided three summary tables summarizing previous work related to potential South Platte Basin G&MOs. The first table listed seven (7) "Low/No Regrets" goals with actions that may be appropriate regardless of the course of future conditions such as the rate of sustained population growth and potential for increased hydrologic variability. The second table listed 12 "long-term" goals that may be appropriate depending on the trajectories that water demand factors such as population growth and climate take over the next decade or so. These 19 potential goals are accompanied by numerous potential measurable outcomes and by potential BIP actions and other information from the previous East Slope Roundtable "white paper" recommendations.[1] There are also many other key references that support the development of G&MOs including, but not limited to, the South Platte Needs Assessment, the Metro Needs Assessment, East Slope Water Supply Paper and records of previous BRT and Interbasin Compact Committee (IBCC) meetings (especially the July 2013 Joint BRT meeting and its polling process results).

The documents referenced above reflect serious consideration by diverse stakeholders over several years and many meetings. Many of the comments offered by South Platte and Metro BRT members have encouraged extensive use of this work (not going backwards). However, there have also been many comments that the measurable outcomes in the CWCB table and other documents that are expressed numerically were the result of initial brainstorming and/or portfolio tool analysis and are not supported by appropriately detailed technical analysis. Comments have expressed concern about the BRTs ability to review and either adopt or modify these numbers in the time frame allocated by the state. Other comments have suggested a strong desire to simplify things, to communicate effectively and to ***focus on the highest priority goals and messages that the South Platte Basin wants to communicate to the rest of the State in the CWP process.***

[1] Note – the East Slope Roundtable "white paper" did not take the environmental, recreational, and agricultural gaps into consideration. This joint statement focuses on what the Basins learned about the municipal gap by going through the portfolio planning tool exercise that all the Basins did for their municipal supply gaps.

Presented below are goals in eight (8) categories that support the four overarching themes presented previously:

1. Agriculture
2. Municipal Water Conservation, Reuse and Efficiency
3. Identified Projects and Processes
4. South Platte Storage and Other Infrastructure
5. Water Quality
6. New Colorado River Supplies
7. Environmental and Recreational
8. Statewide Long-term

Goals and Measureable Outcomes related to environmental and recreational needs and uses were developed by the Environmental and Recreational Subcommittee established by the BRTs with West Sage Water Consultants under separate contract.

Agriculture

Goal: 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.

> **MO#1** –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.
>
> **MO#2** – Support strategies by municipalities and other local and state land use authorities that reduce urbanization on irrigated acreage.
>
> **MO#3** – Support strategies to address agricultural water shortages through IPPs, new multi-purpose projects and innovative measures to maximize use of available water supplies.
>
> **MO#4** – Develop local tools and political/community support for tools to sustain irrigated farmland.
>
> **Nonconsumptive (NC) MO#1** – Encourage maintenance of existing wetlands in focus areas associated with agricultural lands.
>
> **NC MO #2** - Ensure agricultural dry-up and alternatives take into consideration environmental and recreational focus areas and attributes.

Municipal Water Conservation, Reuse and Efficiency

Goal: Continue the South Platte River Basin's leadership in wise water use.

> **MO#1** – Further quantify the successes of programs implemented in the past several years throughout the South Platte River Basin and establish a general baseline against which the success of future programs will be assessed.

MO#2 – Distribute and encourage adoption of "best management practices" as "guidelines" (not standards) for M&I water suppliers to consider in their "provider-controlled" programs recognizing the significant differences in climates, cultures and economic conditions throughout the South Platte River Basin.

MO#3 – 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.

NC MO#1 – Ensure conservation, reuse and drought management plans take into consideration environmental and recreational focus areas and attributes.

IPP Implementation

Goal: Bring a high percentage of entries in the updated IPP list on-line as a key strategy consistent with the "no/low regrets" scenario planning approach.

MO#1 – Maximize implementation of the updated IPP list.

NC MO#1 - Encourage projects that also provide environmental and recreational considerations.

NC MO#2 – Foster opportunities to improve environment and recreation conditions of affected watersheds in association with IPPs.

South Platte Storage and Other Infrastructure

Goal: To the extent possible, develop multipurpose 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.

MO#1 – Explore opportunities to maximize yield from additional South Platte Basin strategic and multipurpose storage and other infrastructure including collaborative inter-connections between water supply systems and including both above ground and groundwater (e.g. ASR) storage.

NC MO #1 - Encourage multipurpose projects that provide environmental and recreational considerations.

NC MO#2 - Take into consideration environmental and recreational attributes when considering Storage and Other Infrastructure projects and methods.

Water Quality

Goal: Maintain, enhance and proactively manage water quality for all use classifications.

MO#1 – Maintain or improve the delivery of safe water supplies throughout the basin.

NC MO#1 – Monitor, protect and improve watershed water quality and identify and document progress and improvements.

NC MO#2 – Improve areas where water quality may be limiting the suitability of focus areas identified by BRTs through environmental and recreational mapping efforts.

New Colorado River Supplies

Goal: Develop agreements governing additional transbasin water imports that: 1) are in accordance with the South Platte Basin's overarching theme that economic and environmental and recreational benefits should equitably accrue to both the West Slope and the East Slope; 2) include project(s) or project elements that provide multiple types of uses; 3) supported with State investment and 4) provide enough certainty in conditions to significantly lessen current trends of traditional buy-and-dry transfers from agricultural uses to M&I uses.

MO#1 – Negotiate a conceptual agreement with the West Slope BRTs on investigating, preserving, and developing potential options so that future multipurpose projects benefiting both slopes can be addressed on a timely basis.

NC MO#1 - Encourage multipurpose projects that provide environmental and recreational considerations.

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.

Please note the inclusion of existing projects below is to encourage cooperative agreements when and where possible. This language does not suggest scrutinizing existing projects but rather continuing to keep the focus areas in mind when possible cooperative re-operation or enhancements with willing project owners may benefit the environmental and recreational attributes.

NC MO #1 – Promote Restoration, Recovery, and Sustainability of Endangered, Threatened, and Imperiled Aquatic, Riparian and Wetland Dependent Species and Plant Communities:

i. Maintain or increase the habitat for federally and state listed threatened and endangered species or plant communities.

ii. Maintain or increase habitats in the nonconsumptive focus areas with imperiled species or plant communities and secure the species in these reaches as much as they can be secured within the existing legal and water management context

iii. Maintain or increase the wetland, lake or stream habitat used by migratory and breeding birds.

NC MO #2 – Protect and Enhance Economic Values to Local and Statewide Economies Derived from Environmental and Recreational Water Uses, Such as Fishing, Boating, Waterfowl Hunting, Wildlife Watching, Camping, and Hiking

i. Maintain or increase the surface area, stream miles or public access for recreational opportunities of high economic value.

ii. Maintain or increase the miles and general appearance of trails and greenways to promote aesthetic values and quality of life.

iii. Maintain or increase public access to fishing opportunities in lakes and streams.

iv. Maintain or increase the total area for birding, waterfowl hunting and wildlife viewing.

v. Maintain or improve the amount of river miles or flatwater surface acres available to river and flatwater boaters.

NC MO #3 – Protect, Maintain, and Improve Conditions of Streams, Lakes, Wetlands, and Riparian Areas to Promote Self-Sustaining Fisheries and Functional Riparian and Wetland Habitat to Promote Long-Term Sustainability

i. Maintain or increase the number of stream miles or surface area of streams, lakes, wetlands and riparian areas for self-sustaining aquatic species populations, and wetland/riparian habitat.

ii. Maintain or improve fish habitat by providing habitat enhancements, eliminating dry up points, and promoting connectivity.

iii. Maintain or improve watershed health through source water protection, wildfire mitigation, sedimentation control and erosion control.

iv. Encourage existing and develop innovative tools to protect instream flows where appropriate.

Statewide Long-term Goals

The South Platte Basin has four additional statewide goals supporting the values stated in the Governor's Executive Order.

MO#1 – 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, multipurpose projects and methods; and 3) Assuring strong drought protection programs through broad development of protection plans and dedicated reserves potentially including storage, interruptible service agreements (ISAs), water banks, water use restrictions and non-tributary groundwater, etc.

MO#2 – Meet Colorado's Agricultural Needs by: 1) Ensuring that irrigated agriculture remains a viable statewide economic driver and supports food security, jobs and rural communities and protects private property rights; 2) Meeting agricultural water demands through IPPs and other multipurpose projects and 3) Implementing efficiency and conservation measures to reduce agricultural water shortages.

MO#3 – Meet Colorado's Environmental and Recreational Needs through the goals and outcomes as discussed in Section 1.9.7.

MO#4 – Meet Colorado's Water Quality Management Needs by continuing to provide safe and reliable water and proactively managing water quality for all use classifications.

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2

Future Water Needs: Municipal & Industrial, Agricultural, Environmental & Recreation

2 Future Needs: Municipal & Industrial, Agricultural, Environmental & Recreational

Key Points:

- Between 2008 and 2050, the South Platte Basin is projected to grow from approximately 3.5 million to about 6 million people.
- Municipal and Industrial (M&I) water usage is expected to nearly double with Colorado's projected 2050 population. The South Platte water supply gap is defined by the difference between the existing supplies and the 2050 The combined M&I and self-supplied industrial water supply gap for 2050 may reach 428,000 AFY under a medium level demand scenario.
- Agricultural is critical to Colorado's overall economy and even though irrigated land may decrease by 160,000-235,000 acres as water is transferred to municipal uses, significant water needs will remain to sustain strong agricultural production.
- Preserving and enhancing the environmental and recreational aspects of the South Platte River is important to Colorado's economy and quality of life. Water is necessary to maintain aquatic, riparian and wetlands habitats that are essential for ecological diversity. In addition, flows in streams are essential to many recreational economies, including fishing, waterfowl hunting and boating, and for general aesthetics near waterways, including greenways, trails and wildlife viewing. The current environmental and recreation conditions must be assessed, with consideration of the potential for future changes driven by water supply decisions that may impact environmental and recreational attributes.

This section of the SP-BIP summarizes the consumptive and non-consumptive needs evaluations documented in both the SWSI 2010 Metro and South Platte Basin Reports. The SP-BIP does not include quantified updates of the future needs of the Metro Basin or the South Platte Basin, but rather provides a summary of the needs of each basin to be used by the BRTs to measure progression towards meeting the goals and objectives presented in Section 1. An update of the Basin needs will be a part of the SWSI 2016 update process.

The following subsections are extracted from the SWSI 2010 Metro and South Platte Basin reports, exceptions are noted.

2.1 Municipal and Industrial Needs

Projections for M&I and SSI water needs in the South Platte Basin were calculated using standard methods. In developing these projections, the objectives were to develop a reconnaissance level water use forecast that employs consistency in data collection and forecast methodology across the state, and maximizes available data. The methods utilized herein are for the purpose of general basinwide planning. They are not intended to replace demand projections prepared by local entities for project-specific purposes.

Reference Documents

The following discussion is extracted from:

SWSI 2010 Metro (& South Platte) Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments - Section 4

The M&I water demands forecast takes a "driver multiplied by rate of use" approach. This is a commonly accepted forecast methodology that accounts for changes in water demand resulting from changes in the driver. County and statewide population projections are the most accepted predictor of future growth for the state. Therefore, the driver for the M&I water demands forecast is population and the rate of use is gallons per capita per day (gpcd).

2.1.1 Future Population Projections

Population projections were estimated using the forecasting process and models utilized by the Colorado State Demographer's Office (SDO). Because of the uncertainty in projecting economic conditions and employment levels in 2050, low, medium, and high scenario population projections were developed. A detailed analysis of the population projections is included in Appendix H of the SWSI 2010 Report, an analysis of the South Platte basin's water supply needs and recommendations for an implementation phase to determine and pursue solutions to meeting South Platte's consumptive and nonconsumptive supply needs.

2.1.1.1 2050 POPULATION PROJECTION METHODOLOGY

The first step in developing 2050 population projections was to identify a population forecasting methodology that could meet the needs of the 2050 water demand projections. These included:

- The forecasting methodology must be valid and widely acceptable, both by users of the results and demographic forecasting practitioners.
- The forecasting approach must be transparent and understandable to the extent possible.
- The projections must be replicable.
- In keeping with state-of-the-art practice employed by the SDO, the projections must be economically based and then linked to demographic factors in an integrated manner.
- The projections must be able to produce population forecasts for each county to the year 2050 under high, medium, and low economic development assumptions.

It was determined that the forecasting process and models utilized by the SDO and its consultant, the Center for Business and Economic Forecasting (CBEF), met all of those criteria. Therefore, the SDO forecasting process was adopted for the 2050 effort.

As of 2010, the SDO/CBEF projections are available through the year 2035. It was determined that the forecasting models, equations, and algorithms could be extended or adjusted as needed from 2035 to 2050. To adjust the models from 2035 to 2050 assumptions regarding the national and international driving forces behind Colorado's basic economic sectors were developed.

Basic economic sectors include those activities that bring money and economic stimulus into a geographic area. Employment was projected for each of Colorado's basic economic sectors based on what were assumed to be the driving forces behind those basic sectors. Along with projections of basic employment, industry-specific employment multipliers were applied to arrive at total Colorado jobs in 2050.

Because of the uncertainty in projecting economic conditions and employment levels in 2050, low, medium, and high employment scenarios were developed for each key employment sector, leading to low, medium, and high population projections. Each of the scenarios reflects unique assumptions for the economy and for each employment sector. These assumptions are detailed in Appendix H of the SWSI 2010 Report.

Additionally, the populations for counties spanning two or more basins were allocated proportionately into each basin based on estimates of known population centers within each basin.

2.1.1.2 2050 POPULATION PROJECTION RESULTS

Between the years 2008 and 2050, the State of Colorado is projected to grow from approximately 5.1 million people to between 8.6 million and 10 million people. Under low economic development assumptions, state population is projected to grow to about 8.6 million people, or by about 71 percent. Under high economic development assumptions, including an oil shale industry of 550,000 barrels per day, the State's population is projected to grow to just over 10 million people, or by 98 percent, as compared to Colorado's 2008 population. On average, statewide population projections from 2008 forward indicate an increase of about 1.4 million people every 15 years.

Reference Documents

The following discussion is extracted from:

SWSI 2010 Metro (& South Platte) Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments - Section 4

Based on SDO population projections, the Arkansas, Metro, and South Platte Basins will continue to have the largest population in the state. However, the West Slope will continue to grow at a faster rate than the Front Range of Colorado. Table 2-1 shows population growth within the South Platte and Metro Basins during the next 40 years.

Figure 2-1 shows how population growth will vary throughout the South Platte Basin at the county level. As the most populous river basins in the state, the South Platte and Metro Basins are projected to grow from approximately 3.5 million people in the year 2008 to about 6 million people by the year 2050. This amounts to an increase of about 2.5 million people, or about 73 percent, during that period. In 2008, about 69 percent of all Colorado residents resided in the South Platte Basin; by the year 2050 that proportion will decrease slightly to about 66 percent. Consistent with predicted population trends, the South Platte and Metro Basins have the highest employment of all basins, totaling over 2 million jobs in 2007. Over 3.4 million job opportunities are expected by 2050. Regional and national service jobs led employment in 2007 and will remain the largest source of employment in these basins in 2050. Household basic sector employment is anticipated to grow more rapidly than other basic sectors (174 percent increase between 2007 and 2050), and tourism jobs are expected to grow by about 83 percent over the same period.

Table 2-1. Population Projections

Basin	2008	2035	Percent Change 2008 to 2035	Percent Average Annual Growth Rate	2050			Percent Change 2008 to 2050	Percent Average Annual Growth Rate
					Low	Medium	High		
Metro	2,513,000	3,622,000	44	1.4	4,018,000	4,144,000	4,534,000	60-80	1.1-1.4
South Platte	977,000	1,622,000	66	1.9	1,808,000	1,902,000	2,065,000	85-111	1.5-1.8
Total	**3,490,000**	**5,244,000**	**50**	**1.6**	**5,826,000**	**6,046,000**	**6,599,000**	**67-89**	**2.0-2.5**

Source: Table 4-1 SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment

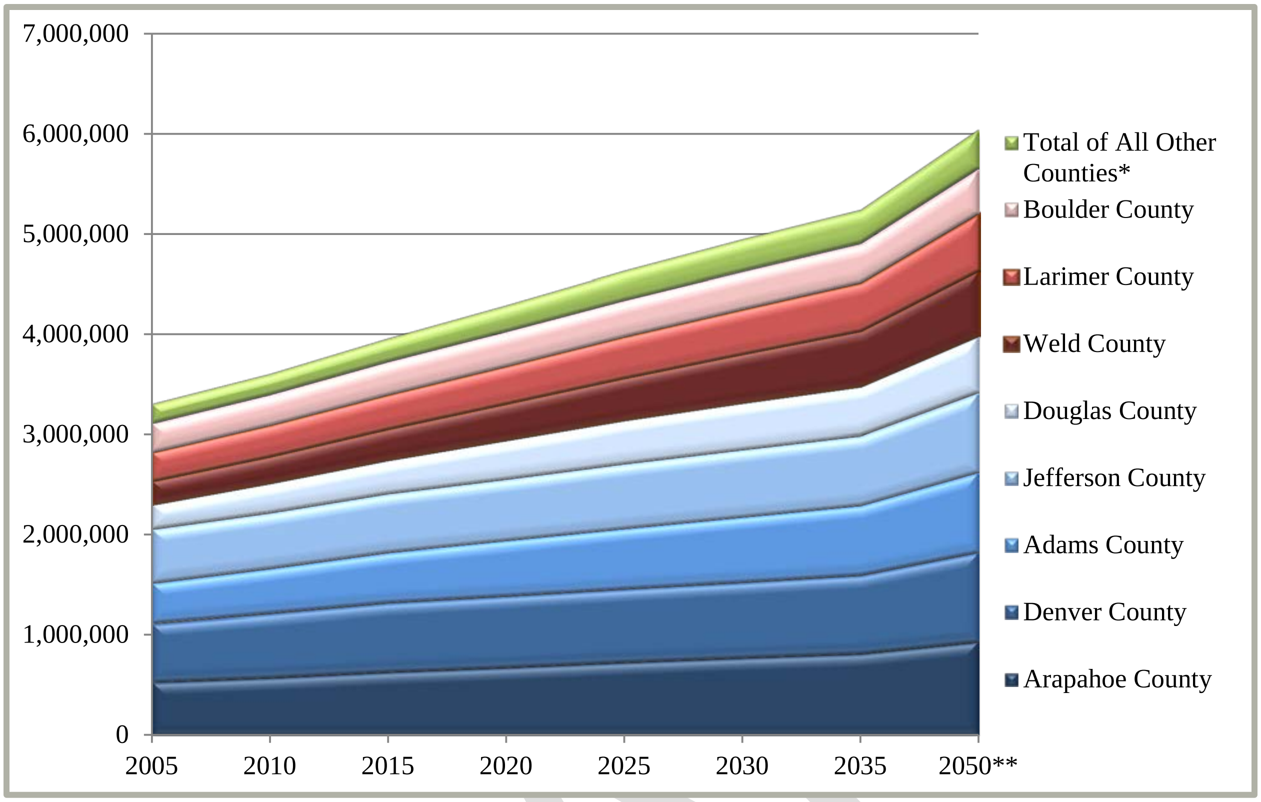

Figure 2-1. South Platte and Metro Basin Population Projection by County through 2050

Source: SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment and SWSI 2010 Metro Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments
* Referenced counties are Broomfield, Morgan, Elbert (Metro portion), Park, Logan, Teller (South Platte portion), Clear Creek, Yuma, Gilpin, Kit Carson, Washington, Phillips, Sedgwick, Cheyenne (South Platte portion), and Lincoln (South Platte portion).
** 2050 Population Projections reflect medium growth

2.1.2 Projected 2050 M&I Water Demands

The goal of the M&I demand forecast is to capture the water needs of an increased population. M&I demands include the water uses typical of municipal systems, including residential, commercial, light industrial, nonagricultural-related irrigation, non-revenue water, and firefighting. For this report, the M&I demand forecast also captures households across the Basin that are self-supplied and thus not connected to a public water supply system.

Reference Documents

The following discussion is extracted from:

SWSI 2010 Metro (& South Platte) Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments - Section 4

Table 2-2 contains the definitions of the M&I demand terms used throughout this report.

Table 2-2. Definition of M&I Demand Terms

Demand Terminology	Definition
Municipal & Industrial Demand	All the water users of typical municipal systems, including residential, commercial, industrial, irrigation, and firefighting
Self Supplied Industrial Demand	Large industrial water uses that have their own water supplies or lease raw water from others
Municipal & Industrial Demand and Self Supplied Industrial Demand	The sum of M&I and SSI demand
Source: Table 4-2 SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment	

The demand projections presented in this document include baseline demands (without passive conservation) as well as baseline demands minus passive conservation. Passive conservation refers to water demand reductions associated with the impacts of state and federal policy measures, such as the implementation of high efficiency water fixtures and appliances, and does not include active conservation measures and programs sponsored by water providers.

It is important to mention that the M&I demand forecasts do not include potential increases in demand due to climate change or potential decreases in demand due to active conservation programs.

Even with passive conservation savings, the M&I water usage is expected to nearly double with Colorado's projected 2050 population. South Platte and Metro municipal water demands are estimated to increase from 643,000 acre-feet per year AFY to 880,000 AFY by 2035 and 1 million AFY by 2050 under medium demand scenarios. This requires an additional 237,000 AFY of water to meet the basin's municipal water needs in 2035 and an additional 357,000 AFY of water to meet the basin's municipal water needs in 2050.

Table 2-3. M&I Demand Forecast by Basin Counties and Figure 2-2 illustrate the M&I water demand projections including passive conservation savings for each of the counties in the South Platte and Metro basins.

Table 2-3. M&I Demand Forecast by Basin Counties

County	Water Demand (AFY)	Baseline Water Demands (AFY)				Water Demands with Passive Conservation (AFY)			
	2008	2035	2050 Low	2050 Medium	2050 High	2035	2050 Low	2050 Medium	2050 High
SOUTH PLATTE BASIN									
Boulder County	59,000	77,000	86,000	89,000	97,000	69,000	77,000	80,000	88,000
Cheyenne County	58	68	72	80	90	61	64	72	82
Clear Creek County	2,400	3,800	4,300	4,700	5,300	3,600	4,000	4,400	5,000
Gilpin County	450	700	850	1,100	1,300	550	680	900	1,200
Kit Carson County	3,100	3,600	4,000	4,300	4,700	3,400	3,800	4,100	4,500
Larimer County	59,000	95,000	110,000	110,000	120,000	86,000	97,000	100,000	110,000
Lincoln County	220	280	310	340	370	260	290	320	350
Logan County	7,900	12,000	13,000	14,000	15,000	11,000	12,000	13,000	14,000
Morgan County	7,800	13,000	14,000	15,000	16,000	12,000	14,000	14,000	16,000
Park County	2,200	4,900	5,300	5,500	5,900	4,400	4,700	4,900	5,200
Phillips County	2,000	2,200	2,300	2,400	2,700	2,100	2,200	2,300	2,500
Sedgwick County	950	1,100	1,200	1,300	1,300	1,000	1,100	1,200	1,300
Teller County	10,000	16,000	17,000	19,000	20,000	14,000	15,000	17,000	19,000
Washington County	1,700	1,800	1,900	2,000	2,200	1,700	1,800	1,900	2,100
Weld County	53,000	120,000	130,000	140,000	150,000	110,000	120,000	130,000	140,000
Yuma County	3,200	3,800	4,000	4,300	4,700	3,500	3,700	4,000	4,500
METRO BASIN									
Adams County	69,000	110,000	120,000	130,000	140,000	98,000	110,000	110,000	120,000
Arapahoe County	100,000	150,000	170,000	170,000	190,000	140,000	150,000	160,000	170,000
Broomfield County	11,000	17,000	19,000	20,000	22,000	16,000	17,000	18,000	20,000
Denver	110,000	140,000	160,000	160,000	180,000	130,000	140,000	140,000	160,000
Douglas	46,000	81,000	90,000	93,000	100,000	73,000	81,000	84,000	93,000
Elbert County	86	240	260	270	280	230	250	260	270
Jefferson	94,000	120,000	130,000	140,000	150,000	100,000	120,000	120,000	130,000
Total	**643,064**	**973,488**	**1,083,492**	**1,126,290**	**1,228,840**	**879,801**	**975,584**	**1,010,352**	**1,107,002**

Source: Table 4-3 SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment and SWSI 2010 Metro Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments.

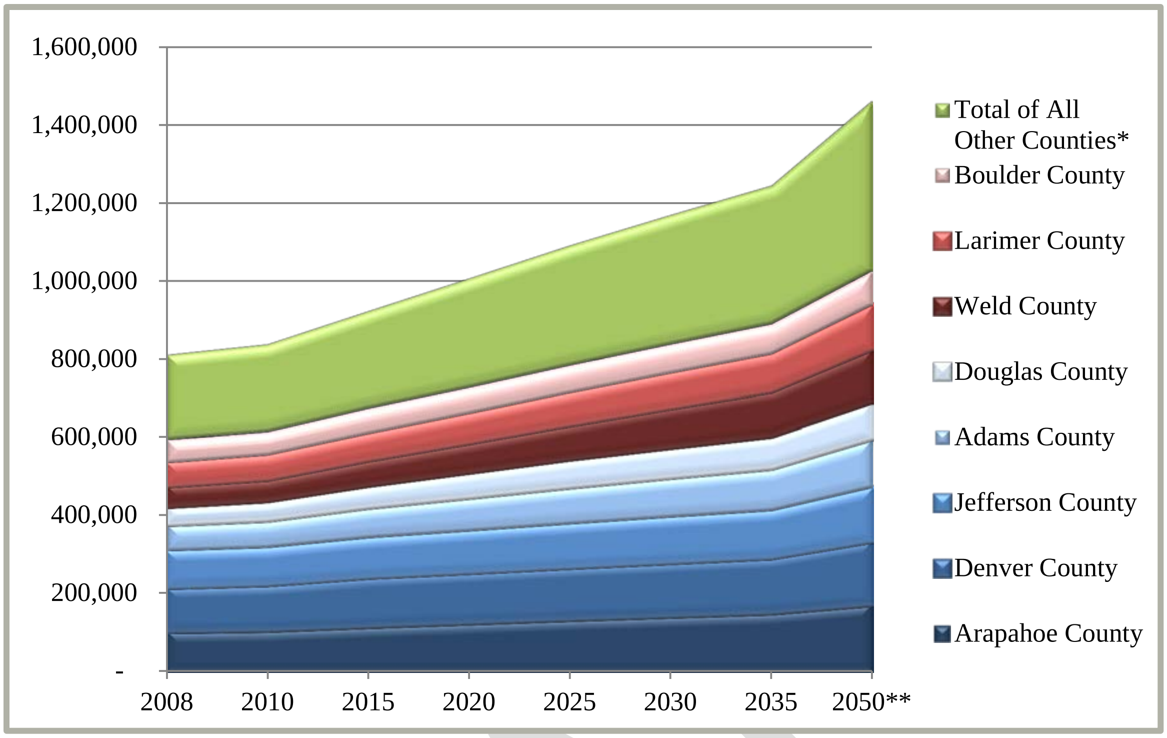

Figure 2-2. Metro and South Platte Basin M&I Water Demands with Passive Conservation

Source: SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment and SWSI 2010 Metro Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments.

** Referenced counties are Broomfield, Morgan, Elbert (Metro portion), Park, Logan, Teller (South Platte portion), Clear Creek, Yuma, Gilpin, Kit Carson, Washington, Phillips, Sedgewick, Cheyenne (South Platte portion), and Lincoln (South Platte portion). ** 2050 Demand Projections reflect medium growth.*

2.1.3 SSI Water Demands

Standard methods were adapted for use in SWSI for estimating future SSI water demands throughout the South Platte Basin. SSI water demands include water use by self-supplied and municipal provided large industries.

> **Reference Documents**
>
> The following discussion is extracted from:
> SWSI 2010 Metro (& South Platte) Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments - Section 4

The subsectors that are included in SSI are:

- Large industries, including mining, manufacturing, brewing, and food processing
- Water needed for snowmaking
- Thermoelectric power generation at coal- and natural gas-fired facilities

Minimal energy development was predicted within the Metro or South Platte Basin during the SWSI 2010 assessment. The energy development industries in the South Platte Basin enhance economic growth within the basin and the availability of water resources is vital to their growth. Water management and drought planning are a major concern of energy producers because the availability of water is critical to their industry.

As the population continues to grow in the South Platte Basin, citizens will continue to expect reliable and affordable electricity. Water conservation continues to get increasing attention from energy researchers, planners, and the citizens of the South Platte Basin. Water is essential to developing and generating energy. According to the Colorado Division of Water Resources, the power plants within the State of Colorado withdraw approximately 64,500 acre feet of water annually, and consume about 90 percent of that. That's enough water to meet the needs of more than 350,000 people, although in exchange, these plants generate more than 87 percent of the electricity used in Colorado.

As compared to other sectors of water use in Colorado, energy production diverts a relatively small amount of water. Figure 2-3 illustrates the amount of water withdrawals from each sector is Colorado.

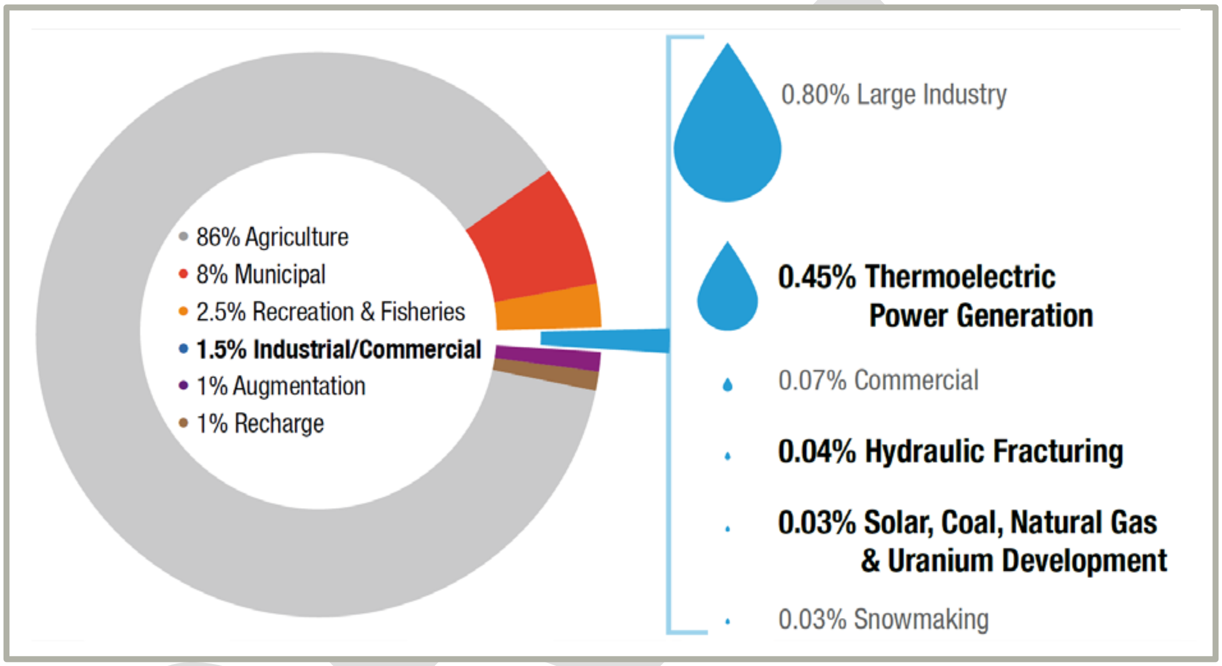

Figure 2-3. Water Withdrawals in Colorado

Source: Headwaters. Colorado Foundation for Water Education. The Energy Issue. Fall 2013.

Natural gas plants use less water and are more efficient; however, the amount of water used in the process of obtaining natural gas through drilling and hydraulic fracturing is a major point of criticism from opponents. Depending on the depth of a well, an operator may use from 2 million to over 5 million gallons of water to initially drill and frack a site, a volume significantly greater than that required for conventional drilling.[1] The fracking process typically contaminates most of the fracking water. However, most operations in the South Platte Basin are implementing treatment technologies to allow reuse of fracking water.

Another concern of fracking is the potential impacts to water quality. In the past, there have been spills and other evidence of mistakes, but with 51,000 active wells in Colorado, most of them fracked, the chemicals used in the process have never been shown to migrate underground to drinking water supplies.

[1] Headwaters. Colorado Foundation for Water Education. The Energy Issue. Fall 2013.

Aquifers tapped for drinking water are typically found within 1000 feet of the surface. Oil and gas drillers plunge concentric circles of steel pipe through these shallower layers of rock containing potable water, encase the pipes in layers of concrete, then drill much deeper through impermeable layers called cap rocks. In layers 3,000 to 10,000 feet below ground are hydrocarbons and also more water. This deep water is usually salty, high in dissolved minerals, and unfit for human consumption.[2]

Theoretically, potable groundwater supplies can be harmed by drilling and hydraulically fracturing a well if the steel casing or concrete lining of the well bore fails or if the fractures themselves create pathways extending thousands of feet upward. Design standards and regulations are in place to monitor the integrity of well casings, which must extend below potable groundwater supplies. Of the 38,000 wells drilled in Colorado since 1990, there have been 15 cases where well-bore failures led to groundwater contamination by methane, the primary component in natural gas. Most of these failures, however, occurred prior to 2008, when state rules were changed to require steel casing and concrete extended 50 feet below the deepest aquifer being used for drinking water.[2]

Of greater concern in recent media is produced, or formation water, which is water pre-existing in hydrocarbon-containing formations that must be removed to bring up the oil and gas. In the case of coalbed methane wells, which are shallower than other oil and gas wells, the quality of the water is typically high and, in some cases, may be released into streams with little or no treatment. Produced water from deeper sandstone formations is high in salt content and dissolved solids.

Weld County is Colorado's highest oil and gas producing county, producing approximately $4 billion dollars a year in revenues.[2]

Table 2-4 summarizes the SSI demands by county. Detailed discussions of data sources, methodologies, and results are provided in Appendix H of the SWSI 2010 Report. Table 2-4 and Table 2-5 summarize the M&I and SSI demands in the Metro and South Platte Basins.

[2] Headwaters. Colorado Foundation for Water Education. *The Energy Issue.* "Do Oil and Water Mix?" Fall 2013.

Table 2-4. SSI Demands by County

County	Thermoelectric					Large Industry					Snow Making				
	2008	2035	2050 Low	2050 Medium	2050 High	2008	2035	2050 Low	2050 Medium	2050 High	2008	2035	2050 Low	2050 Medium	2050 High
Adams	9,600	9,600	10,100	12,000	14,400	-	-	-	-	-	-	-	-	-	-
Boulder	2,900	2,900	3,100	3,700	4,400	-	-	-	-	-	230	230	230	230	230
Clear Creek	-	-	-	-	-	-	-	-	-	-	90	90	90	90	90
Denver	2,400	2,400	2,500	3,000	3,500	-	-	-	-	-	-	-	-	-	-
Jefferson	-	-	-	-	-	52,400	52,400	52,400	52,400	52,400	-	-	-	-	-
Larimer	5,200	11,200	11,700	14,000	16,700	-	-	-	-	-	-	-	-	-	-
Morgan	5,900	13,900	14,600	17,400	20,900	2,100	2,100	2,100	2,100	2,100	-	-	-	-	-
Weld	-	-	-	-	-	4,500	4,500	4,500	4,500	4,500	-	-	-	-	-
Total	**28,900**	**42,900**	**45,100**	**53,800**	**64,300**	**59,000**	**59,000**	**59,000**	**59,000**	**59,000**	**320**	**320**	**320**	**320**	**320**

Table 2-5. Summary of M&I and SSI Demands

Basin	Demand Type[1,2]	2008 (AFY)	2035 (AFY)	2050 Low (AFY)	2050 Medium (AFY)	2050 High AFY)
Metro	M&I	437,000	557,000	620,000	642,000	709,000
	SSI	64,400	64,400	65,000	67,400	70,300
	Total	**50,1400**	**621,400**	**685,000**	**709,400**	**779,300**
South Platte	M&I	206,000	311,000	347,000	367,000	401,000
	SSI	28,320	42,320	44,120	51,320	60,020
	Total	**234,320**	**353,320**	**391,120**	**418,320**	**461,020**

[1] M&I demands for 2035 and 2050 include passive conservation savings
[2] SSI demands include large industry, snowmaking, and thermoelectric.
Source: Table 4-1 SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment

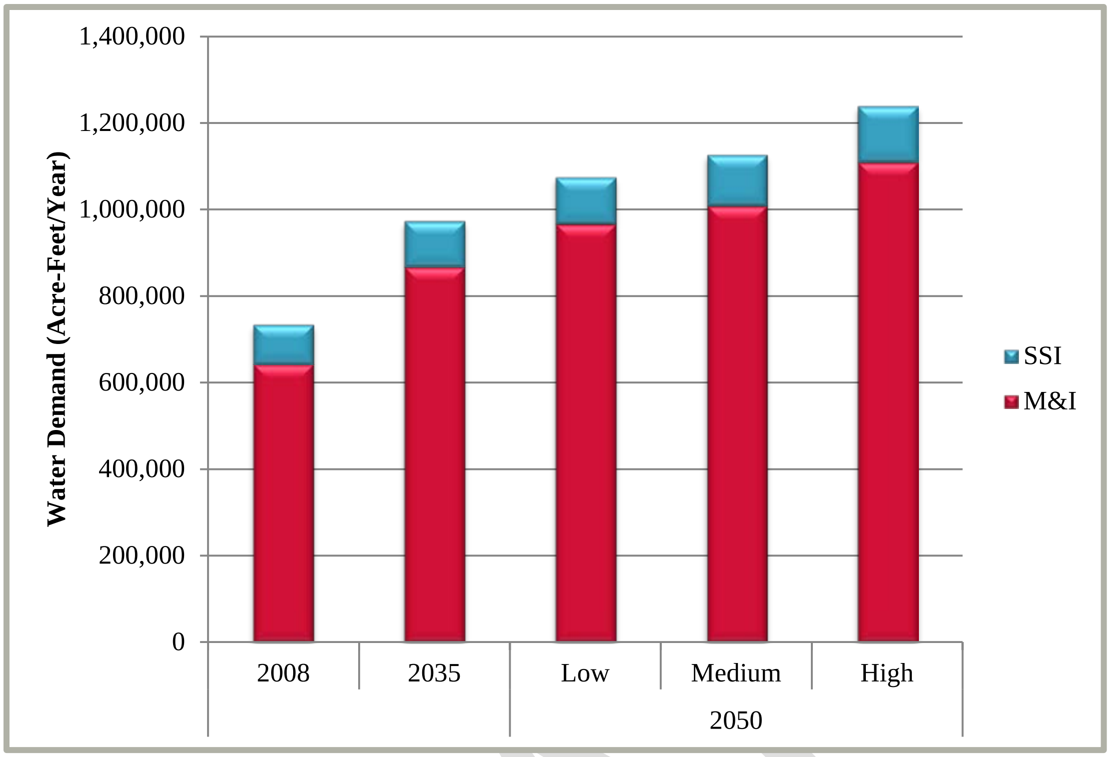

Figure 2-4. Metro & South Platte Basin M&I and SSI Water Demands

2.2 Agricultural Needs

Agriculture plays a key role in the economy and water use of the South Platte and Republican River basins. There are approximately 831,000 irrigated acres in the South Platte Basin with an additional 550,000 irrigated acres in the Republican Basin. In 2012, seven of the top ten agriculture producing counties in the State were located in the South Platte Basin. These counties, in order of production, are Weld, Yuma, Morgan, Logan, Kit Carson, Washington, and Phillips. The agricultural sales in the South Platte Basin were $5.8 billion, representing 75 percent to the statewide total.[3]

Sales of agricultural products from the South Platte Basin generated nearly $3.2 billion in 2002, representing 72 percent of the statewide total. In 2007, sales increased to more than $4.4 billion, representing 73 percent of total sales of agricultural products[4]. Sales further increased in 2012 to $5.8 billion. A summary table of the total sales in each county is given in Table 2-6.

[3] USDA. (2012). 2012 Census of Agriculture. National Agricultural Statistics Service.
[4] USDA. (2009). 2007 Census of Agriculture. National Agricultural Statistics Service.

Table 2-6. Total Agricultural Sales by County

County	Total Sales	County	Total Sales
Weld	1,860,718,000	Lincoln	75,567,000
Yuma	1,150,344,000	Elbert	44,961,000
Morgan	615,319,000	Boulder	33,883,000
Logan	566,903,000	Arapahoe	31,659,000
Kit Carson	499,775,000	Douglas	13,653,000
Washington	220,713,000	Jefferson	9,099,000
Phillips	208,006,000	Park	7,745,000
Larimer	128,647,000	Broomfield	1,537,000
Adams	116,464,000	Teller	1,254,000
Sedgwick	101,263,000	Clear Creek	343,000
Cheyenne	87,084,000	Gilpin	165,000
*Not Listed: Denver County – withheld from study			

2.2.1 Agricultural Needs Methodology

This section describes methods used to estimate the water needed to support the South Platte Basin's agriculture, both currently and in 2050.

Reference Documents

The following discussion is extracted from:

SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- Section 4.3 Agricultural Consumptive Needs

The estimates used describe only consumptive use (CU) water, rather than larger volumes of water being pumped or diverted, both for the irrigation of crops and livestock production. CU water includes water being incorporated into crops, lost through evapotranspiration, and water being lost to soil evaporation. Deep percolation into groundwater aquifers also reduces water availability for downstream uses. The CU does not include water that is diverted and then returned to the system through return flows.

In addition to crop consumptive use, the South Platte Basin's agricultural demands also included three other types of agricultural CU:

- Livestock CU
- Stockpond Evaporation
- Losses incidental to delivering irrigation water

Water needs for irrigation were characterized in this analysis by the Irrigation Water Requirement (IWR). The IWR refers to the irrigation demand, or the volume of water required to completely satisfy the CU for a specified crop. This irrigation water requirement is produced from a mathematical model that reflects weather, the growing season, and crop physiology.

CU modeling was executed using a recent decade of climate and water supply information. The future irrigation demand was examined by assuming that historical climate conditions will continue.

2.2.1.1 CURRENT IRRIGATED ACRES METHODOLOGY

The Colorado Decision Support System (CDSS) program has produced irrigated lands mapping and crop CU models in the South Platte Basin. These maps are available as spatial databases, which include crop types, irrigation practices, and associations with diversion structures or wells. The structure identifier associated with the irrigated land indicates the location of the headgate that serves the area. Irrigated acres are assigned to the water district where the diversion is located, not by where the irrigated acreage is located.

Reference Documents

The following discussion is extracted from:
SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- Section 4.3.1.1 Current Irrigated Acres Methodology.

CDSS has not been implemented in the Republican Basin so information had to be gathered from other sources or developed for this project. Groundwater irrigated acreage for the Republican River Basin was obtained from the Republican River Compact Administration accounting spreadsheets from 2007. Precise information on surface water irrigated lands in the Republican River Basin is not available, but according to the State Engineer's Office, the total amount is believed to be no more than 1,000 acres.

2.2.1.2 2050 IRRIGATED ACRES METHODOLOGY

Using the most current irrigated acres for the South Platte Basin, estimates of the 2050 irrigated acres were based on the following factors:

- Urbanization of existing irrigated lands
- Agricultural to municipal water transfers
- Water management decisions
- Demographic factors
- Biofuels production
- Climate change
- Farm programs
- Subdivision of agricultural lands and lifestyle farms
- Yield and productivity
- Open space and conservation easements
- Economics of agriculture

Reference Documents

The following discussion is extracted from:
SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- Section 4.3.1.2 2050 Irrigated Acres Methodology

The first three factors (urbanization of existing irrigated lands, agricultural to municipal water transfers, water management decisions) were quantified based on future growth estimates, municipal water demand gaps that will be met by 2050, and interviews with water management agencies across the State. The remaining factors were based on information provided by the CWCB and the Colorado Department of Agriculture.

The urbanization of existing irrigated lands was established using 2050 population projections, estimation of future urban area size, and the current irrigated acres as described in the previous section. As discussed above, current irrigated acres in each administrative water district were determined from geographic information system (GIS) data sources. However, certain types of data (e.g., future population forecasts) were only available on a county basis. Therefore, future losses of irrigated acres were calculated first for each county, and then re-distributed by water district. The detailed methodology is described in Appendix I of the SWSI 2010 Report.

The M&I gap analysis was used as the basis for the analysis of irrigated acreage changes associated with agricultural to municipal water transfers. The amount of the M&I gap was summarized in AFY on a low, medium, and high basis. For the purposes of predicting future irrigated acres, it was assumed that 70 percent of M&I gap would be met from agricultural to municipal transfers. This percentage is a conservative estimate based on the assumption of 100 percent yield success rate for IPPs. Therefore, it does not take into account the projects or methods that may not be successful in meeting the basin's future M&I demands. If IPPs are unsuccessful, it is likely that M&I water providers will turn to increased agricultural transfers to meet future demands. The following equation was used to estimate irrigated acres that would be needed for agricultural to municipal transfers to address M&I gaps:

$$Irrigated\ Acres\ Transferred = \frac{M\&I\ Gap}{Transferrable\ Consumptive\ Use\ \times (1 - Safety\ Factor)}$$

A safety factor of 25 percent was applied to account for the additional amount of irrigated acres that may be needed to provide the transferred water on a firm yield basis due to various uncertainties associated with the water court transfer process.

During SWSI 2010, CWCB staff and their consultants interviewed entities within the South Platte and Republican River Basins to estimate what changes may occur in irrigated acres due to water management decisions influenced by compact compliance or maintaining groundwater levels. For the remaining factors (demographic factors, biofuels production, climate change, farm programs, subdivision of agricultural lands and lifestyle farms, yield and productivity, open space and conservation easements, economics of agriculture), CWCB identified trends that are expected to occur within each area over the next 40 years and then developed a qualitative assessment on whether each factor would cause a negative or positive impact on irrigated agriculture by 2050. Climate change is projected to increase hydrologic variability, the frequency of droughts in Colorado, and, as a result of increasing temperatures, water yields may, in general, decrease. Warmer temperatures will likely result in precipitation occurring as rain rather than snow, an earlier spring melt, more intense precipitation events, and increased evapotranspiration. Consequently, runoff would start earlier and reservoirs would fill earlier. The water that cannot be stored in the spring and early summer will be unavailable when agricultural and lawn irrigation highest in mid to late summer. Decreased runoff in the summer could result in additional reservoir drawdown and many studies agree that higher temperatures and lower precipitation during summer months will further increase agricultural demands, thus causing even more stress on reservoir storage. The CWCB anticipates publication of update to their previous climate change report soon and a detailed description of potential effects is available in Appendix I of the SWSI 2010 Report.

2.2.1.3 CURRENT AGRICULTURAL WATER DEMAND METHODOLOGY

Reference Documents

The following discussion is extracted from:

SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- Section 4.3.1.3 Current Agricultural Demand Methodology

Current irrigation demand for water in the South Platte Basin can be defined as the average amount of water consumptively used by crops on land currently under irrigation. Typically, water supply is plentiful early in the irrigation year, crop CU is not limited and is equal to the crop IWR. As the irrigation season continues, the available water supply generally decreases, becoming less than the crops' uptake capacity, and CU is limited by supply. In order to quantify crop CU, one must have credible estimates or measurements of the crops' average capacity to use irrigation water, referred to as IWR, as well as the average water supply. The minima of these two values over a series of time increments (typically months) is the Water Supply Limited (WSL) CU.

For this analysis, average IWR (Section 2.2.2.3) and average WSL CU (Section 2.4.2.1) are reported. The latter may be considered to be the current agricultural demand; that is, the water required to sustain current levels of farming. IWR provides perspective on the amount of water that would be used, if it was physically and legally available. It is an upper limit on consumption by current agriculture, and a reminder that the South Platte Basin is a dry state with over-appropriated streams.

IWR estimation requires a time series of climate information, particularly precipitation and temperature, over the study period; WSL CU estimation requires information about the time-varying water supply available to the crop. For this analysis, a recent 10-year study period was used. The 10-year period allowed for estimation of average conditions with respect to both climate and hydrology. IWR and WSL CU were calculated assuming that the most current estimate of number of irrigated acres, and most recent information on crop types, prevailed during each year of the study period. The results demonstrate demand for 2010 agricultural conditions in the South Platte Basin, based on a 10-year sample of climate and hydrology.

Where applicable, CDSS methodologies were applied to estimate non-irrigation agricultural consumptive demands (e.g., livestock and stockpond evaporation) as well. Livestock CU was estimated by multiplying the number of cattle, sheep, and hogs located within the basin by their corresponding per capita water use. Stockpond evaporation was based on net evaporation rates and stock pond surface area estimates. In general, the method estimates net reservoir evaporation by subtracting average monthly effective precipitation from the estimated gross monthly free water surface evaporation.

Lastly, incidental losses may include, but are not limited to, vegetative CU that occurs along canals and in tailwater areas. The CDSS program, in preparing Consumptive Uses and Losses (CU&L) Reports for the state, has adopted 10 percent as the factor for computing incidental losses associated with irrigation CU. The value is in the middle of the range of factors (5 percent to 29 percent) used by the Bureau of Reclamation in their parallel CU&L accounting throughout the upper basin states.

2.2.1.4 2050 AGRICULTURAL WATER DEMAND METHODOLOGY

Following the techniques described in the 2050 Irrigated Acres Methodology, changes in numbers of acres irrigated have been developed for each water district. Since this study intentionally avoids identifying specific water rights or ditches for change of use, there is no basis for calculating the structure-specific CU by which a water district's irrigation demand will change. CU per irrigated acre varies from structure to structure, and depends on available supply, seniority of a water right, and system efficiency. The variability of these factors makes it impossible to predict future losses of irrigated land on a structure-by-structure basis. Consequently, simplifying assumptions were made such that irrigation demand was considered directly proportional to number of acres irrigated. To derive future irrigation demand, current irrigation demand for each water district was scaled by the ratio of future irrigated acreage to current irrigated acreage.

Reference Documents

The following discussion is extracted from:

SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- Section 4.3.1.4 2050 Agricultural Demand Methodology

Similarly, non-irrigation demand was estimated as being in proportion to irrigated acres. The relationship between losses incidental to irrigation and number of acres irrigated is proportional. With respect to stockponds and stock watering, it is assumed that predicted changes in irrigated acreage will be accompanied by similar changes in stock raising activities. To derive future non-irrigation demand, current non-irrigation demand was scaled by the ratio of future irrigated acreage to current irrigated acreage.

2.2.2 Irrigated Acreage and Water Demand Results

2.2.2.1 CURRENT IRRIGATED ACREAGE RESULTS

Figure 2-5 shows the location of the South Platte Basin's water districts and the spatial distribution of current irrigated acres in the South Platte Basin are based on the methods presented previously.

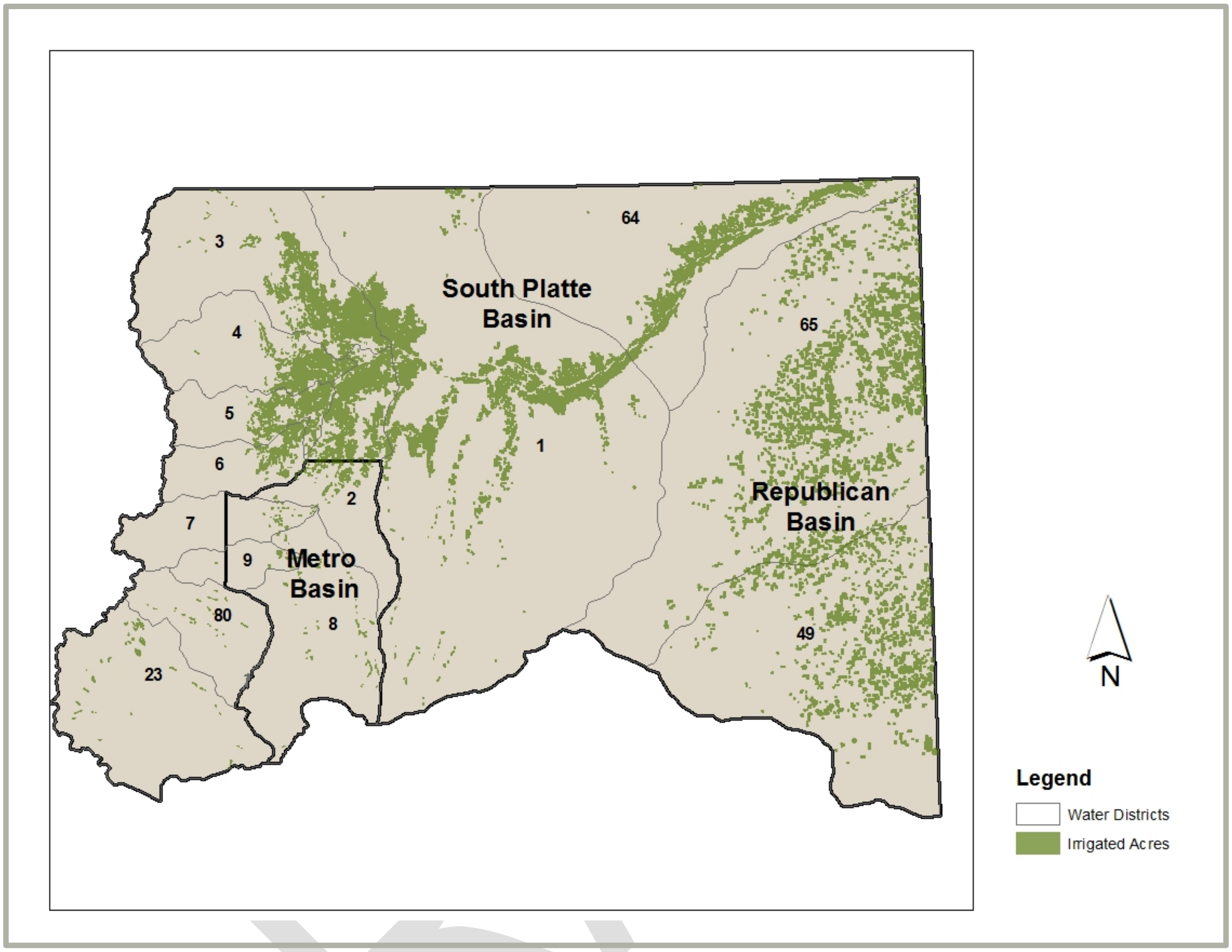

Figure 2-5. Irrigated Acres by Water District

Colorado currently has approximately 3,466,000 acres of irrigated land. Of that, 831,000 acres of irrigated land are in the South Platte Basin with an additional 550,000 acres in the Republican Basin. The South Platte Basin has the highest number of acres of irrigated land of any basin in Colorado. The Republican Basin has the third highest number of acres of irrigated land in Colorado. The South Platte, Republican and Metro Basins account for 40 percent of Colorado's irrigated acres. The current number of irrigated acres for each basin is shown in Table 2-7.

Table 2-7. Current Irrigated Acreage by River Basin

Basin	Irrigated Acres	Percentage of Colorado's Irrigated Acres
Republican	550,000	16%
South Platte	831,000	24%
Total	**1,381,000**	**40%**

Source: Table 4-8 SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments

2.2.2.2 2050 IRRIGATED ACREAGE RESULTS

Reference Documents

The following discussion is extracted from:

SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- Section 4.3.2.2 Future Irrigated Results

Table 2-8 shows the future irrigated acreage results. The total irrigated acres in the South Platte Basin may decrease by 160,000 – 235,000 acres, under low and high population growth projections, respectively. The biggest impact on the South Platte Basin in terms of irrigated acres lost is the transfer from agricultural to municipal uses of water to meet the M&I gap.

Potential losses of irrigated land are due to a variety of factors. These include:

- For the South Platte Basin, a significant number of irrigated acres have been taken out of production because of a shortage of augmentation water, which led to numerous wells being shut down in the central South Platte Basin in 2006. This reduction of irrigated acres is expected to be more or less permanent because the cost of acquiring augmentation water in the central South Platte River Basin can be prohibitive for the agricultural community. This reduction in acreage is not reflected in the current irrigated acreage of 831,000 AFY in Table 2-8.

- In the Republican River Basin, a total of about 35,000 acres were removed from irrigation through conservation programs by 2009. An additional 64,000 acres are estimated to be removed from irrigation due to the declining saturated thickness of the Ogallala aquifer, and another 10,000 acres are to be dried up in District 65 in association with the construction of a pipeline for Republican River compact compliance reasons.

Table 2-8. Future Irrigated Acreage by River Basin

Basin	Current Irrigated Acres	Decrease in Irrigated Acres Due to Urbanization		Decreases in Irrigated Acres due to Other Reasons	Decreases in Irrigated Acres Due to Agricultural to Municipal Transfers	Decreases in Irrigated Acres Due to Ag Transfers to Meet Gap		**2050 Irrigated Acres**	
		Low	High			Low	High	Low	High
Republican	550,000	300	600	109,000	-	-	-	440,400	440,700
South Platte	831,000	47,000	58,000	14,000	19,000	81,000	143,000	596,000	671,000
Total	**1,381,000**	**50,000**	**58,600**	**123,000**	**19,000**	**81,000**	**143,000**	**1,036,400**	**1,111,700**

Source: Table 4-9 SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment.

Figure 2-6 depicts the potential change in irrigated acres in the South Platte and Republican Basins by the year 2050. Under high population projections, the South Platte Basin is expected to see a 19 percent decrease in irrigated acres and the Republican Basin is expected to see a 20 percent decrease in irrigated acres.

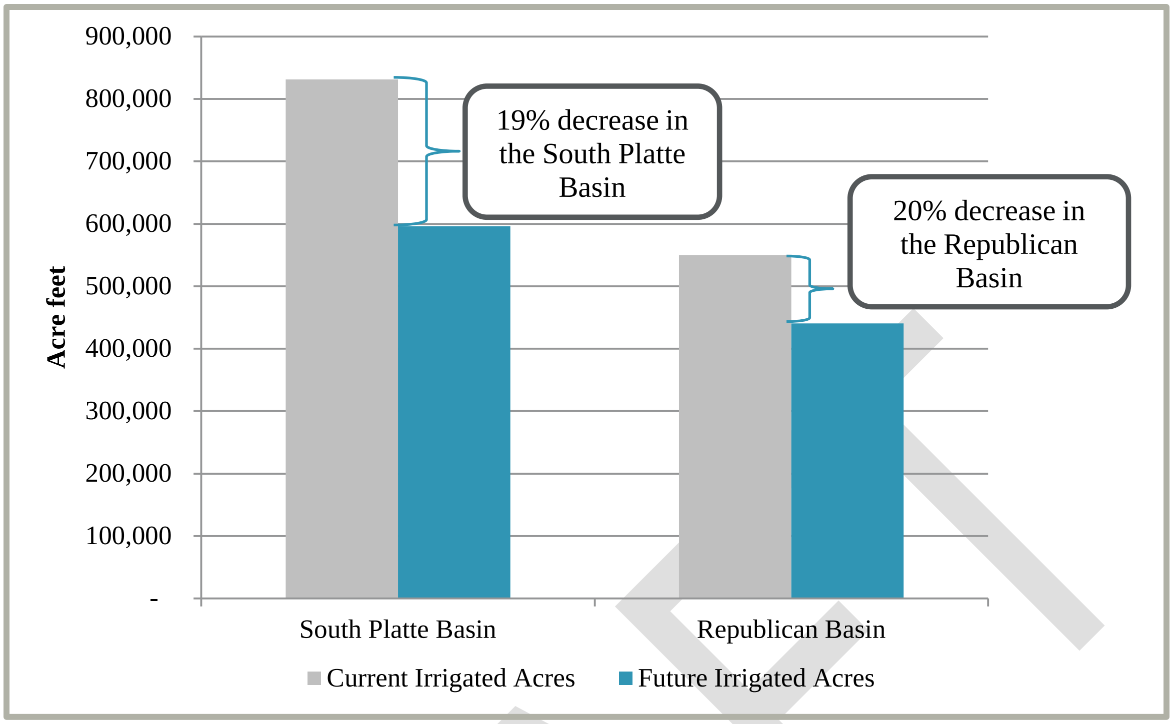

Figure 2-6. Potential Change in Irrigated Acres by 2050

2.2.2.3 CURRENT AGRICULTURAL DEMAND RESULTS

Table 2-9 summarizes the results of the average annual current agricultural demand within the South Platte and Republican River Basins including irrigated acres, irrigation water requirements, and non-irrigation demands.

Table 2-9. Estimated Current Agricultural Demands

Basin	Irrigated Acres	Irrigation Water Requirements (AFY)	Non-Irrigation Demand (AFY)
Republican	550,000	802,000	67,000
South Platte	831,000	1,496,000	115,000
Total	**1,381,000**	**2,298,000**	**182,000**

Source: Table 4-10 SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment.

2.2.2.4 2050 AGRICULTURAL WATER DEMANDS RESULTS

Similar to Table 2-10 summarizes the average annual agricultural demand in each basin by the year 2050, assuming that historical climate and hydrology continues into the future.

Table 2-10. Estimated 2050 Agricultural Water Demand by Basin

Basin	Irrigated Acres	Irrigation Water Requirements (AFY)	Non-Irrigation Demand (AFY)
Republican	441,000	640,000	5,000
South Platte	633,500	1,140,000	84,000
Total	**1,074,500**	**1,780,000**	**89,000**

Source: Table 4-11 SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment.

2.3 Environmental and Recreational Needs

The South Platte Basin has diverse ecological and hydrologic qualities. The overall environmental and recreational goal of the SP-BIP is to enhance the health and vitality of rivers and streams in the South Platte Basin, sustaining ecosystems and providing important environmental, societal, and economic benefits to the region. The environmental and recreational assets within the basin include high mountain stream, foothills stream and warm water stream habitats, metropolitan corridors and areas of recreational opportunity.

In previous work within the basin, including SWSI 2010, the term nonconsumptive attributes was used to refer to environmental and recreational attributes. There are various environmental and recreational attributes throughout the basin. General categories of the Basin's environmental and recreational attributes include:

- State endangered, threatened, species of special concern (includes several Federally listed species)
- Greenback Cutthroat Trout[5]
- Important Riparian Habitat
- Migratory Bird Viewing/Hunting
- Fishing
- Recreation (including whitewater and flatwater boating)

The South Platte Basin's environmental and recreational opportunities provided by mountain streams and rivers, greenways, flatwater reservoirs, wetlands and open space, are extremely important to Colorado's economy and quality of life.

Environmental and recreational needs are inherently location-specific, and the needs can vary throughout the year. An assessment of environmental and recreational needs must be done to establish baseline needs, avoid degradation of current conditions, determine how to restore ecosystems to sustainable and resilient levels, and maintain current conditions where they are adequate. Not only must the current conditions be assessed, but the future changes that are driven by water supply decisions can impact

[5] Since SWSI 2010, the Greenback Cutthroat Trout has been determined to only be located in the Arkansas Basin, with what was previously considered the Greenback Cutthroat Trout actually being another native cutthroat trout. This categorization and attribute will be updated with the new native cutthroat trout species name, once determined. (*Historical stocking data and 19th century DNA reveal human-induced changes to native diversity and distribution of cutthroat trout*. Metcalf, Stowell, Kennedy, Rogers, McDonald, Epp, Keepers, Cooper, Austin, and Martin. Molecular Ecology, Vol 21, Issue 21, pages 5194-5207, Nov 2012.)

environmental and recreational attributes. Assessments of specific reaches may indicate that additional streamflows or riparian or wetlands habitat is needed to sustain or enhance environmental or recreational attributes within the reach.

2.3.1 Environmental and Recreational Needs Overview

The South Platte Basin's environmental and recreational needs were developed based on the Nonconsumptive Needs Assessments (NCNA) completed by the Basin Roundtables for the SWSI 2010. The South Platte Basin's NCNA subcommittee determined 37 environmental and recreational attributes for inclusion in the Basin's NCNA. The attributes were assessed by the BRTs and "nonconsumptive" subcommittee (environmental and recreational subcommittee) based on input from the statewide attributes as well as input from stakeholders in the South Platte Basin. These attributes were approved by the BRTs in the NCNA and SWSI processes.[6] The South Platte Basin's environmental and recreational attributes are listed in Table 2-11.

[6] SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment

Table 2-11. South Platte Basin Environmental and Recreational Attributes

Attributes	***Category***
Gold Medal Trout Lakes	Fishing
Gold Medal Trout Streams	Fishing
Reservoir and Lake Fishing	Fishing
River and stream fishing	Fishing
Greenback Cutthroat Trout[7]	Greenback Cutthroat Trout
Rare Aquatic-dependent plants	Important Riparian Habitat
Significant Plant Communities	Important Riparian Habitat
Brassy Minnow	Plains Fish State Endangered, Threatened, Species of Special Concern
Common Shiner	Plains Fish State Endangered, Threatened, Species of Special Concern
Northern Redbelly Dace	Plains Fish State Endangered, Threatened, Species of Special Concern
Plains Minnow	Plains Fish State Endangered, Threatened, Species of Special Concern
Stonecat	Plains Fish State Endangered, Threatened, Species of Special Concern
Suckermouth Minnow	Plains Fish State Endangered, Threatened, Species of Special Concern
Iowa Darter	Plains Fish State Endangered, Threatened, Species of Special Concern
Plains Orangethroat Darter	Plains Fish State Endangered, Threatened, Species of Special Concern
Flatwater Boating	Recreation
Recreational In-Channel Diversion Structures	Recreation
Whitewater Boating	Recreation
Boreal Toad	State Endangered, Threatened, Species of Special Concern
Lake Chub	State Endangered, Threatened, Species of Special Concern
River Otter	State Endangered, Threatened, Species of Special Concern
Yellow Mud Turtle	State Endangered, Threatened, Species of Special Concern
Northern Leopard Frog	State Endangered, Threatened, Species of Special Concern
Northern Cricket Frog	State Endangered, Threatened, Species of Special Concern
Plains Leopard Frog	State Endangered, Threatened, Species of Special Concern
Preble's Meadow Jumping Mouse	State Endangered, Threatened, Species of Special Concern
Common Garter Snake	State Endangered, Threatened, Species of Special Concern
Wood Frog	State Endangered, Threatened, Species of Special Concern
Waterfowl Hunting / Viewing	Waterfowl Hunting/Viewing
Ducks unlimited projects	Waterfowl Hunting/Viewing
Audubon important bird areas	Waterfowl Hunting/Viewing
Colorado Outstanding Waters	
CWCB Instream Flow Water Rights	
CWCB Natural Lake Level Water Rights	
Eligible Wild and Scenic	
Active Bald Eagle Nests	
Wilderness Waters	

[7] See previous note regarding Greenback Cutthroat Trout.

The attributes listed in the table above were agreed upon by the South Platte and Metro BRTs. Information regarding each of these attributes was gathered from various sources, as identified in Appendix C of SWSI 2010. Many of the un-categorized attributes, other than Bald Eagle Nests, Wilderness Waters and Wild and Scenic Eligible Segments, are actual means of protecting other attributes. The Nature Conservancy is indicating that they will be working on removing these “attributes” from the attributes list and placing them in the projects or protections area of the assessments that will be discussed in detail later.

In addition, the only designated Wild and Scenic River in Colorado is a seventy-mile stretch of the Cache la Poudre River. Thirty miles of the Cache la Poudre are designated Wild, and forty-five miles are designated Recreational. The Wild and Scenic portion of the river is located on either National Park or National Forest Lands.[8]

In general, the environmental and recreational attributes in the South Platte Basin rely upon streams, lakes, wetlands and riparian habitat. The environmental attributes include three federally listed threatened and endangered species within the state, and four species downstream of the state line. There are two additional fish species that are at risk of being federally listed as threatened and endangered in accordance with the Endangered Species Act. There are seven fish and amphibian species in the South Platte Basin that are imperiled in Colorado (State-listed threatened and endangered species), as well as various imperiled plant communities. There are also other various species that are locally valued.

There are significant recreational opportunities within the basin, as well, including whitewater and flatwater boating, fishing, and wildlife hunting and viewing.

2.3.2 Environmental and Recreational Mapping

The environmental and recreational needs in the South Platte Basin are based on the NCNA mapping done in SWSI 2010 and the NCNA work prior to SWSI 2010 including the NCNA database and other mapping efforts. The locations where environmental and recreational attributes exist were reviewed and assessed by the South Platte Basin’s NCNA subcommittee and BRTs. The subcommittee and the BRTs determined “Candidate Focus Areas” to indicate areas where the environmental and recreational attributes should be focused on in the basin.

Since SWSI 2010 was released, the South Platte Basin and Metro BRTs added several new Focus Areas. These new areas include:

- Additional focus areas also included several areas added near the canyon mouths of various Front Range tributaries to the South Platte River. The mapping was updated to include reaches voted to be included by the South Platte Basin Roundtable in 2011. These reaches include the Big Thompson River, the North Fork of the Big Thompson River (and tributaries), Cache la Poudre River, South Boulder Creek, Middle Boulder Creek, and Left Hand Creek.

[8] Cache la Poudre Wild and Scenic River Final Management Plan, March 1990.

- Various reaches in Park County with significant riparian plant communities as well as recreational attributes not previously mapped. The focus area mapping was updated to include South Park reaches approved by the South Platte Basin Roundtable in January 2014.

Due to BRT approval of additional focus areas, this portion of the SWSI 2010 “gap” assessment was updated. A detailed description of the mapping update methodology and results are provided in Appendix B. The updated focus area maps and associated tables regarding the specific information for each focus area are also included in Appendix B. The updated map of the focus areas is shown in Figure 2-1. [Please note: the revised map and list of segments is being finalized.] A larger version of the map is attached in Appendix B.

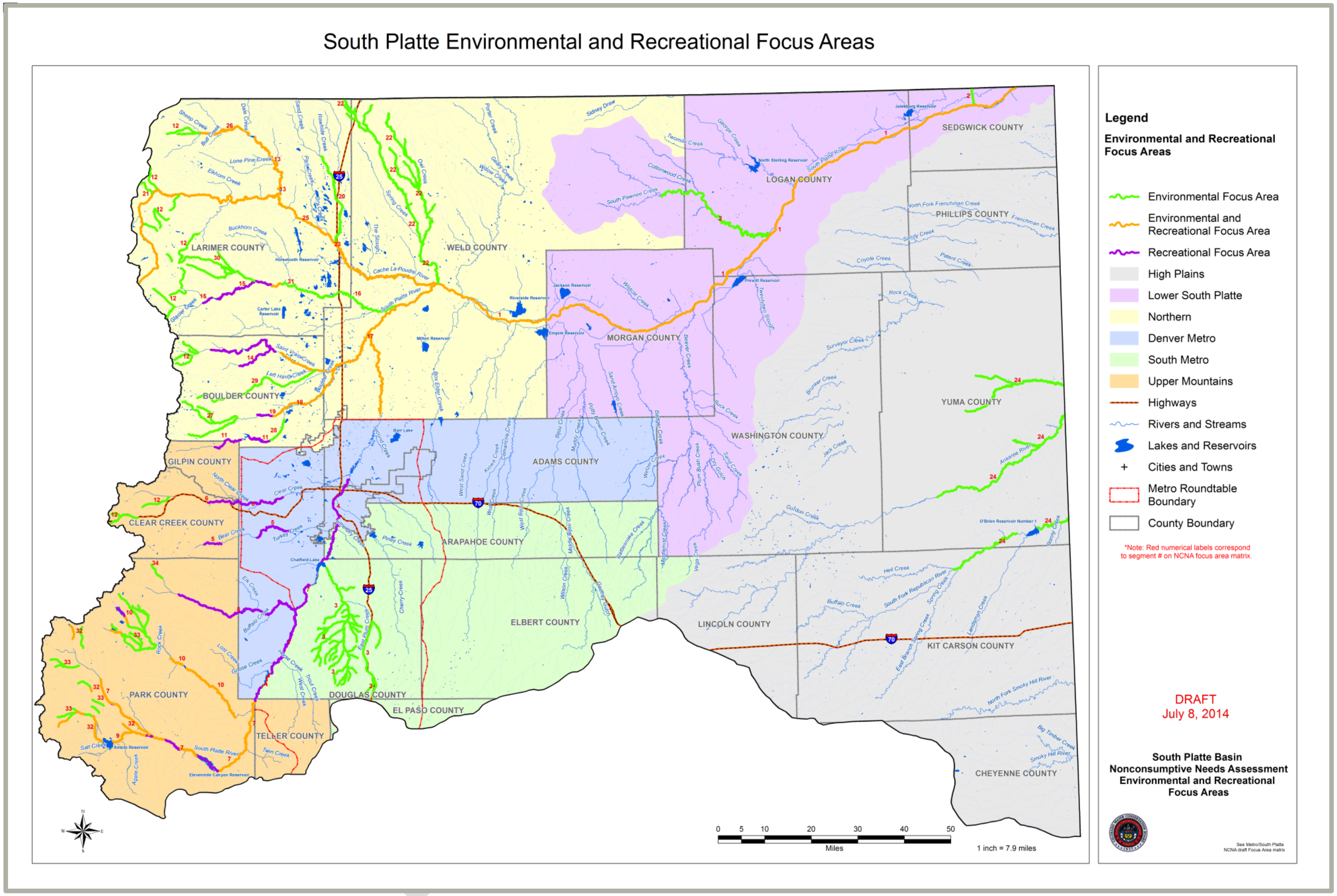

Figure 2-7. South Platte Focus Area Map

The map and associated descriptions of the focus areas shown in Appendix B were completed to serve as a useful guide for water supply planning;

- The maps can assist in identifying future study or implementation projects in the basin;
- The maps can help the basin plan for the water needs of species of special concern so that they do not become federally listed in the future;
- The maps can provide opportunity for collaborative efforts for future multi-purpose projects; and
- The maps may help identify areas for future cooperation to help avoid issues in future water planning.

The NCNA process and the focus area mapping is not intended to create a water right for the environment and it is not the intent of the process to diminish, impair, or cause injury to existing absolute or conditional water rights.

2.4 South Platte 2050 Gap Analysis

The South Platte water supply gap is defined by the difference between the existing supplies and the 2050 demands. The following sections summarize the M&I and SSI, agricultural, and environmental and recreational gaps. The purpose of the gap analysis is to demonstrate where projects and methods need to be identified to meet future needs.

2.4.1 Municipal & Industrial and Self Sustained Industrial

The M&I and SSI 2050 gap was evaluated at three different levels (low, medium, and high) to account for the uncertainty in long range population, demand and water supply forecasting. For the purpose of this report, demand projections include passive conservation levels. The following equation was used to calculate the gross gap.

$$M\&I\ and\ SSI\ Water\ Supply\ Gap = Projected\ 2050\ Water\ Demands\ with\ Passive\ Conservation\ (low/medium/high) - Existing\ Supply$$

Table 2-12 summarizes medium gaps in the Metro and South Platte Basins. For this report, both Basin Roundtables chose to use the medium demand scenario, and the medium Gap scenario to represent variability. The medium gap is illustrated for the Metro Basin, South Platte Basin, and the total medium gap in Figure 2-8 through Table 2-10.

Table 2-12. South Platte and Metro Basin M&I and SSI Gap

Basin	Existing Supply	2050 M&I and SSI Water Demands Medium	2050 Gap Medium
Metro	502,000	746,000	244,000
South Platte	234,000	418,000	184,000
Total	736,000	1,164,000	428,000
Source: SWSI 2010 South Platte and Metro Basin Reports Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments			

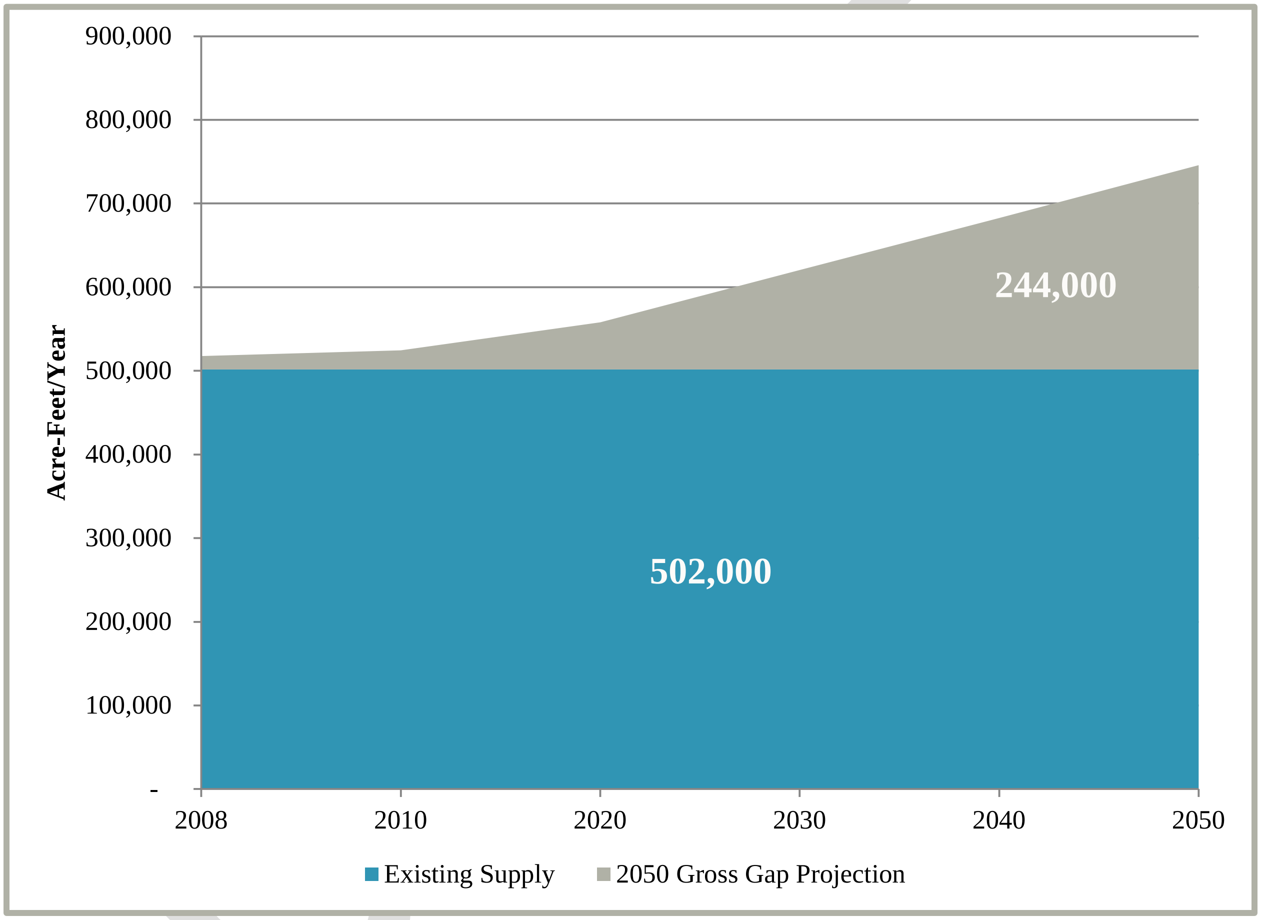

Figure 2-8. Metro Basin M&I and SSI Gap Summary Medium Scenario (Medium Demand Projection)

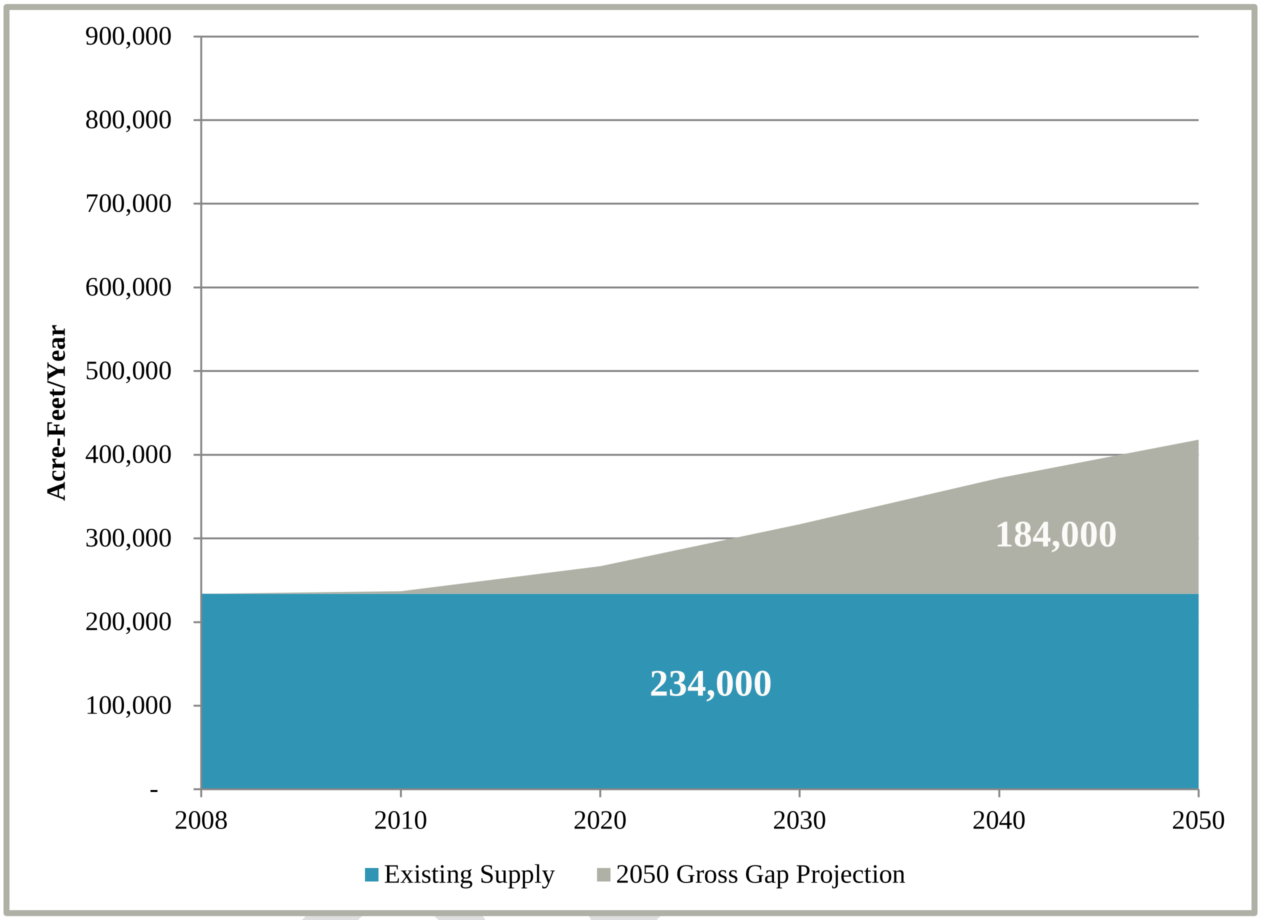

Figure 2-9. South Platte Basin M&I and SSI Gross Gap Summary Medium Scenario (Medium Demand Projection)

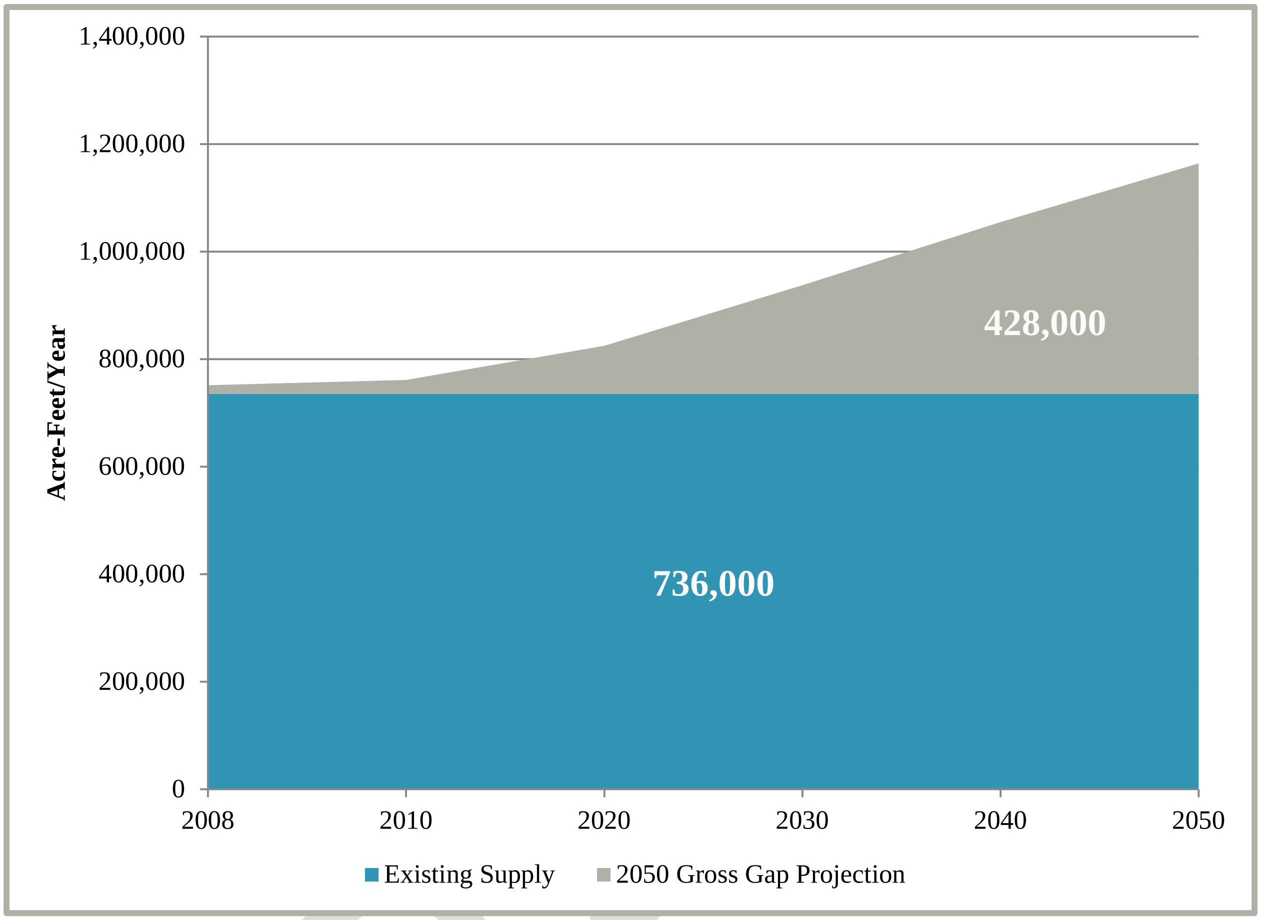

Figure 2-10. Metro and South Platte Basin M&I and SSI Gross Gap Summary Medium Scenario (Medium Demand Projection)

2.4.2 Agricultural

Typically in the South Platte and Republican Basins, water supply is only adequate to satisfy the IWR during part of the growing season. Water supply in the South Platte and Republican Basins is plentiful early in the irrigation year, and crop CU is not limited and is equal to the crop IWR. As the irrigation season continues, the available water supply generally decreases, becoming less than the crops' uptake capacity, and CU is limited by supply. For this reason, there exists a current and 2050 agricultural gross gap. The actual consumptive use, WSL CU, is smaller than the IWR and reflects the water supply deficit condition that exists throughout most of the South Platte and Republican Basins. The difference between these two values is referred to as the gap.

2.4.2.1 CURRENT AGRICULTURAL GAP

Table 2-13 summarizes the current agricultural gap within the South Platte and Republican River Basins including irrigated acres, IWR, WSL CU, and gross gap (difference between IWR and WSL CU). The table also shows the non-irrigated demand. The current gross gap in the South Platte Basin is approximately 379,000 AFY with an additional gross gap of 200,000 AFY in the Republican Basin. Table 2-12shows the current WSL CU and gross gap amounts in the South Platte and Republican Basins.

Table 2-13. Estimated Current Agricultural Gap

Basin	Irrigated Acres	Irrigation Water Requirements (AFY)	Water Supply Consumptive Use (AFY)	Gap (AFY)	Non-Irrigation Demand (AFY)
Republican	550,000	802,000	602,000	200,000	67,000
South Platte	831,000	1,496,000	1,117,000	379,000	115,000
Total	**1,381,000**	**2,298,000**	**1,719,000**	**579,000**	**182,000**
Source: Table 4-10 SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment					

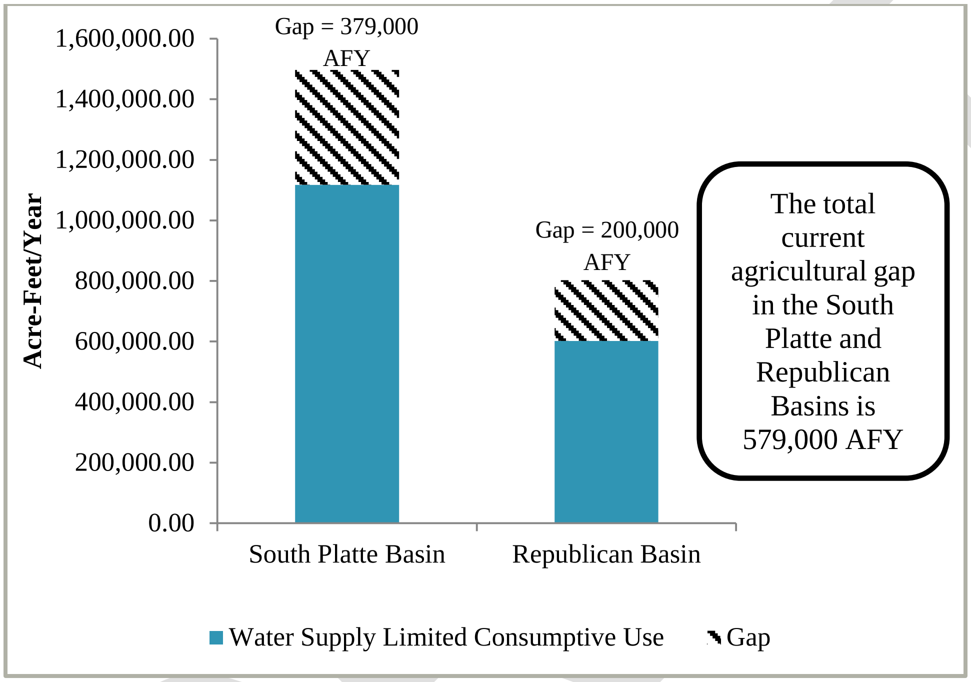

Figure 2-11. Current Agricultural Demands and Gap

2.4.2.2 2050 AGRICULTURAL GAP

Similar to Table 2-13, Table 2-14 summarizes the average annual agricultural demand in each basin by the year 2050, assuming that historical climate and hydrology continues into the future. The predicted agricultural gap for 2050 in the South Platte Basin is 262,000 AFY, a reduction from the current gap. The predicted gap for 2050 in the Republican River Basin is 160,000 AFY, also a reduction from the current gross gap. This is primarily due to expanding urbanization reducing the amount of irrigated acreage in the basin. Figure 2-12 shows the 2050 WSL CU and gap amounts in the South Platte and Republican Basins.

Table 2-14. Estimated 2050 Agricultural Gap

Basin	Irrigated Acres	Irrigation Water Requirements (AFY)	Water Supply Consumptive Use (AFY)	Gap (AFY)	Non-Irrigation Demand (AFY)
Republican	441,000	640,000	480,000	160,000	5,000
South Platte	633,500	1,114,000	852,000	262,000	84,000
Total	**1,074,500**	**1,754,000**	**1,332,000**	**422,000**	**89,000**

Source: Table 4-11 SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment.

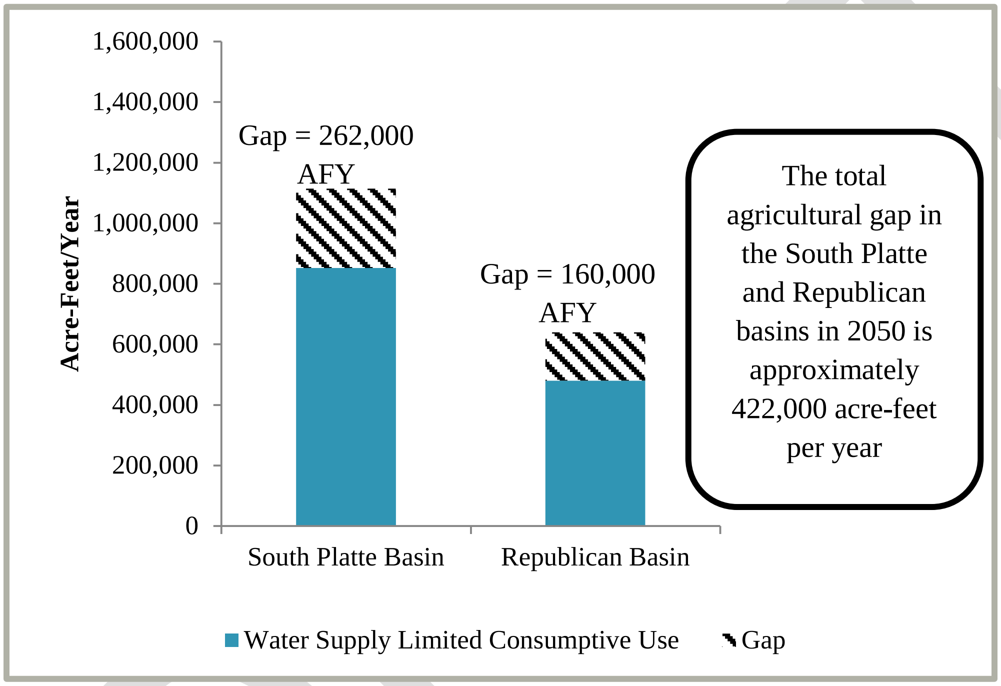

Figure 2-12. 2050 Agricultural Demands and Gap

When considering water supply, the amount of available return flows should be taken into account. Irrigators are continuing to update irrigation systems to center pivot sprinklers and lined ditches and laterals. New systems will increase agricultural irrigation efficiencies, but will impact future river flows that historically benefitted from return flows associated with flood irrigation. Figure 2-13 illustrates the decrease in the amount of flood irrigation and the transfer to center pivot sprinklers. These transfers may significantly impact the lower reaches of the river and future river calls. This could further impact winter storage rights and recharge projects that currently benefit from lagged return flows from flood irrigation. The impact of reduced return flows to recharge projects may also limit their ability to divert water sufficient to meet the augmentation needs of wells[9].

[9] SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment

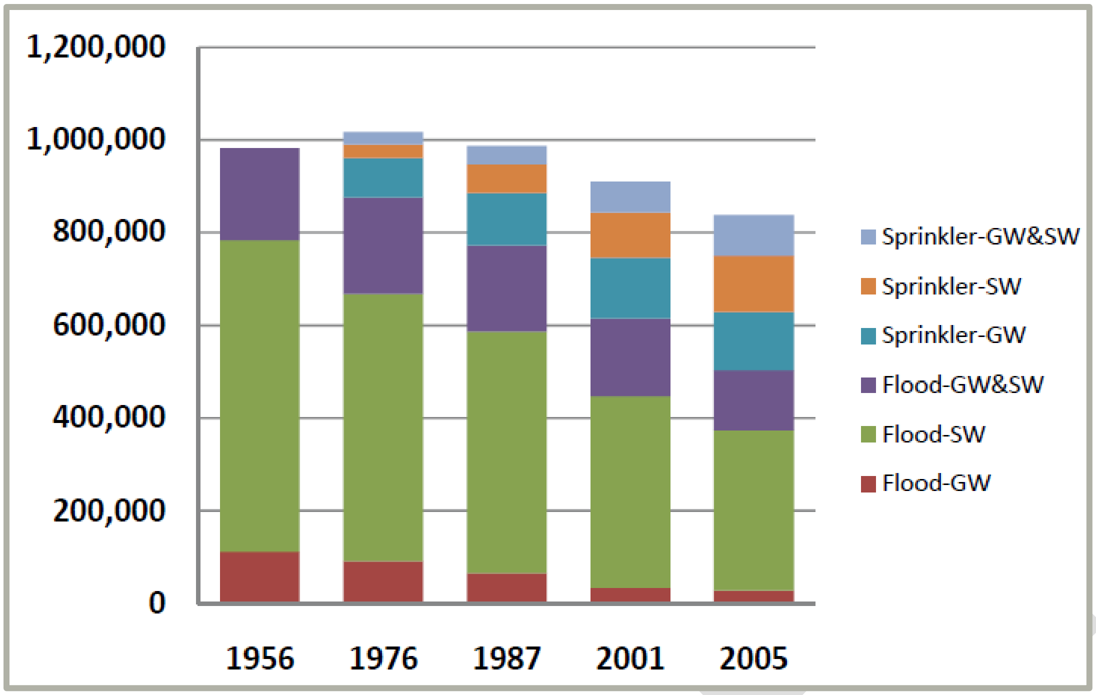

Figure 2-13. Water Division 1, Irrigated Acreage by Irrigation Type and Water Source

** GW = groundwater, SW = surface water, Flood refers to flood irrigation, Sprinkler refers to center pivot sprinkler irrigation Source: Figure 6-17 SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessment.*

2.4.3 Environmental and Recreational

Based on the environmental and recreational needs discussed in Section 2.3, a methodology was developed to determine where the environmental and recreational needs may have shortages or a "gap" of protection. A protection is a project (or method, such as a study) that is intended to assist in maintaining or enhancing an environmental or recreational attribute. The environmental and recreational needs in the South Platte basin are summarized in the focus areas that were the result of the work described in Section 2.3 and in detail in Appendix B.

In order to determine the gap in protections in place to address the environmental and recreational needs, the projects and methods must be analyzed in conjunction with the attributes and focus areas. The types of projects and methods reviewed will be described in further detail in Section 4. The methodology used to review the projects and methods is described in detail in Section 4 and Appendix D.

The total reach lengths for each attribute within a Focus Area was used to determine the amount of each attribute (length and percent) by Focus Area in the South Platte Basin. These data can provide the existing amount of the attribute and to some extent the current protections and the possible amount of potential increase and the potential for future projects and protections. This potential is one measure of the environmental and recreational gap. However, the sufficiency of protections is not addressed by this comparison. The gap in environmental and recreational attributes can still exist, even in an area with protections in place, if those protections are not sufficient to protect or enhance environmental and recreational attributes. This will be discussed further in the following sections. Similarly, the presence of an attribute in the data available does not necessarily indicate that the attribute exists throughout the reach, or that the species that may exist within the reach identified is a robust population of that species. In addition, there exists a substantial gap in available data for proper assessment of the presence of attributes and the presence and sufficiency of protections.

Although the assessment of the gap may be lacking regarding data for the presence of attributes and sufficiency of protections, the assessment is a valuable starting point in identifying key environmental and recreational gaps for the basin.

3

South Platte Basin Water Availability – Challenges and Opportunities

3 South Platte Basin Water Availability

Key Points:

- A shared understanding of the challenges and opportunities by water managers, regulatory agencies, elected officials, the business community, and the general public will enhance our Colorado's ability to maintain reliable and sustainable water supplies for public safety, economic prosperity, environmental diversity and recreational enjoyment
- 16 Water Challenges in the South Platte Basin:
  - Lack of unappropriated South Platte and Republican River water.
  - Needs for water in the South Platte Basin have long exceeded the native water supplies of the South Platte and Republican river systems.
  - Degree of successive water use in the South Platte Basin.
  - Limitations on additional water reuse.
  - Further reductions in per-capita water consumption.
  - Additional use of Denver Basin Aquifer water
  - Opportunity for Groundwater Storage.
  - Use of the alluvial aquifer along the South Platte River.
  - Republican River Basin water use constraints.
  - Programs to manage and recover protected species and their habitats
  - Water quality management
  - Time and cost to obtain regulatory decisions on new water supply
  - Vulnerability to water service disruptions
  - Opportunities for further system
  - The roles of elected officials, the business community and the general public in water supply planning.
- The South Platte is fully appropriated – any remaining water is available only during spring runoff in wetter-than-average years. Storage is needed to make these supplies available in dry years. New storage projects currently under consideration include: above ground off-channel reservoirs, enlargements of existing reservoirs and aquifer storage and recovery.
- Conservation - The South Platte Basin has reduced its water use by approximately 20 percent since 2000 and has one of the lowest per capita water uses in the state.
- Reuse – Nearly all the growing South Platte Basin municipalities plan to fully utilize the water that they are legally entitled to reuse
- Successive Use of Water - The South Platte Basin is one of the most highly managed and efficient river basins in Colorado
- Groundwater - The Denver Basin Aquifer (DBA) is an important or sole source of water for many Metro-area water supply agencies. Declining water levels are expected without changes to existing aquifer use and management. Managed use of alluvial aquifers needs to be reevaluated but still in the context of Colorado water law.
- Environmental and Recreational Challenges- Hydrologic connectivity is important for many aquatic species, as it allows passage both up and downriver. Dry-up locations along the South Platte River and its tributaries brake hydrologic connectivity and habitat is fragmented.

Several water supply challenges and opportunities specific to the South Platte Basin shape the ways that solutions for water availability in the basin are identified, analyzed and implemented. A shared understanding of these challenges and opportunities by water managers, regulatory agencies, elected officials, the business community and the general public both within the South Platte River basin and throughout Colorado will enhance our State’s ability to maintain reliable and sustainable water supplies for public safety, economic prosperity, environmental diversity and recreational enjoyment. ***A good Colorado Plan needs a good South Platte Plan.***

Presented below are 16 topics for which challenges and opportunities will affect the implementation of projects and methods for South Platte Basin water management consistent with the overall well-being of the State of Colorado:

1. **Lack of unappropriated South Platte and Republican River water**. Many previous studies including SWSI 2010 conclude that there is little or no additional water available in either the South Platte or Republican Basins for new uses. While there may be water available during high snowpack or flood years, a large amount of storage would be required to make this yield reliable. This is the single biggest constraint in identifying and implementing projects and methods to solve future water needs in this area. This situation does, however, drive the need for *collaborative opportunities and solutions to address our municipal, industrial, agricultural, environmental, recreational and other water needs.*
2. **Needs for water in the South Platte Basin have long exceeded the native water supplies of the South Platte and Republican river systems**. South Platte water leaders realized decades ago that the economic development of this basin was key in establishing Colorado as a State. The earliest trans-basin import to the South Platte for irrigation was the Cameron Pass Ditch, constructed in 1882 by the Larimer County Ditch Company, known today as the Water Supply and Storage Company. The drought of the 1930’s solidified support for the development of the Colorado-Big Thompson (C-BT) Project, the largest transbasin project in the State, to supplement South Platte water supplies. Limited South Platte supplies compared to the consumptive water needs for Colorado’s economic engine along the Front Range not only drives the development of transbasin projects, but also results in both intense competition over South Platte water supplies and frequent collaboration in managing supplies and developing joint water supply projects. *Therefore, the limited native water supply to serve future needs is a constraint in identifying projects and methods that are easy to implement, but it also serves as an opportunity to drive water use efficiencies and collaboration among water supply agencies*.
3. **Degree of successive water use in the South Platte Basin**. Limited water supplies also drive extreme overall water use efficiency in the basin as a whole. As an upstream water user (municipal or agricultural, for example) diverts and uses water in accordance with their established water rights, a portion of that water returns to the South Platte River or its tributaries and is subsequently available for the next most senior downstream water right owner to use. It is generally understood that water is used perhaps seven times before it leaves Colorado at the Nebraska state line. This degree of successive downstream water uses either constrains the ability of water agencies to exchange water or to convey it back upstream or reduces the amount of water that has been previously available to downstream water users. *Opportunities for additional water supplies from the lower reaches of the South Platte River exist, but there are major economic and water quality permitting challenges as presented below*.
4. **Limitations on additional water reuse.** To assure that the State’s water is beneficially used, our water administration laws require that each water right specially cite the approved water use(s) and whether there is a limit to a single use of the water. Typically, only non-tributary

groundwater and most water imported from another river basin (the C-BT Project is an important exception) can be reused. In addition, native water transferred from agriculture may be reused. Many South Platte Basin water agencies have implemented reuse projects primarily for non-potable uses such as industrial consumption and greenbelt and golf course irrigation. Denver Water's Recycling Plant at 30 mgd (expandable to 45 mgd) is the largest in the State. Other water supply agencies are also planning on additional water reuse to the extent that their water rights allow and many others in the South Platte Basin are currently using their "reusable" supplies either directly by treating the water and pumping it back for non-potable uses or by "exchange". In "exchanges", the water rights owner has a source of substitute supply available downstream, which allows the owner to divert the same amount of water into their system upstream, without the cost, operational complexity and potential public concerns associated with the treatment and pumping systems. *There are some limited opportunities for additional water reuse in the South Platte Basin, but a major constraint is the large percentage of the available reuse supply that has already been put to use either directly through treatment and pump-back or by exchange, or by use as an augmentation supply by many entities that use wells as their water source.*

5. **Further reductions in per-capita water consumption.** Opportunities exist to reduce per capita water consumption but they face the following challenges: 1) Many water suppliers have already implemented major water conservation programs which are nationally recognized as "best-practices" 2) Current rural domestic water configuration systems require extensive pipe systems to serve a dispersed customer based 3) Several important local industries have high water use needs that cannot be significantly reduced using current best-practices (livestock operations, food processing, beverage production, energy production and oil, gas and mineral extraction) 4) Major climatic variation across the basin which correlates to vastly different water consumption needs 5) A large range in land-uses across the basin resulting in significant variation in lot size and landscaping requirements 6) Further reductions will exacerbate shortages for agriculture and reduce flows in the river if reductions are used to meet the M&I supply gap. 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. *This will help focus attention on opportunities to improve water use efficiencies and reduce future water demands in the South Platte Basin and throughout the State.*

6. **Additional use of Denver Basin Aquifer water.** Continuation of current withdrawals and/or potential expansion of the use of this important regional asset are constrained by declining water levels and well productivity in large areas of the Denver Basin Aquifer. Recent studies released by the United States Geological Study (USGS Denver Basin Aquifer Study, 2013) and the Douglas County Water Resource Authority (Rural Water Supply System Feasibility Study, 2013), differ on their predictions for depletions in the Denver basin aquifer between 1-5 feet per year (USGS modeling) and 5-13 feet per year by a Colorado Division of Water Resources (CDWR) Investigation. However, there are also major opportunities to use the aquifer in combination with other strategies including conjunctive use strategies where renewable sources supply the water in average and wet years and the Denver Basin water is used to provide safe yield in dry years. There may also be other areas overlying the aquifer where additional water may be available. In addition, studies conducted by the USGS, the

South Metro Water Supply Authority and the Douglas County Water Resource Authority suggest that the availability of water in the Denver Basin Aquifer is not uniform throughout. Certain areas may provide additional groundwater supplies. *Denver Basin Aquifer opportunities are especially attractive and potentially reliable when they are combined with surface and/or groundwater storage to firm, or partially firm, the renewable supplies. Specific opportunities that appear attractive for further investigation include, but are not limited to, Denver Basin supplies coupled with: 1) limited agricultural water transfers, especially alternatives to traditional 'buy-and-dry" and 2) transbasin water from either existing or new projects*.

7. **Opportunity for Groundwater Storage**. The Denver Basin Aquifer provides the opportunity for small water providers to store excess water through ASR. ASR provides the potential for water providers to utilize the existing aquifer as a storage vessel. Excess water supplies are either pumped into the aquifer through existing wells retrofitted with baski valves (Centennial Water and Sanitation District, located in Northern Douglas County, began using ASR to store excess surface water off of the South Platte River in the mid-1990's).[1] Additionally, other municipalities and water districts have invested in research for potential ASR projects as well as the infrastructure necessary for implementation. Current investigations are being conducted by the South Metro Water Supply Authority, which could result in utilizing the existing Denver basin aquifer as a storage vessel for excess surface water supplies. *The challenge of aquifer storage and recovery is obtaining water supply to store and balancing the capabilities of storing excess water with the ability to retrieve it as needed.*

8. **Use of the alluvial aquifer along the South Platte River**. Currently the South Platte Basin is successfully using 450,000 AF of alluvial groundwater, however, greater use of this water supply is constrained due to the effects that lagged depletions have on river flows.[2] There is limited availability of augmentation water to offset the effects of groundwater pumping. In the South Platte Basin, there is a complex history and considerable controversy over the administration of alluvial aquifer wells that has resulted in specific legislation to execute groundwater studies (for example, House Bill 1278 Colorado General Assembly 2012) and other management actions. The South Platte Basin Roundtable is addressing these concerns through a Groundwater Subcommittee comprised of BRT members and other interested parties and, together with the Metro BRT has formally adopted a process to address these concerns (including potential strategies related to water rights administration) that will extend well beyond the publication of the draft South Platte BIP in July 2014. *This process will offer opportunities to build on the work done in response to House Bill 1278 and help determine the degree to which this resource may be effectively, reliably and legally put to some greater level of use*.

9. **Republican River Basin water use constraints**. The Republican River Compact between Colorado, Nebraska and Kansas places severe constraints on Colorado's citizens living and working in this basin. In addition, the Republican River Basin is physically distinct from the South Platte Basin and the Rocky Mountain snowmelt feeding the South Platte River does not

[1] CentennialWSD.org; SMWSA ASR Pilot Project, 2011

[2] Waskom, Reagan. HB 12-1278 Study of the South Platte River Alluvial Aquifer. Colorado Water Institute, Colorado State University. December 2013

benefit the Republican River basin. The Ogallala Aquifer that spans eight Great Plains states supplies the basin's agricultural economy (Yuma, Kit Carson, Phillips, and Washington counties are ranked in the top ten agricultural producing counties in the state according to the 2012 USDA agricultural census). Irrigation with Ogallala Aquifer water contributes to superior crop yields but a declining groundwater table raises concerns about how much longer or to what degree the Republican Basin will be able to benefit from this water source. Additionally, recent declines in aquifer levels have caused concern about water quality. Aquifer recharge from rainfall is limited due to the Republican Basin's soils. Opportunities for conservation and public education have been pursued by the RRWCD, however, it is the overwhelming desire of well owners in the Basin that mandates not be placed on conservation and that strategies be pursued on an individual voluntary basis.

10. **Programs to manage and recover protected species and their habitats**. The most notable species protection program in the South Platte Basin is the PRRIP. This three-state program, established in 2007 through an agreement between Colorado, Nebraska, Wyoming and the U.S. Department of the Interior, is designed to resolve conflicts between water use and endangered species protection in the Platte River Basin. The PRRIP does this by providing programmatic benefits (through land protection, water management, and financial support) for four federally listed species and their associated habitats in the central and lower Platte River in Nebraska. In Colorado, the water part of this commitment is implemented through "Tamarack Plan" operations, which utilize managed groundwater recharge from recharge wells and ditches located in the lower reaches of the South Platte River in Colorado to re-time river flows from periods exceeding species flow targets to periods short of target flows. The Tamarack Plan also obtains annually, by payment, certain recharge accreditation credits not needed by local well augmentation plans during free-river periods. The water is first diverted for an initial beneficial use within Colorado, with some of the unused return flows subsequently reaching the river in times that benefit the Platte species. These operations also provide benefits for certain aquatic species of concern in Colorado.

    The PRRIP provides a means for streamlined ESA compliance for existing and future water-related activities in Colorado, as an alternative to stand-alone ESA Section 7 compliance through measures offsetting the depletive effects of each individual project undergoing permitting and consultation. The PRRIP has not only facilitated additional water use in the South Platte Basin, but also extended and protected the supplies currently and historically used by many of the Basin's municipal and agricultural water users through various types of permits with the federal government. ESA coverage under the PRRIP for "new" (post-1997) water-related activities is constrained in several respects:

    a. The program will not cover new water-related activities once the average annual water supply to serve Colorado's population increase from wastewater exchange/reuse and native South Platte flows exceeds 98,010 acre feet of gross water deliveries during the February-July period.

    b. The program does not cover the construction of a major on-stream reservoir located on the mainstem of the South Platte River downstream of Denver. In addition, the program does not cover hydropower diversion/return projects that divert water and sediment from the mainstem of the South Platte River downstream of Denver and return clear water to the South Platte River.

In the event a new water-related activity is not covered by the program, the project proponent can pursue stand-alone ESA consultation and project-specific ESA compliance; alternatively, Colorado and the activity's proponent could propose amendments to the Colorado plan that would allow the PRRIP to provide ESA coverage for that new water-related activity. *The PRRIP Program and many other lesser known species and habitat protection programs throughout the South Platte Basin offer very important opportunities to collectively consider and pro-actively plan for the protection and enhancement of key environmental and recreational focus areas.*

11. **Water quality management.** Domestic and agricultural water users recognized even in the late 1800s that there is higher quality water with greater flow reliability in the mountain streams where the rivers exit the foothills and on to the plains. They planned delivery systems, in some cases very long systems to serve uses on the high plains and growing towns and cities. Today, these higher quality water sources are essentially fully tapped and municipal water suppliers are facing the challenges of using lower quality, more distant water sources. They are meeting this challenge through technological innovation; shared risk through collaborative projects, programs and research and, in some cases, significant impact to their rate structures and customers. After current IPPs are implemented, greater use of the lower quality water sources may be significantly constrained depending on whether the industry's technological advancements satisfy regulatory requirements for disposal of highly concentrated waste streams from advanced water treatment processes. In some cases, water agencies with adequate volumes of higher quality water may be able to blend them with lower quality supplies for their next major increment of water supply and avoid the advanced treatment technologies that result in concentrated brine streams. However, after this next increment of supply, *the challenges of inland brine disposal could be a major issue for South Platte water suppliers both due to financial challenges and environmental impacts*.
12. **Time and cost to obtain regulatory decisions on new water supply projects.** Regardless of the outcome of these decisions, a key constraint in the ability of South Platte Basin water supply agencies to plan for reliable sources of future supply is the time and cost of complying with the National Environmental Policy Act (NEPA), preparation of federal agency-led Environmental Impact Statements (EISs) and finalizing the regulatory decisions and mitigation plans. Some of the major water supply EISs are still not complete after approximately 10 years and 10 million dollars of preparation, while several others continue to make progress in these complex and costly processes. *A high success rate for the implementation of these IPPs is key to the South Platte Basin meeting its future water supply needs. Several of these projects offer opportunities for lessons-learned and new strategies for balancing diverse needs such as the development of multi-party agreements like the Colorado River Cooperative Agreement and the Eagle River Agreement.*
13. **Diverse environmental and recreational water needs and concerns.** Protecting and enhancing the diverse environmental and recreational needs throughout the South Platte Basin should be balanced with the limited opportunities to meet the Basin's growing demands. These needs may present opportunities for multi-purpose projects that can benefit both consumptive uses as well as environmental and recreational attributes. There are opportunities for agreements and cooperative operation of projects that will allow additional water supply development while addressing concerns related to environmental attributes.

There are many water-related and environmental interconnections and co-dependencies that can benefit from continued collaborative water supply planning efforts, such as threatened and endangered species recovery programs, watershed and water quality programs. There are funding challenges to proactively protecting and enhancing environmental and recreational attributes. While mitigation for projects must be addressed by the project proponent, additional enhancements may be possible if additional funding sources for environmental and recreational needs can be identified or developed. *Addressing environmental and recreational concerns in the initial planning stages of water supply projects may help to streamline the process of permitting. In addition, multi-purpose projects with multi-party agreements may benefit from additional sources of funding.*

14. **Vulnerability to water service disruptions.** Past experience in the South Platte Basin including the Buffalo Creek Fire of 1996 and a subsequent rain event that brought intake-clogging debris into Strontia Springs Reservoir (a primary intake for Denver Water and Aurora Water) highlights potential vulnerabilities of municipal water systems to service disruptions. With concerns over increasing hydrologic variability including extreme weather events and concerns over the hydrologic response of our watersheds due to forest health issues, water supply agencies in the South Platte Basin now have an even broader recognition of the need for diversity in water sources, redundancies in infrastructure capacity and adequacies of stored water for adverse or emergency situations. However, *with increased competition for scarce water supplies, water agencies are constrained in their options and are looking for solutions where risks and opportunities can be shared through collaborative, regional approaches (see item 15).*

15. **Opportunities for further system interconnections.** In the South Platte Basin there are likely currently unidentified options for additional system interconnections, such as the Water Infrastructure and Supply Efficiency (WISE) Project being jointly developed by Denver Water, Aurora Water and the South Metro Water Supply Authority, that will help share water supply risks. However it is likely that there are few additional "low hanging fruit"; meaning options that are easily afforded, implemented and permitted and significantly reduce the water supply gap. *The underlying issues presented above have existed for decades and considerable effort has been applied to identifying creative solutions involving regional or interconnected systems.*

16. **The roles of elected officials, the business community and the general public in water supply planning.** As solutions to South Platte and statewide water supply issues tend to get more technologically complex and expensive and as more compromises are required in the allocation of water among competing municipal, industrial, agricultural, environmental and recreational needs there is an opportunity to more fully engage the input and creativity of diverse interested parties to help develop solutions consistent with our combined vision of what we want for the South Platte Basin and the entire State. Elected officials, along with public and business community support of identified solutions will help create a successful and unified plan. Again, "*A good Colorado plan needs a good South Platte Plan." Political leadership will be needed for developing new Colorado River supplies and conservation programs.*

These water supply challenges, coupled with the diverse population and economic drivers in the basin, define how the Metro and South Platte Basins will meet their future water needs. The South Platte BIP's integrated approach, utilizing the IBCC's "four legs of the stool" (conservation, new supply, IPPs and agricultural transfer plus storage), will utilize existing opportunities and facilitate new ways to meet future water demands. The following sections analyze the water availability in the Metro and South Platte Basin.

3.1 Current South Platte Water Operations and Hydrology

3.1.1 Identification of Unappropriated Water

Reference Documents

The following discussion is extracted from:

SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- Section 6.3 Statewide Water Availability Summary

There are several factors impacting the analysis of unappropriated water in the South Platte and Metro basins. In addition to increased competition for the same sources of water, there are other factors that must be accounted for when evaluating the availability of any unappropriated water. These include:

- Return to normal precipitation and runoff after a lengthy period of above average conditions (1970s – 1990s).
- Rapid population growth coincident with the three wettest decades of last century, thus masking the impacts of this increased water demand on available supplies.
- Projected increased reuse and recapture of consumable M&I return flows (nontributary groundwater, transbasin diversions, and/or consumptive use agricultural transfers).
- Development of augmentation/recharge projects that capture surplus flows for agricultural well augmentation programs in order to prevent injury to senior rights.
- Less cooperation among water users such as the discontinuation of the "Gentlemen's Agreement" among certain reservoir owners to not call for water in the nonirrigation season. This practice did not add more water to the hydrologic system and delayed filling downstream reservoirs.
- Climate change creating a warmer and drier environment affecting the amount of available water.

3.1.1.1 HISTORICAL HYDROLOGY – PRECIPITATION AND RUNOFF PATTERNS

River flows in the basins in the 2010s have shown a return to normal precipitation and runoff patterns after 4 decades of above-average flows. Figure 3-1 through Figure 3-3show the flows by decade at the Henderson, Kersey, and Julesburg gages, respectively, and their period of record (POR) averages. At the Henderson gage, flows during the decades of the 1970s through the 2000s were above average while the decadal average of the 2010s based on available data until water year 2012 is below average. The decadal averages at the Kersey and Julesburg gages are above average for the 1970s through 1990s and for the 2010s while the decadal averages for the 2000s are below average for the two gages. It is notable that as one moves downstream from Henderson to Kersey and then to Julesburg, the flows from the 2000s decrease further and further. This is likely attributable to:

- Increased consumptive use in the lower South Platte from higher irrigation efficiency (i.e., conversion to sprinkler irrigation);

- Return to historical levels of use of downstream senior reservoir water, either for direct irrigation or for well augmentation, which results in more flows required to fill the reservoirs each year; and
- Reduced return flows from upstream due to reuse of treated effluent, reuse of lawn irrigation return flows from reusable sources, watering restrictions, and water conservation efforts that reduce M&I return flows, especially outdoor use return flows.

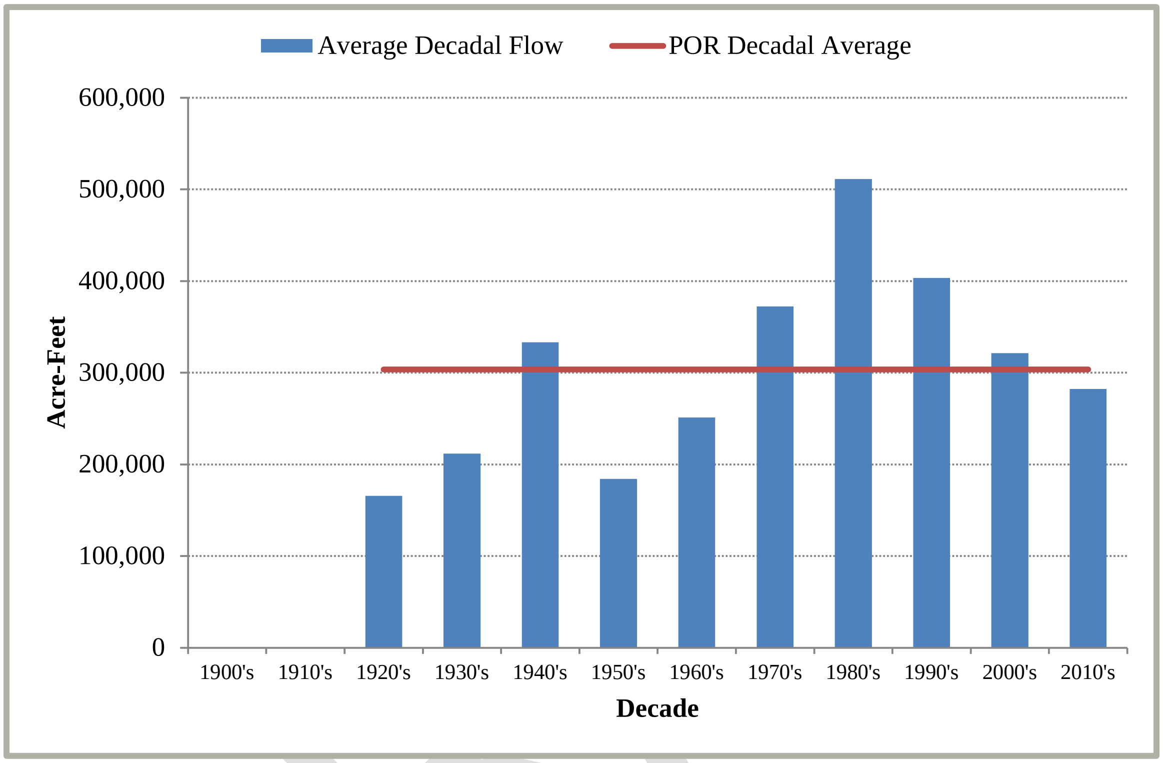

Figure 3-1. South Platte River at Henderson POR: 1927 through 2012

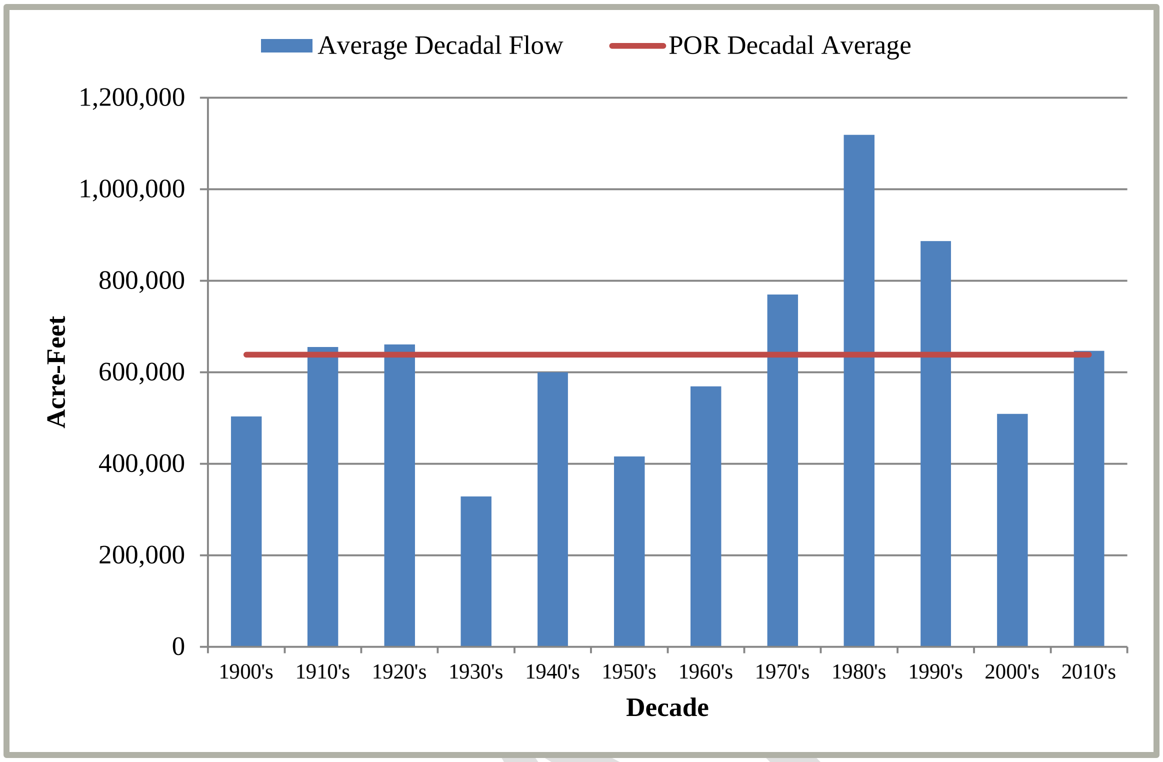

Figure 3-2. South Platte River at Kersey POR: 1902 through 2012

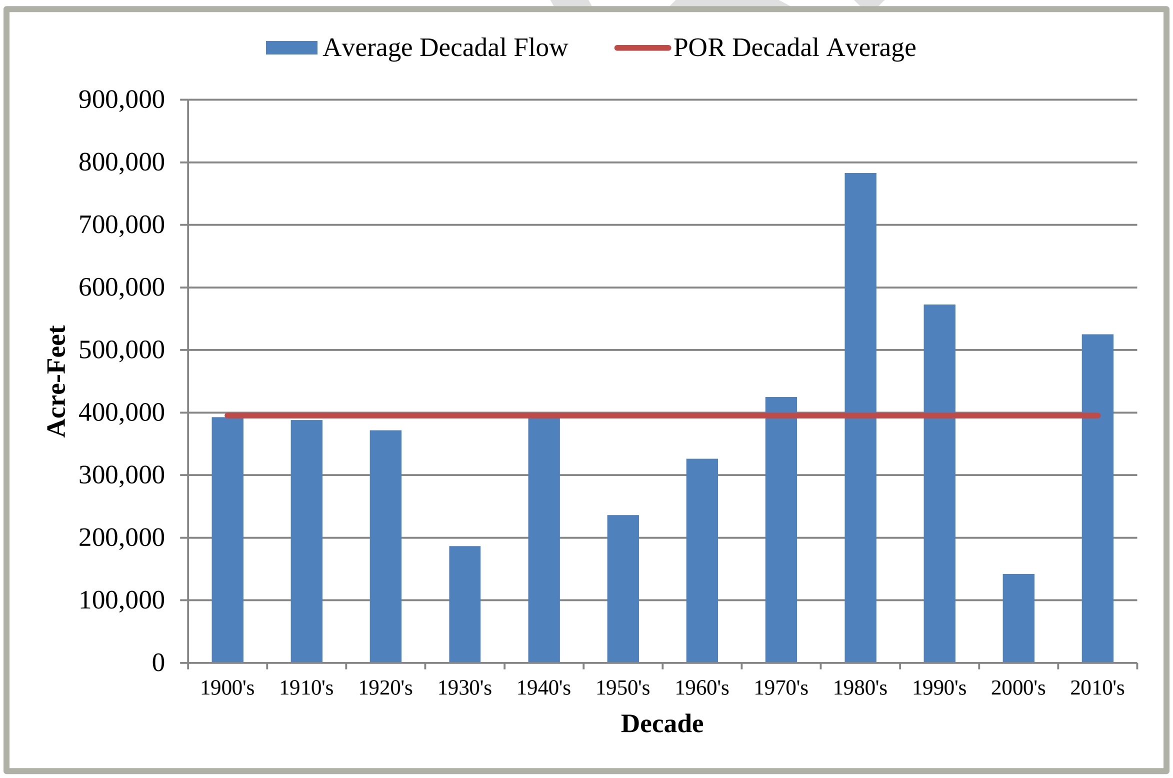

Figure 3-3. South Platte River at Julesburg POR: 1903 through 2012

These reduced return flows are impacted by drought, maximum diversions by more senior agricultural water rights, and increasing reuse of consumable M&I return flows. Figure 3-4 presents the percent change from average by decades.

Unappropriated water in the Metro and South Platte Basins may only be available to produce yields during the spring runoff period in average to above-average years. This may not meet the needs for some users of firm supplies. However, it constitutes a valuable opportunity for some water users that can divert supplies when available to offset groundwater pumping, primarily within the DBA.

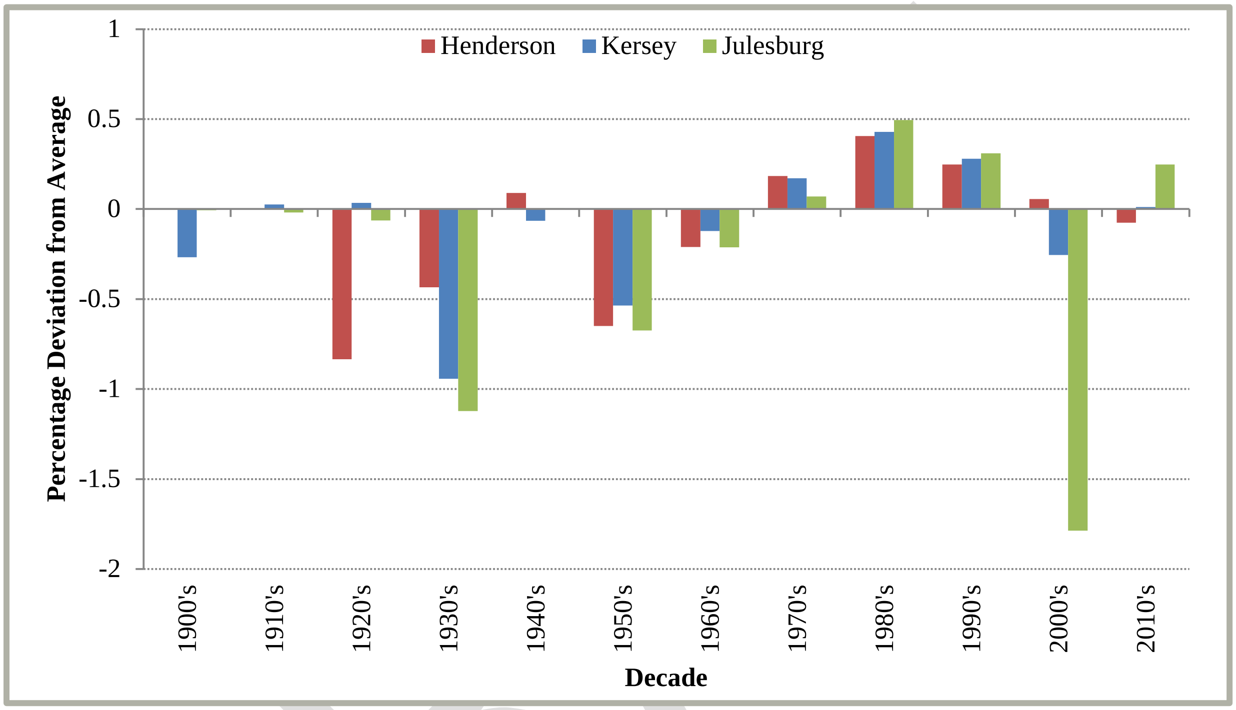

Figure 3-4. Percent Deviation from POR Averages

3.1.1.2 WATER SUPPLY AVAILABILITY IN THE SOUTH PLATTE BASIN

The previous assessments of water supply availability for new or expanded water uses in the South Platte were presented in the June 2011 Needs Assessment Reports for the Metro and South Platte Basin Roundtables and presented in SWSI 2010 that built upon the SWSI 1 (2006) findings. The original work referenced previous assessments that were developed for a variety of purposes using Denver Water's model, the Platte and Colorado Simulation Model (PACSM), the Northern Integrated Supply Project (NISP) study, and the Lower South Platte River Water Management and Storage Sites Reconnaissance Study to illustrate the range of potentially available water supplies in the South Platte Basin. For example, NISP's Galeton Reservoir will incorporate diversions from the South Platte River downstream of Greeley during the winter and springtime.[3]

Much of the modeling work is now outdated. It may not incorporate many factors currently affecting water supply availability in the basin including, but not limited to, the following:

[3] For more information on NISP:

1) recently implemented water projects such as the City of Aurora's Prairie Waters Project, East Cherry Creek Valley Water and Sanitation District's (ECCV) Northern Pipeline Expansion Project, Denver Water's Recycling Plant, extensive gravel pit development and many others;

2) more days of water shortage and associated calls for water since the 2002 drought

3) additional exchange and operating agreements to support additional M&I reuse programs, and

4) restrictions associated with the PRRIP (see page 3-5). Also, previous modeling did not reflect the potential water development through the many identified future projects such as the Chatfield Reallocation project.

When presented in the original State-sponsored reports, the results helped illustrate the limited water availability in the Metro and South Platte Basin. For example, the work concluded that there was no unappropriated water available during dry years and only limited unappropriated flows available during above average years. Their conclusion that a large amount of storage would be required to obtain firm yield from water captured during wet years is likely even greater under current conditions. The conclusion that there is little unappropriated water remaining that can produce a firm yield in the upper and lower portions of the South Platte River Basin without extensive storage is still considered valid, but new analyses would need to be prepared to determine reasonable estimates of the limited remaining water availability in average to wet years. In addition, 13,600 AFY of nontributary groundwater will need to be replaced in the South Metro area; a portion of which is reduced through implementation of the WISE project.

The State of Colorado, through the CWCB and the Division of Water Resources, is in the process of developing surface and groundwater models for the South Platte Basin as components of the South Platte Decision Support System (SPDSS). However, these models are not yet completed. Additional analysis should be made using the SPDSS models and/or other models and types of analyses to determine reasonably accurate assessments of the very limited remaining South Platte basin water availability.

3.1.1.3 CONJUNCTIVE USE OF GROUNDWATER AND SURFACE WATER

A possible alternative for new storage in the South Platte Basin is conjunctive use with nontributary groundwater. Surface water would be used heavily in average to wet years directly for potable use and/or for groundwater recharge of the Denver Basin aquifers, with a reliance on nontributary groundwater in drier years when the junior surface water rights would produce little or no yield. This concept would allow for the storage and beneficial use of a portion of Chatfield's average 36,000 AF under an existing conditional or new junior water right. As noted in the discussion of the various water allocation models, the perfection of other more senior conditional water rights could impact this average yield. This conjunctive use concept has been studied by the South Metro Water Supply Authority (SMWSA) and its members intend to use reallocated Chatfield Reservoir storage and other storage reservoirs conjunctively with their Denver Basin nontributary groundwater supplies.

3.1.1.4 WATER AVAILABILITY IN THE DENVER BASIN AQUIFER

The Denver Basin Aquifer (DBA) is a deep groundwater basin that underlies the Denver metropolitan area and is comprised of four separate aquifers or layers (the Dawson, Denver, Arapahoe and Laramie-

Fox Hills Aquifers). It underlies part or all of Weld, Boulder, Adams, Arapahoe, Douglas, Elbert and El Paso Counties and is an important or sole source of water for many Metro-area water supply agencies.[4]

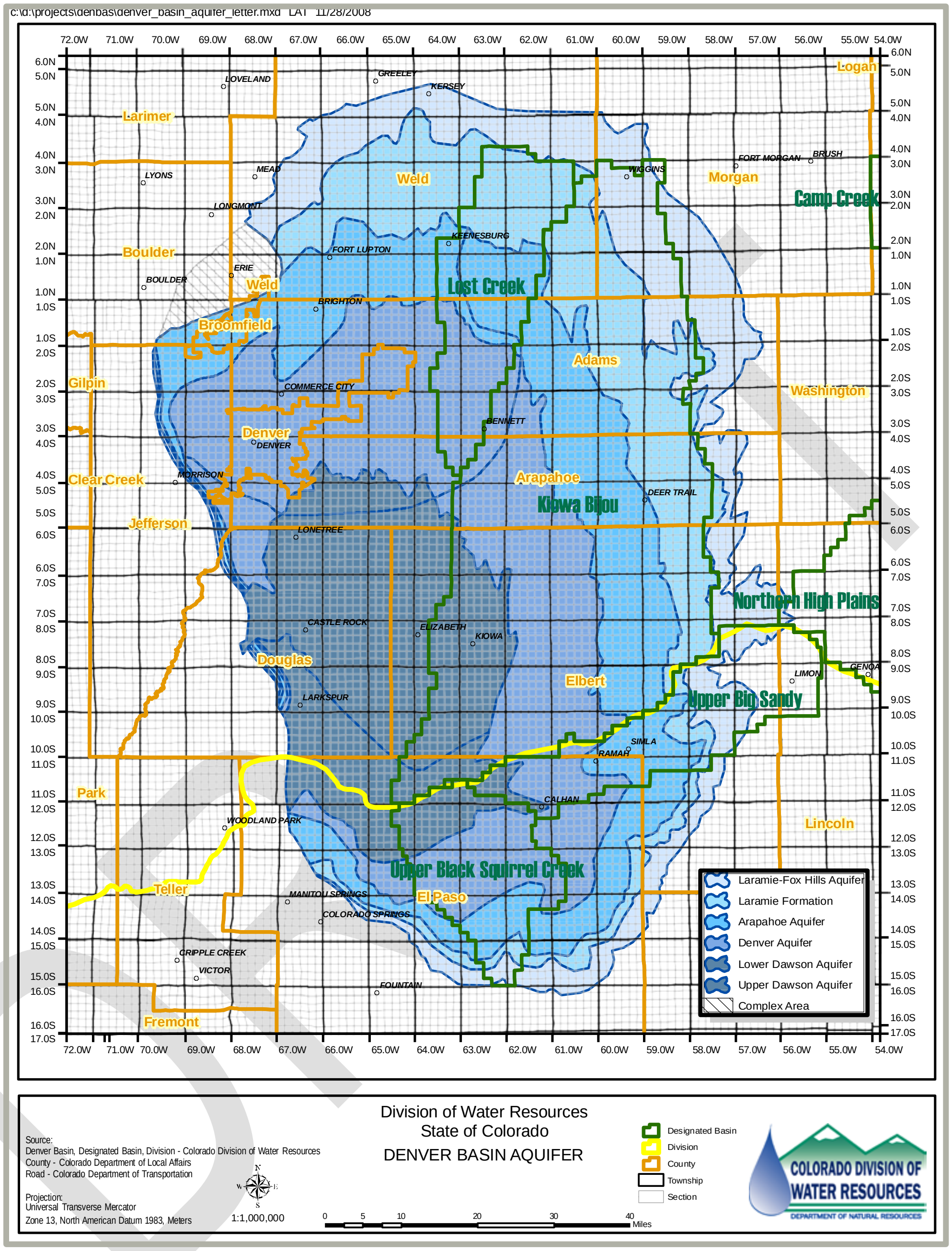

Figure 3-5. Denver Basin Aquifer

Source: Colorado Division of Water Resources

The DBA is not connected to surface water sources and, therefore, is not recharged through natural processes. As a “non-tributary groundwater source” it is considered to be a non-renewable resource that

[4] Groundwater Availability of the Denver Basin Aquifer System, Colorado, 2013

deserves special management.[5] Recent work conducted by the USGS and regional water authorities such as the Douglas County Water Resource Authority (DCWRA) and SMWSA, show increasing vulnerability (decreased water levels, reduced well yields and large increases in pumping costs) to water suppliers using the DBA over the coming decades if current or greater pumping rates are allowed.

3.1.1.4.1 DENVER BASIN AQUIFER WATER SUPPLY RELIABILITY

In 2004, the USGS began a large-scale regional study to review the availability and reliability of groundwater resources across the United States (USGS Study). For the Denver Basin Aquifer, a modular finite-difference groundwater flow computer program (MODFLOW-2000) was used to assess the affects of population growth and regional development on the Denver Basin groundwater resources. The work considered historic water levels and pumping from 1880-2004 to make predictions on future hydrologic systems for modeled aquifer conditions and response for the 2004-2053 period.[4] Findings from this modeling demonstrated that due to pumping rates in recent decades, there are declining water levels in the DBA and further declines and reduced well yields can be expected without changes in aquifer use and management. Other recent estimates indicate that there are approximately 200 million acre feet of recoverable water within the DBAs.[6] However, the USGS Study predicts a decline of the DBAs of 1-15 feet per year. These calculations vary depending on the location of the wells modeled and the aquifer examined. The anticipated groundwater declines within the DBA provide a challenge for the communities that rely on it for municipal water supplies. As groundwater levels in the DBA decrease, municipalities, water providers and private well owners will no longer be able to receive the yields on which they have depended in the past. They are now facing decisions such as whether to drill more or deeper wells or whether to develop new surface water projects that could be used conjunctively with their groundwater supplies to extend DBA productivity. The recent studies by the USGS, DCWRA and SMWSA demonstrate that there are economies of scale for municipal and special water districts to begin developing additional surface water supplies.[7] In doing so, the DBA continues to provide stability of water supplies through the firming of surface water as well as a drought supply.

3.1.1.4.2 COLORADO GROUNDWATER ADMINISTRATION

In 1965, Colorado set preliminary rules and regulations to the use of groundwater resources. Water resources located in Colorado's Denver Basin or in the other designated groundwater basins along the East Slope are subject to additional rules and regulations under the Colorado Groundwater Management Act (C.R.S. 37-90-101). The following is a brief overview of the laws that govern the Denver Basin and designated basins on the East Slope, including those within the South Platte Basin.

In 1973, the Colorado legislature passed Senate Bill 113 (SB 73-213) which recognizes the existence and general properties of the four aquifers of the Denver Basin and established rules for its administration. Under this law, withdrawal of groundwater from the DBA is tied to ownership or control of the overlying land. Well users are limited to withdrawing up to 1 percent of the water estimated beneath their land, thus preserving the aquifer's 100-year life for any given parcel (under the assumption that effects from pumping from other parcels would either not significantly affect aquifer levels or that the superimposed effects would be acceptable even though the aquifer life would be diminished). In 1985, Colorado's

[5] See: http://water.state.co.us/DWRIPub/Documents/denverbasin.pdf for details regarding DBA

[6] Citizens Guide to Denver Basin Groundwater, Colorado Foundation for Water Education, 2007

[7] Douglas County Rural Water Feasibility Study, June 26 2013

General Assembly provided further clarification for ground water administration under Senate Bill 85-05 (SB 85-05). Under this bill, the DWR, water courts in Division 1 and 2 and the CGWC are tasked with making decisions on the amount of water from the Denver Basin or other designated basins that well owners may use and how that water may be used. Specifically, SB 85-05 adopted a rule to preserve the aquifer's 100 year reliability through the administration of pumping rights. This administration attempts to deal with issues such as impacts for adjacent pumping, decreased well yields with decreased aquifer levels and other factors.

Only about 47% of the DBA is within designated groundwater basins and administered by the CGWC. The remaining 53% is outside of the designated basins and administered by the State Engineer's Office pursuant to water court decrees. Like the Colorado Water Quality Commission, the CGWC provides oversight and additional accountability for the State's administrative and regulatory functions recognizing the importance of the long-term management of these public resources. CGWC was formed by the General Assembly under the Groundwater Management Act as the regulatory and adjudicatory body authorized to administer rules and regulations for the Denver and designated basins (C.R.S. 37-90-102). To be classified as a Designated Basin, the legislation specifies that there must be little or no connection to surface water and there is typically strong concern and controversy regarding long-term management and reliability of the aquifer(s) (C.R.S 37-90-103). The CGWC is tasked with the management and control of Colorado's current eight designated ground water basins, all located in Eastern Colorado. GWMDs provide additional administrative authority within local boundaries within the designated basins. There are eight (8) designated groundwater basins that are managed by thirteen GWMDs. These designated basins and Management Districts can be found through the Colorado Division of Water Resources. GMWDs have the authority to enact additional rules on local groundwater users.[8]

3.1.1.5 GRAVEL LAKE DEVELOPMENT

> **Reference Documents**
>
> The following discussion is extracted from:
>
> SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- Section 6.4.2.5 Gravel Lake Development

Many M&I providers have already purchased and constructed, or are planning to acquire and construct, lined gravel lake storage to capture return flows along the South Platte and the Cache la Poudre rivers.

Table 3-1 (compiled in 2010 for SWSI, HDR analysis did not include an update of the information presented) presents a partial list of planned or completed gravel lakes with their capacities if known. **Figure 3-6** gives an example gravel pit storage development along a portion of the South Platte River. The potential impacts of lined gravel lakes on the movement of alluvial groundwater towards the river are of concern. Some complaints have been made to state agencies that groundwater levels on the up gradient side of the lakes are rising and causing issues associated with shallow water tables.

[8] Designated Basins and Management Districts

Table 3-1. Known, Existing or Planned Gravel Lake Storage

Owner	Name	Existing Storage Capacity (AF)	Planned Storage Capacity (AF)
Adams County	Mann & Nyholt Lakes	3,800	
Centennial Water and Sanitation District	South Platte Reservoir	6,400	
Central Colorado Water Conservancy District	Siebring, JoDee, La Poudre, 83rd Ave, Bernhardt, Nissen, Koenig, Shores Lakes Reservoirs	17,000	
Cherry Creek Project Authority	Chambers, Vessel, or Walker Pit		1,250
City of Aurora	Prairie Waters System		15,000
City of Boulder	Wittemyer Ponds		650
City of Brighton	Ken Mitchell Lakes, Erger and 124th Pit	3,500	1,700
City and County of Broomfield	Heit Pit		1,500
City of Erie	Erie Gravel Lakes		1,000
City of Fort Collins	Overland Gravel Lakes		1,000
City of Greeley	Greeley Flatiron; Overland Trail and 25th Ave Gravel Lakes		3,100
City of Lafayette	Goose Haven Reservoir Complex	1,600	1,900
City of Longmont	Golden Pond	350	
City of Northglenn	Bull Reservoir	4,000	
City of Thornton	Thornton Gravel Lakes	23,400	10,000
City of Westminster	Wattenberg Lakes	1,900	4,000
Consolidated Mutual Water Co.		Unknown	Unknown
Denver Water	Denver Gravel Lakes		30,000
Little Thompson Water District	Little Thompson Gravel Lakes		1,200
Coors Brewing Company	Coors Gravel Lakes	10,000	
South Adams County Water & Sanitation District	South Adams County WSD Gravel Lakes	Storage capacities included with Denver Water and Westminster	
Town of Castle Rock, Castle Pines and Castle Pines North	Plum Creek Reservoir		1,300
Tri-Districts	Overland and Tri-Districts Gravel Lakes		1,900
Town of Lochbuie	Lochbuie Gravel Lakes		
United Water and Sanitation District	United Gravel Lakes		8,000
	Totals	**71,950**	**83,500**

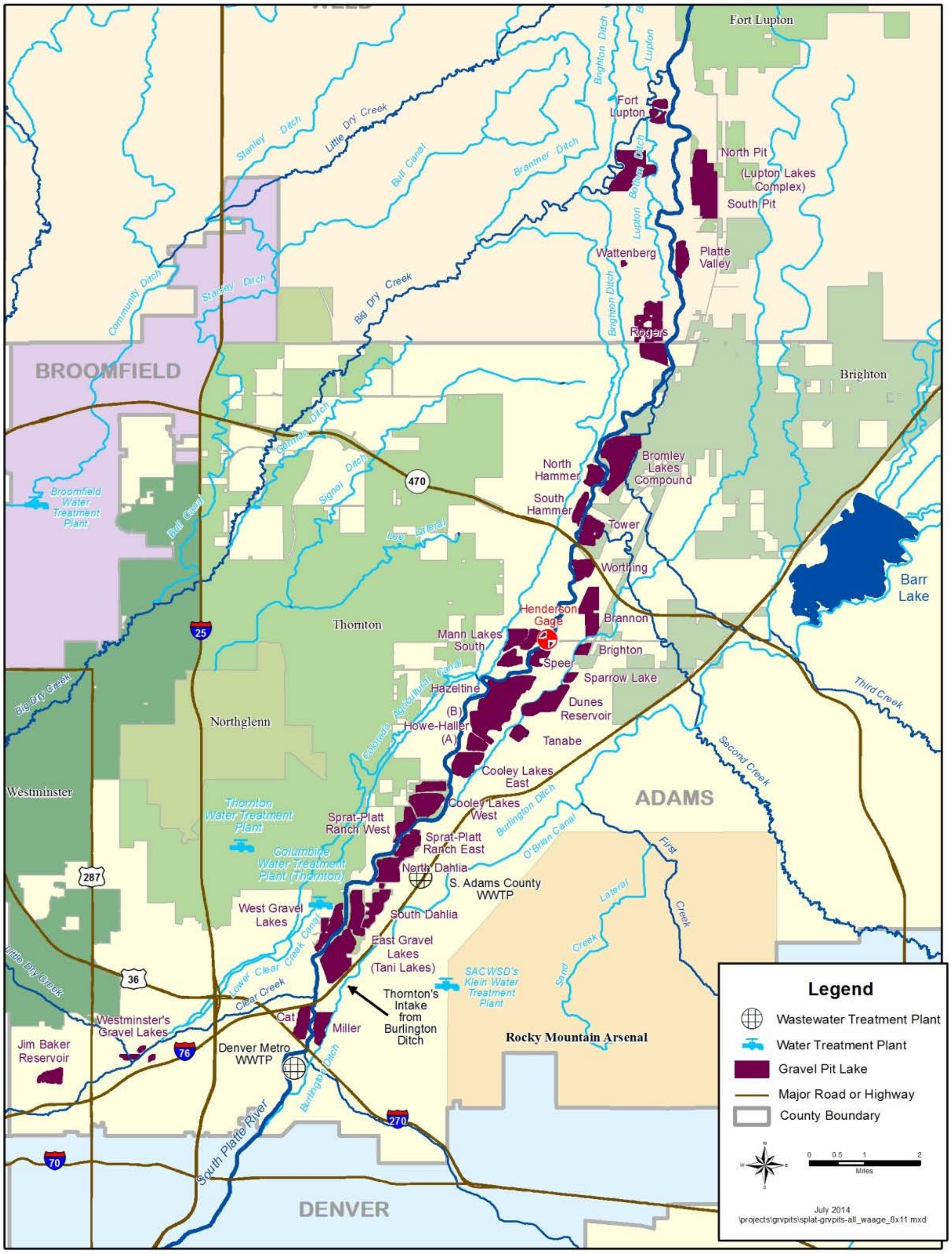

Figure 3-6. South Platte River North of Denver Existing and Proposed Gravel Pit Reservoirs

3.1.1.6 OTHER IMPACTS ON WATER AVAILABILITY

Reference Documents

The following discussion is extracted from:
SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- Section 6.4.2.4 Anticipated changes in River Conditions and Impacts on Water Availability

Over the next decade, several changes are anticipated that will impact South Platte River flows and unappropriated water. These include:

- Acquisition and transfer of agricultural water rights by M&I users.
- Maximization of reuse of consumable M&I return flows.
- Full utilization of existing surface water rights by agricultural and M&I users.
- Increased storage in lined gravel pit lakes and alluvial storage to capture reusable return flows and junior water rights diversions. This storage will be used to cover return flow obligations on transferred agricultural rights directly, or by exchanges with upstream M&I providers when exchange potential exists.
- Water conservation programs by M&I users that reduce lawn irrigation and wastewater return flows.
- Agricultural conversion to more efficient irrigation methods such as sprinkler irrigation, reducing volume, and altering timing of return flows especially in the fall and winter months.
- Increased instream depletions from growth in phreatophytes along the South Platte River. [9]
- Impacts of climate change effecting temperature and altering river flows

The net effect of the above is reduced flows, increased consumptive use, reduction in groundwater gains, more senior calls, and less water for agricultural well augmentation.

3.1.1.7 OTHER FACTORS IMPACTING SUPPLY AVAILABILITY

Reference Documents

The following discussion is extracted from:
SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- Section 6.4.2.6 Other Factors Impacting Supply Availability

- In addition to the changes and water development activities in the basins mentioned above, there are additional factors that could affect future supply availability. All have the potential to reduce flows or change timing and location of flows in the South Platte River and its tributaries. These include: PRRIP
- Recreational in-channel diversions (RICDs)
- Development of conditional storage water rights
- Development of new and conditional recharge projects

[9] Senate Bill 195 signed into law on June 6, 2014 directs the Colorado water conservation board to evaluate the growth and identification of phreatophytes, which are deep-rooted plants that absorb water 10 from the water table or the layer of soil just above the water table, along the South Platte River in the aftermath of the September 2013 flood. The objectives of the study are to determine the relationship between high groundwater and no beneficial consumptive use by the phreatophytes and to develop a cost analysis for the removal of unwanted phreatophytes. There can be environmental and erosion control benefits from native phreatophytes.

- Period of Record for analysis (e.g., extending the period to include the 2000s drought years or incorporating tree ring data)
- Potential Climate Change reducing or altering runoff patterns and increasing crop consumptive use, urban irrigation, and evaporation
- Phreatophyte growth along the South Platte River and its tributaries
- Potential new environmental challenges if projects are not appropriately implemented to keep species of concern from becoming listed, either federally or at the state level.

The purpose of the PRRIP is to provide ESA compliance for new and existing water related activities in the Platte River Basin. Thus, the PRRIP can help to mitigate the effects of water-related activities that are likely to put one or more endangered species protected by the PRRIP in jeopardy. If a new project in the South Platte Basin cannot utilize the program's protection mechanisms, it would have to instead seek to meet ESA compliance with its own plan - a more difficult challenge because the U.S. Fish and Wildlife Service has required one-for-one replacement of depletions for projects permitted prior to the PRRIP.

Colorado's Plan for Future Depletions (Attachment 5, Section 9 of the PRRIP) sets forth the conditions for accounting for a new (post-June 30, 1997) depletion to be covered by the PRRIP for ESA compliance purposes. New water-related activities would not be covered once wastewater exchange/reuse and new native South Platte gross water deliveries exceed 98,010 AF in the February to July period (Section 1.H.1). Section 1.H.2 also provides that the plan does not cover a reservoir larger than 2,000 AF on the mainstem of the South Platte River anywhere below Denver.

During the spring runoff of 2007, there was a period of "free river" where more water was available than was needed for use. Figure 3-6 shows the flows at several key gages along the South Platte River, demonstrating the large amount of use on the lower reaches of the river. These uses include:

- Reservoir fills
- Recharge plans
- Lower return flows due to higher irrigation efficiencies

As more of the above uses are implemented, these diversions will increase. Free river flows on the South Platte River during the spring runoff of 2007 and 2010 are compared in Figure 3-6 to identify the variation in flows surpassing the amount available to diversion by water rights during the two periods. Free river flows during the spring runoff of 2010 are observed to be higher than the spring runoff of 2007; possibly due to the occurrence of a large storm event during the spring of 2010.

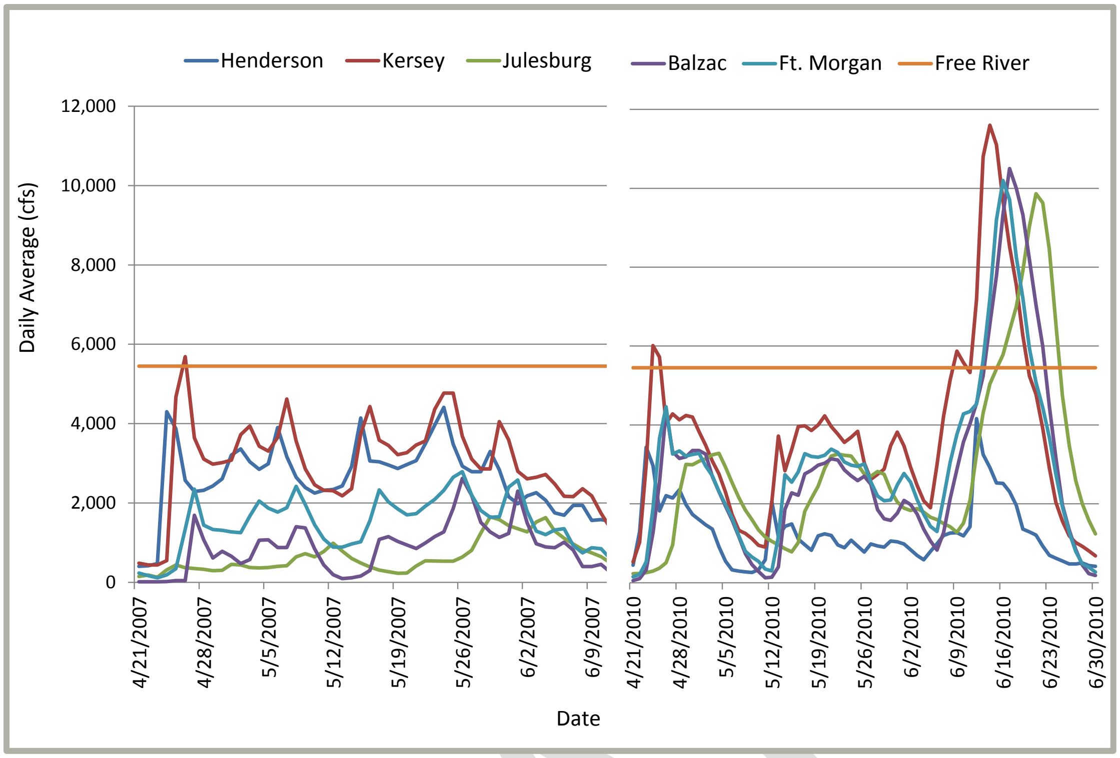

Figure 3-7. Free River Flows on the South Platte River, Spring 2007 and 2010

South Platte River water administration and supplies evolve as the river responds to the changing demands, weather patterns, and competition for water. At this point in time, there is little unappropriated water to develop in the South Platte River.

3.1.2 Competing Water Supply Projects

A concern of the Metro and South Platte Basin roundtables is that many water providers are identifying the same agricultural water sources as possible future supplies. Units in the C-BT Project and agricultural water rights in the South Platte Basin downstream of Denver are two examples of this issue.

Reference Documents

The following discussion is extracted from:

SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- Section 6.4.1 Competing Water Supply Projects

3.1.2.1 COLORADO-BIG THOMPSON PROJECT

Northern Colorado Water Conservancy District (Northern Water) and the U. S. Bureau of Reclamation jointly operate and maintain the C-BT, which collects water on the west slope and delivers it through a 13-mile tunnel beneath Rocky Mountain National Park to portions of eight Northeastern Colorado counties. In addition to operating and maintaining the C-BT, Northern Water collects, distributes and monitors weather and water quality data, tracks streamflows and reservoir levels, and provides water resource planning and water conservation information.

Originally intended primarily as a supplemental agricultural water supply, C-BT water is now utilized as a primary source of existing and future raw water supply by drinking water providers located within the Northern Water service area. The continued acquisition of these units by M&I providers in the South

Platte Basin through acquisitions from willing agricultural sellers results in a loss of valuable supplemental water supply for agricultural irrigators.

There are a limited number of C-BT units potentially available for purchase from individual allottees owning Class D units. Figure 3-7 shows the current ownership of the 310,000 units of C-BT water.

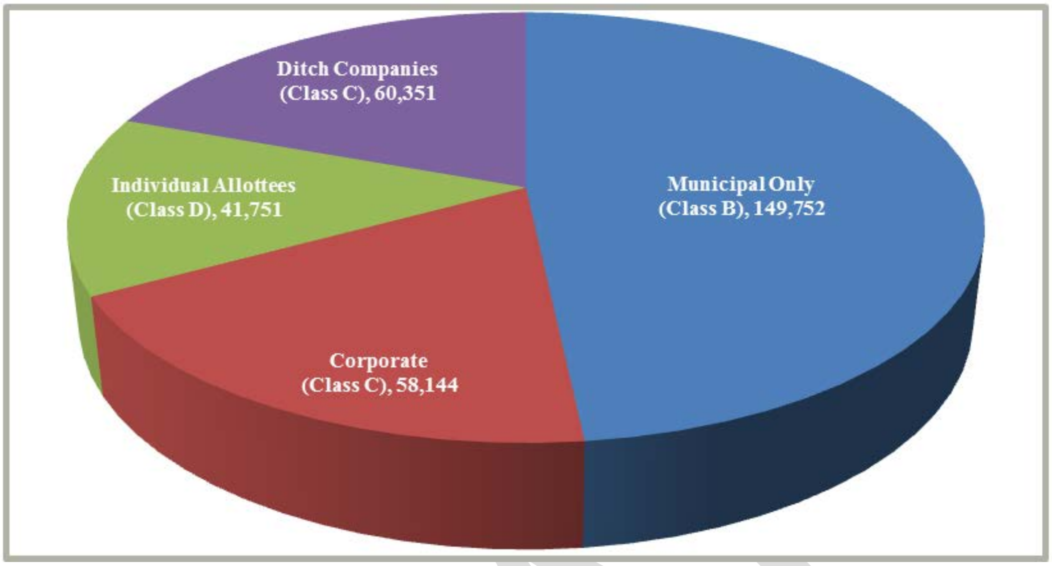

Figure 3-8. Ownership of C-BT Water Units (2014)

The North Poudre Irrigation Company (NPIC) owns 40,000 C-BT units in addition to Poudre River water rights. The majority of shares in the NPIC are owned by water providers including the City of Fort Collins and the Tri-Districts.[10] These water providers receive their pro-rata share of the yield from the 40,000 units owned by NPIC and will likely acquire additional NPIC shares and the associated C-BT units as they develop north into the NPIC service area. This effectively removes the 40,000 NPIC C-BT units from a pool of potential units available for acquisition by other water providers.

Many of the water providers who own units are capped at their present level of C-BT ownership by rules established by the Northern Water Board and cannot directly acquire additional units. In most cases, however, they can acquire additional C-BT units through annexation of additional service areas or through developers who provide units for their developments. Many of these water providers have expressed strong concern over the diminishing ability to acquire significant numbers of C-BT units through these approaches. 66 percent of C-BT water is owned by municipal, industrial, and domestic users, including:

- Boulder
- Broomfield
- Little Thompson Water District
- Erie
- Greeley
- Fort Collins
- Fort Lupton
- Fort Morgan
- Loveland
- Longmont
- Tri-Districts
- Xcel Energy

[10] Tri-Districts consist of Fort Collins-Loveland Water District, North Weld County Water District, and East Larimer County Water District

3.1.2.2 AGRICULTURAL WATER RIGHTS TRANSFERS

M&I providers in the South Platte and Metro Basins have historically met their demand and will continue to pursue the acquisition and transfer of agricultural water rights. This can include direct acquisition and transfer of agricultural water rights or employing alternative agriculture transfer techniques such as rotational fallowing programs or interruptible supply agreements. Historically, acquisition of M&I agricultural water rights acquisitions have resulted in the dry-up of irrigated land instead of rotational crop management or fallowing programs.

There are fewer than 16,000 total irrigated acres in Water Districts 7, 8, 9, 23, and 80 upstream and within the Denver Metro area. As a result, many M&I providers are actively negotiating with owners of irrigation water rights along the South Platte in Water Districts 1, 2, and 64 and many of its tributaries for the purchase of agricultural water rights. This puts Metro water providers in direct competition with water providers in the South Platte Basin. Potential water transfers from the South Platte Basin to the Metro area are further complicated by the use of C-BT return flows by agricultural users in Water Districts 1 and 64. These C-BT return flows can only be used within the boundaries of the NCWCD.

Many of these negotiations are conducted privately and are subject to confidentiality agreements pending finalization of the acquisitions. As a result, it is not possible to quantify competition for the same sources. But, it is likely that the more senior irrigation rights are being sought by more than one entity.

In addition to the costs of purchasing and transferring the water rights described above, the need for firming and regulatory storage, long pipeline distances, pumping elevation, and high water treatment costs to deliver this water from the lower reaches of the South Platte will significantly increase the cost of agricultural water acquisitions and result in rising water costs for M&I providers.

3.1.2.3 MAJOR WATER SUPPLY PROJECTS INVOLVED IN PERMITTING

Many water providers in the South Platte Basin are counting on the NISP, the Windy Gap Firming Project, Halligan and Seaman Reservoirs Water Supply Project, and the Moffat Collection System Project to meet a portion of their water demands through 2050. These projects, all the NEPA federal permitting process, would provide over 80,000 AFY of firm yield. If these projects are not permitted or constructed, the competition for agricultural water rights in the South Platte Basin will significantly increase. The NISP Draft Environmental Impact Statement estimates that the "No Action" Alternative for water providers would result in the dry-up of approximately 60,000 acres of irrigated land as providers acquire and transfer agricultural water rights to replace the anticipated yield from this project.

3.1.2.4 DEVELOPMENT OF CONDITIONAL WATER RIGHTS AIM AT THE SAME AVAILABLE WATER

There are many existing decrees for conditional water rights that have not yet been developed. A concern of the Roundtables is that the owners of these conditional rights might be considering the same water supply to provide for the development of these projects Though existing conditional decrees are generally excluded from the legal analysis of water availability, it seems appropriate to consider the factual reality that many proposed projects may be seeking much of the same physical water supply. Thus, there may not be sufficient water available to develop all of the existing conditional water rights and the development potential for native South Platte water to meet future consumptive needs is limited.

3.1.3 Impacts of South Platte Operations and Hydrology on Environmental and Recreational Attributes

The general hydrology of the South Platte Basin, as well as the operations of water providers within the Basin can impact environmental and recreational attributes. These attributes and the location of many of the attributes within the Candidate Focus Areas were discussed in Section 2. The hydrology of the Basin and the operations of water rights within the Basin can constrain environmental and recreational attributes, as well as provide opportunities for enhancing these attributes.

In general, the hydrology of the South Platte has been altered from its natural state by human impacts including irrigated agriculture and implementation of water supply infrastructure. It would be difficult to return to a natural state and such a state is in some ways undesirable. Examples of impacts and benefits to environmental and recreational attributes include:

- Natural rivers in the South Platte historically flowed for some parts of the year but were dry at other times.
- Irrigated agriculture spreads surplus water onto land away from the river and replenishes groundwater, establishes wetlands, and allows the river to run all year from return flows.
- Storage projects that are designed for municipal and agricultural water supply can also provide flows and habitat for aquatic and terrestrial species.
- Water supply operations can introduce unnatural variations in streamflow.
- Water quality issues may arise due to human impacts.

Environmental and recreational needs are very localized, which can result in significant localized impacts to environmental and recreational needs due to river operations and hydrology. The full evaluation of environmental and recreational impacts requires site-specific data, hydrology and river operations information. Better quantification and understanding of environmental and recreational needs, particularly in priority focus areas, will help to identify both challenges and opportunities.

3.1.3.1 HYDROLOGIC CONNECTIVITY AND DRY-UP POINTS

Hydrologic connectivity is important for many aquatic species, as it allows passage both up and downriver. When dry-up points occur within habitat reaches, that hydrologic connectivity is broken, and species habitat becomes fragmented. There are various dry-up locations along the South Platte River and its tributaries due to diversion of the entire river for irrigation or storage. These dry-up locations have been identified on the Straightline Diagrams prepared by the Colorado DWR for Water Districts 1, 2, and 64.[11] These dry-up points may be areas of opportunity where segmented habitat reaches can have hydrologic connectivity restored. The dry-up points in Water Districts 1, 2, and 64 are shown in Figure 3-9.

[11] Straightline Diagrams available on the DWR website:

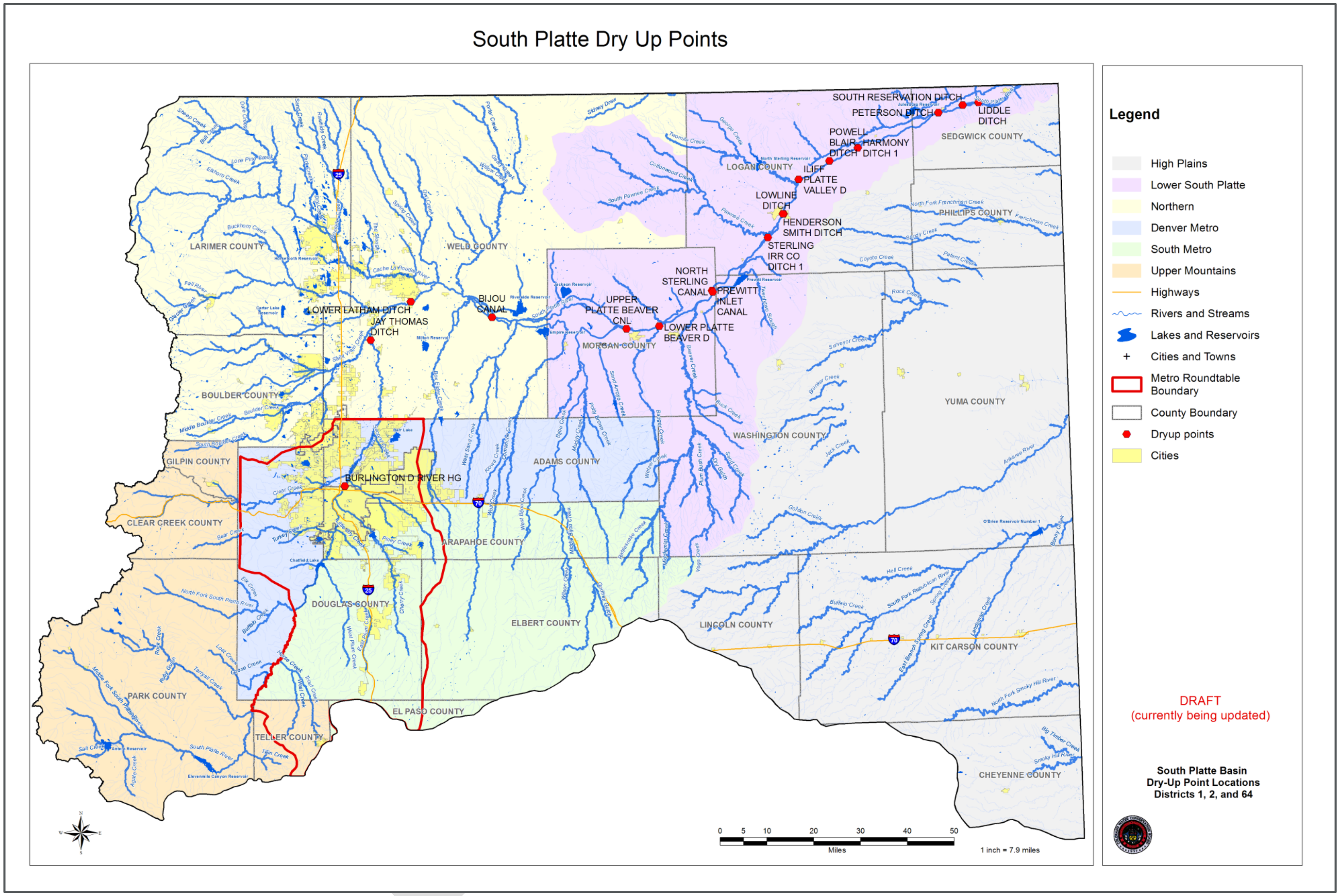

Figure 3-9. South Platte Dry-Up Locations in Water Districts 1, 2, and 64

3.1.3.2 POTENTIAL IMPACTS AND BENEFITS OF AGRICULTURAL USE TO ENVIRONMENTAL AND RECREATIONAL ATTRIBUTES

Agricultural uses of water help to enhance streamflows in many stretches of the South Platte River. While diversions of agricultural water rights can impact stream flows, the movement of water downstream to the irrigated land and the return flows from irrigated agricultural lands can help to maintain riparian habitat and streamflows in the South Platte River. In addition, the irrigated crops provide sources of food for waterfowl as well as habitat for other wildlife. Preserving irrigated agricultural lands in the South Platte River is important to maintaining the environmental and recreational opportunities within the Basin. The agricultural lands currently under irrigation in the South Platte Basin are shown in Figure 2-5.

Additional agricultural dry-up could negatively impact environmental and recreational flows as well as wildlife habitat, wetlands and riparian plant communities. A brief analysis was performed to assess the agricultural dry-up trend in the South Platte Basin based upon the historical dry-up trends in the basin. The historical dry-up trends from 1976 to 2010 were used to estimate the approximate dry-up acreage by county and water district in 2050. The results of this analysis are presented in Figure 3-10 and in Appendix C.

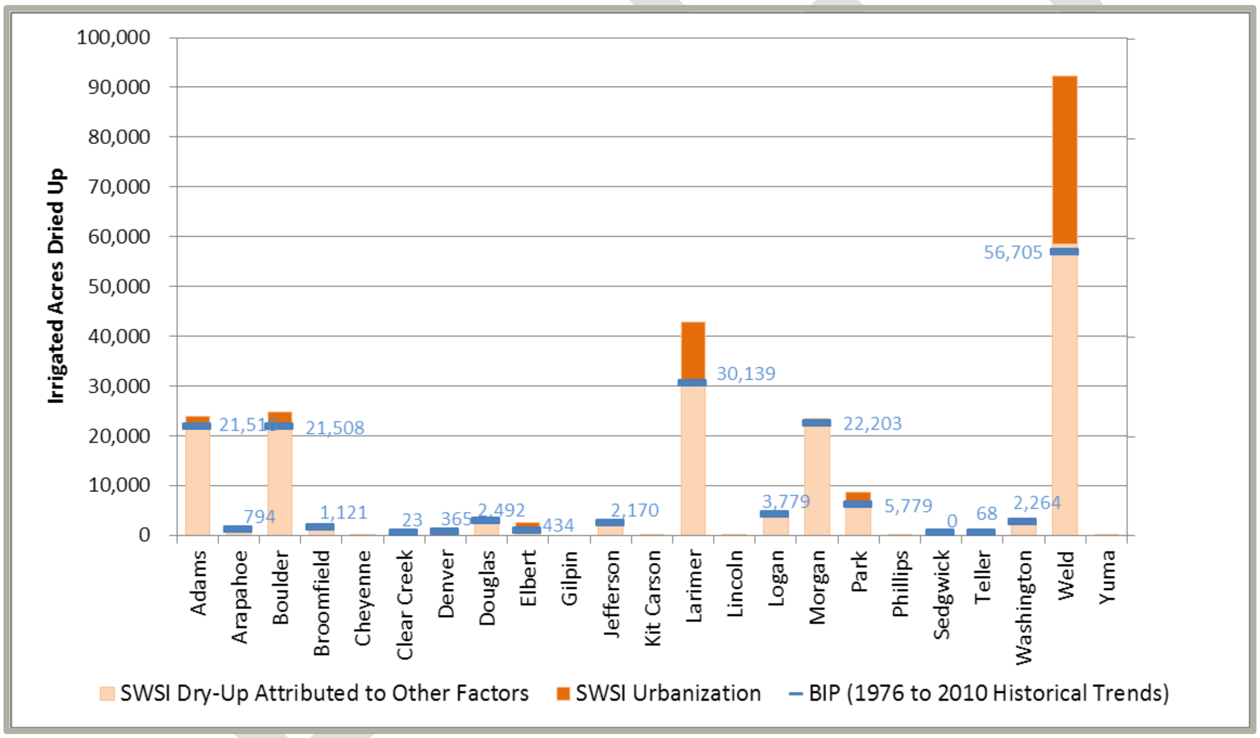

Figure 3-10. South Platte Dry-Up Acreages (SWSI 2010 and trend analysis)

The trend analysis shows less dry-up of irrigated agricultural lands than the SWSI 2010 methodology. Therefore, the trend analysis presented in detail in Appendix C was used to distribute the SWSI 2010 dry-up acreage among the counties. This analysis shows the counties where future dry-up is most likely based upon historical trends. In general, those areas with significant amounts of potential agricultural dry-up could see a reduction in river flows due to changes in water rights out of the area for use in more urbanized areas. While return flows must be maintained for downstream senior calling water rights, those return flows do not need to be replaced if there is not a calling right within a reach of concern. Less agricultural consumptive use downstream could result in reduced streamflows due to the changed water use no longer using the river system to convey the historical agricultural water to the historical agricultural users. In addition, increased agricultural dry-up could impact wildlife habitat and wetlands which exist in certain areas as a result of irrigation practices. Some additional discussion regarding the impacts of the future trend of additional agricultural dry-up is discussed in Appendix C.

3.1.3.3 POTENTIAL IMPACTS AND BENEFITS OF RETURN FLOWS TO ENVIRONMENTAL AND RECREATIONAL ATTRIBUTES

In between dry-up points, there are various inflows to the river segments that may enhance environmental and recreational attributes. These inflows include return flows from irrigation, inflows from tributaries, and municipal waste water return flows. Maintaining these inflows and protecting the return flows in water rights change of use cases is important to maintaining streamflows for environmental and recreational attributes.

3.1.3.4 POTENTIAL IMPACTS AND BENEFITS OF RECHARGE TO ENVIRONMENTAL AND RECREATIONAL ATTRIBUTES

In addition, the operation of recharge projects in conjunction with various augmentation plans throughout the South Platte Basin also help to maintain streamflows that may benefit aquatic species and the recharge ponds also provide wildlife habitat. Ducks Unlimited has cooperatively worked with many agricultural users in the Lower South Platte to use recharge projects as multi-purpose, collaborative projects to address the need for augmentation supplies for well depletions, as well as provide wildlife habitat and increase streamflows in reaches. Many of the existing recharge pond locations in Water Districts 1, 2, and 64 are shown in Figure 3-11. [Please note: updating map to make recharge ponds more legible when printed]

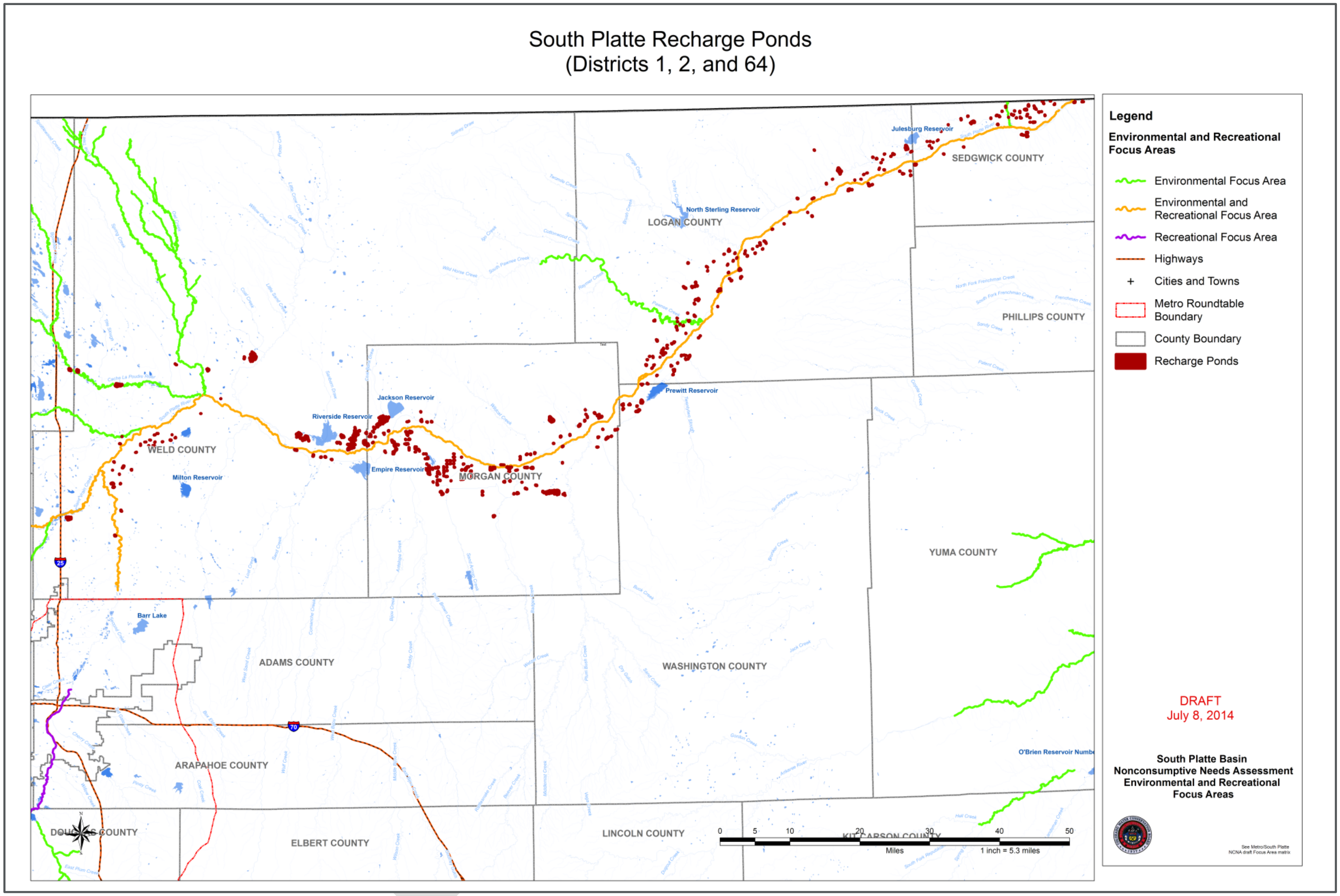

Figure 3-11. South Platte Recharge Locations in Water Districts 1, 2, and 64

3.1.3.5 ADDITIONAL POTENTIAL IMPACTS AND BENEFITS OF OPERATIONS TO ENVIRONMENTAL AND RECREATIONAL ATTRIBUTES

There are additional areas where the hydrology and operations within the Basin can impact or enhance streamflows and wildlife habitat. There are warm water sloughs along the South Platte River that support wildlife and waterfowl habitat, some created by historic braided river channels and others created from irrigation return flows. Maintaining these warm water sloughs is important for the various warm water plains fish species and riparian and wetland habitat.

The Republican River Basin is limited in the groundwater that can be pumped by the Republican River Compact with Nebraska and Kansas. The Republican Basin contains focus areas with plains fish species habitat and imperiled plant species.

3.2 Water Management and Water Administration

Section 3.2 was presented by the CWCB as optional. The South Platte and Metro Roundtables chose to not complete this section due to time constraints. For future work, an inventory should be compiled or updated that includes the following:

- Major controlling structures within each Water District
- Period when general water administration begins and ends
- Acres irrigated (including Republican Basin) in the basin
- Major reservoirs in the basin
- Major basin imports and exports
- Any current compact administration

For purpose of discussion, the following water management and water administration discussion was extracted from SWSI 2010, except where noted.

3.2.1 Interstate Compacts and Endangered Species Recovery Programs

The South Platte Basin is subject to two interstate compacts and one endangered species recovery program, which impact the water availability within the basin. These are shown in Table 3-2.

Table 3-2. Interstate Compacts and Endangered Species Recovery Programs

Interstate Compacts, Equitable Apportionment Decrees and Endangered Species Recovery Programs	Flows Legally Available under Compact or Decrees for Future Development	Year of Compact or Decree
South Platte River Compact	✓	1923
Republican River Compact		1942
Platte River Recovery Implementation Program		—

South Platte River Compact – Divides the waters of the South Platte River between Colorado and Nebraska, giving Colorado the right to fully use the water between Oct. 15 and April 1. During the Irrigation season, Colorado will deliver 120 cubic feet per second to Nebraska at the state lines which lies within District 64 and below the Balzac gage.. If the flow is less than 120 cubic feet per second, Colorado must curtail junior diversions. The State Engineers are authorized to administer the compact.[12]

Republican River Compact - Divides the waters of the Republican River Basin among Colorado, Kansas, and Nebraska. Colorado is granted 54,100 AF of water each year. The compact allocates 190,300 AF of water each year to Kansas and 234,500 AF of water each year to Nebraska. If the water supply of any source varies, the allocation also changes.[13]

Platte River Recovery Implementation Program - The PRRIP is a Cooperative Agreement between Colorado, Nebraska, Wyoming, and the Department of Interior designed to resolve conflicts between water use and endangered species protection in the Platte Rive Basin by providing programmatic benefits (through land protection, water management, and financial support) for four federally listed species and their associated habitats in the central and lower Platte River in Nebraska. In Colorado, the water part of this commitment is implemented through “Tamarack Plan” operations, which utilizes managed groundwater recharge from recharge wells and ditches located in the lower reaches of the South Platte River in Colorado to re-time river flows from periods exceeding species flow targets to periods short of target flows. The Tamarack Plan also obtains annually, by payment, certain recharge accretion credits not needed by local well augmentation plans during free-river periods. The water is first diverted for an initial beneficial use within Colorado, with some of the unused return flows subsequently reaching the river in times that benefit the Platte species. These operations also provide benefits for certain aquatic species of concern in Colorado.

The South Platte Basin has water that is legally and physically available for development in wet years, although unappropriated water is extremely limited.

3.2.2 Historical and Projected Changes in River Administration and River Calls

The South Platte River Basin has experienced significant growth during the period from 1950 to present, resulting in the need for additional supplies, uses, and changes of use of water. These changes in water development have the potential to change the river call regime over time. Changes in administration have impacted different water districts differently, yet all districts are affected by changes in others. Major water developments that impact the South Platte Basin are summarized below.

Reference Documents

The following discussion is extracted from:

SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- Section 6.4.3 Historical and Projected Changes in River Administration and River Calls

- Mid-1950s to present: Full operation of C-BT and transition from agricultural to M&I uses of C-BT water and agricultural supplies throughout the South Platte and Metro Basins.
- Mid-1950s to present: Significant increases in agricultural use of groundwater supplies.

[12] Colorado Foundation for Water Education. Citizen’s Guide to Colorado’s Interstate Compacts. 2010.

[13] Colorado Foundation for Water Education. Citizen’s Guide to Colorado’s Interstate Compacts. 2010.

- 1955 to 1982: Large dam construction or rehabilitation (Gross Reservoir, Boulder Reservoir, Button Rock Reservoir, Spinney Mountain Reservoir, Standley Lake Reservoir).
- Mid-1960s to present: Denver Water Roberts Tunnel deliveries of Blue River water supplies.
- Mid-1960s to present: Homestake Project water delivered to Aurora and Colorado Springs through Otero pump plant and pipeline.
- Early-1970s to present: Increased use by effluent exchange of Denver Water's Blue River return flows.
- Mid 1970s to present: Nontributary water supplies utilized to meet municipal water supply needs with additional return flows in the river.
- Late 1970s to present: Center pivot sprinkler systems installed to increase agricultural irrigation efficiencies.
- 1980s to present: Water conservation plans implemented by municipalities with increasing measures, reducing lawn irrigation return flows (LIRFs).
- Early-1980s to present: Increased adjudication of well augmentation plans and junior recharge water rights.
- Late 1980s: City of Thornton changes Water Supply and Storage Company shares in the Poudre Basin and seeks to exchange to gravel pits along the South Platte River and to the Burlington Ditch.
- Late 1990s to present: Metro area water providers acquire gravel pit storage along the South Platte River for reuse projects, exchanges, and augmentation.
- Late-1990s to present: Metro area municipalities pursue nonpotable recycling plants and nonpotable use of fully consumable water supplies.
- Late 1990s: Cities of Fort Collins, Littleton, and Golden obtain RICD water rights.
- 2000s: Metro area water providers acquire irrigation water rights in Water Districts 1, 2, and 64.
- 2002: Return to historical levels of use of downstream senior storage rights for supplemental irrigation and/or for augmentation of well pumping depletions. Of note, landowners under the North Sterling and Riverside Reservoirs rely primarily on storage water.
- 2003: Irrigation wells required to submit augmentation plans to water court rather than continue to operate annually on substitute water supply plans. Subsequently many irrigation wells and high capacity wells are issued orders to cease pumping due to failure to submit an augmentation plan to water court by 12/31/2005 and lack of augmentation supplies.
- 2006: The Division 1 Engineer no longer allows out of priority upstream storage if water cannot be released directly back to the river from the reservoir that originally diverted the water unless a water court approved plan is in place to make replacements to the affected senior storage rights if the senior storage rights did not fill their storage decrees.
- 2007: PRRIP signed providing for a recovery implementation plan for endangered species in Nebraska.

3.2.2.1 SOUTH PLATTE EVALUATION

3.2.2.1.1 RIVER CALLS

Reference Documents

The following discussion is extracted from:

[SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments]- Section 6.4.3.1 South Platte Mainstem Evaluation

In the South Platte River Basin, there are two basic types of calls – standard and bypass.

When a standard call is placed, any water right junior to the senior calling right and located upstream is curtailed completely. Multiple calls can be active in the river basin at the same time, and if this occurs the upstream calls are most often more senior than the downstream calls. Water rights in the basins were developed over time generally moving downstream. The more senior water rights are located upstream where flows were initially more stable. As return flows from these diversions filled the alluvium and then returned to the rivers resulting in more stable flows, additional water rights were perfected downstream of the return flows. This pattern was followed along the South Platte resulting in flows finally reaching the state line and providing water to Nebraska in the summer and fall months when the river was historically dry or had very low flow.

A bypass call generally operates when an upstream junior water right can divert a portion of its water right while bypassing a sufficient amount past its headgate to satisfy a downstream senior water right (more recently the Division Engineer has used junior water rights that are not being allowed to divert as bypass calls). The priority date of the call at the downstream structure is the priority date of the junior water right of the ditch which passes a portion of the water available at its headgate to the senior water right that otherwise would not get its full amount of water. All users with rights junior to the call date that are located upstream of the senior downstream ditch are called out. For example, the Cheesman Reservoir 6/27/1889 right bypassed to satisfy the downstream Burlington Ditch direct 11/20/1885 water right is administered with the 6/27/1889 priority at the Burlington Ditch headgate. In other water divisions in the state and in Division 1, the ditch passing a portion of its water is sometimes called the "swing ditch." Figure 3-12 shows the location of the water districts in the South Platte and Metro basins.

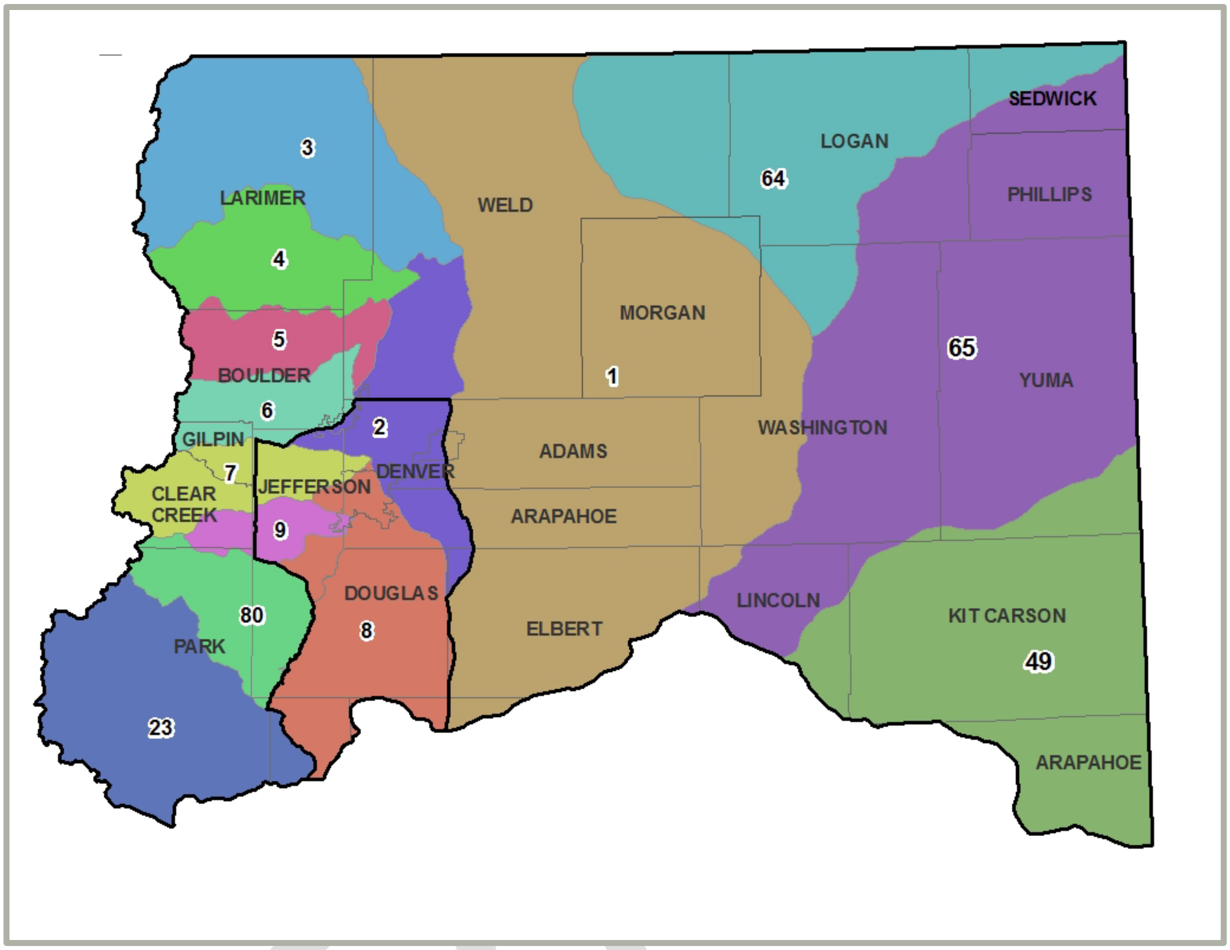

Figure 3-12. Water Districts in the South Platte Basin

3.2.2.1.2 HISTORICAL CALLS

Historical call records include an indication of the Water Districts affected by the call; however, prior to 1980, bypass calls were not explicitly recorded as the call and the records did not consistently identify where the dry up in the river occurred on the mainstem of the South Platte River. In most instances the mainstem calls during the irrigation season do not actually affect the tributary Water Districts 3 through 7 and Water District 9 because the direct flow water rights are more senior on the upstream tributaries. It may impact the lower reaches of those Water Districts, but in most instances the upstream portions of these tributary Water Districts experience calls during the irrigation season from water rights in their own Water Districts that are senior to those occurring on the mainstem, except during higher flows and the non-irrigation season. The South Platte compact call was not recorded prior to 2005. Compact calls only affect the lower reaches of the South Platte River from the Nebraska state line to the Washington county line in Water District 64.

Calls placed by non-mainstem water district water rights have historically not been recorded by the Division 1 office. Although there are some Clear Creek calls (Water District 7) in early records, non-mainstem water district calls were not recorded consistently by the Division 1 office until the mid-2000s.

An historical call dataset from 1950 to present that is consistent with current call recording standards has recently been developed with input from Division 1.

Administration of the upper South Platte River Basin is typically controlled by the senior rights at the Jay Thomas Ditch (6/1/1865 – 18 cubic feet per second [cfs] – this water right was reduced by the decree in Case No. 02CW154(B)), Western Mutual Ditch (5/5/1866 – 27.45 cfs and 8/10/1871 – 71.12 cfs), and the Evans No. 2 Ditch (10/1/1871 – 177.07 cfs), all of which have headgates located on the South Platte River above the confluence with St. Vrain Creek. Calls historically recorded on the South Platte River above the Clear Creek confluence often included Water District 7 (Clear Creek) as a district affected (e.g., Burlington Ditch call affecting Water District 7). According to Division 1 personnel, these calls were bypass calls to the Jay Thomas Ditch or Western Mutual Ditch. The Jay Thomas Ditch is typically listed as the location of the calling structure in recent call records. Therefore, a new comment "bypass to the Jay Thomas Ditch" was added to the historical call records when the calling right was located above Clear Creek and Water District 7 was listed as a district affected.

Administration of the lower South Platte River Basin is typically controlled by the senior right at the Sterling No. 1 Ditch (7/15/1873 – 113.547 cfs), located on the South Platte River in Water District 64. A number of ditches (i.e., Bijou Canal, Fort Morgan Canal, Upper Platte and Beaver Canal, Lower Platte and Beaver Canal, and Farmers Pawnee Canal) in Water Districts 1 and 64 have water rights with 1882 priority dates or 1882 and 1888 priority dates. These water rights, 1882 in particular, are frequently operated as bypass calls to the Sterling No. 1 Ditch. When the Water District 1 ditches were limited to diversion of their 1882 water rights and not allowed to divert their 1888 water rights, it is an indication of a bypass call. Therefore, a new comment was added to the call records, when downstream diversions were limited, by signifying the calling ditch was actually the ditch required to "bypass to the Sterling No. 1."

3.2.2.1.3 CALL REGIME OVER TIME: WATER DISTRICT 1 AND 64 (LOWER SOUTH PLATTE)

Calls from 1950 to present have changed based on changing water demands and uses of water, available water supplies, varying climate, and river administration practices. Historically recorded calls occurred predominantly during the summer. Starting in the mid-1970s, 1929 reservoir refill calls (associated with the Riverside, Empire, Bijou No. 2, Jackson, and Prewitt Reservoirs) have occurred more frequently. Additionally, junior recharge calls started occurring more frequently in the late-1980s/early-1990s to provide supplies for augmenting out-of-priority well depletions. The demand by junior recharge rights is increasing and now requires senior water rights to place calls during both the irrigation and non-irrigation seasons to prevent the juniors from diverting available water flows. Since the 1950s the bypass calls have seen a general trend of more junior river bypass calls being placed upon the river along the mainstem of the South Platte River. This is partially attributable to increased and unused return flows from transmountain diversions, nontributary return flows, increased runoff from urban development in the Metro area, higher precipitation in the 1970s to 2000s, and transferred agricultural rights not yet fully utilized by municipalities.

From the 1970s until early 2000s, a Gentlemen's Agreement existed among certain reservoirs in Water Districts 1 and 2. The Gentlemen's Agreement, by which the owners of the senior mainstem reservoirs agreed not to place calls during the fall and winter seasons, historically allowed water to be stored higher in the basin and out of priority by certain upstream junior reservoirs. The senior downstream reservoirs would divert water available under a "no call" condition. If they did not fill their reservoirs, some upstream storage users agreed to limit their diversions or make up the shortfall. In general, senior reservoirs filled each year. There has not been an agreement for operation of the gentlemen’s agreement since 2003 due to the shortage of water.

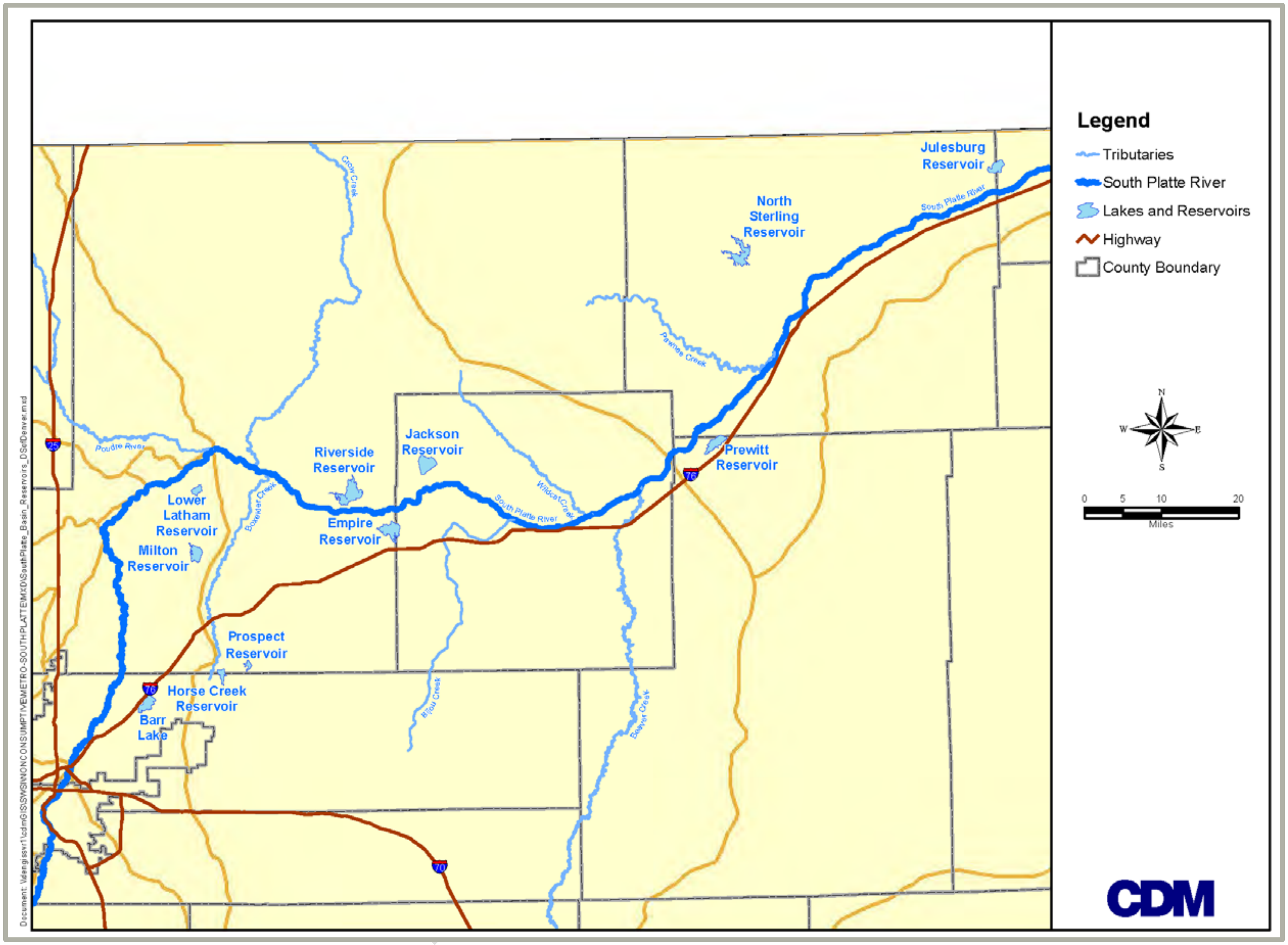

Figure 3-13. Major South Platte Reservoirs Downstream of Denver

Under the present reality of strict priority administration, water will be called down to the senior reservoirs in the fall and winter, preventing junior upstream reservoirs from storing.

The Division Engineer can allow storage in junior upstream reservoirs at a time of call by a downstream senior reservoir if the water stored can be released to the senior reservoir if it does not fill (CRS 37-80-120). The Division Engineer presently has a policy allowing upstream out-of-priority storage upon the fulfillment of the following conditions: 1) after notice and a comment period for potentially affected water users, 2) the use of the "paper fill" requirement for affected downstream senior reservoirs and 3) if he can be assured that the water can be released directly from the upstream junior reservoir and delivered to the downstream senior reservoir. Since the implementation of notice and comment policy in 2007, and the inclusion of the "paper fill" requirement, there has been little, if any, out-of-priority storage authorized by the Division Engineer under CRS 37-80-120.

Over time, District 1 refill rights and the 1972 and junior recharge rights and storage calls have become more frequent. The Harmony #1 Ditch 1895 direct flow water right has affected upstream water rights more frequently since the mid- to late-1970s.

The numerous 1882 and 1888 direct flow water rights in Water District 1 play an increased role in river administration starting in the early-1980s, corresponding with the increase in recorded bypass calls. Although historical call data includes more explicit coding of the historical bypass call, use of bypass calls has become much more common now that river administration occurs on a daily basis.

Farms once supplied with a "supplemental" well are now heavily (or exclusively) reliant upon a surface supply including, in many instances, storage rights. At one time, these producers irrigated in the early season (i.e., for germination) with groundwater and did not request surface deliveries. Historically, this kept the call off or more junior as compared to current practices.

The increasing adaptation of automated sprinklers, as opposed to the previous flood/furrowing irrigation method, forces a deeper call on the river.

Figure 3-14 illustrates the comparison of frequency of calls in District 1 for 1982 through 2012.

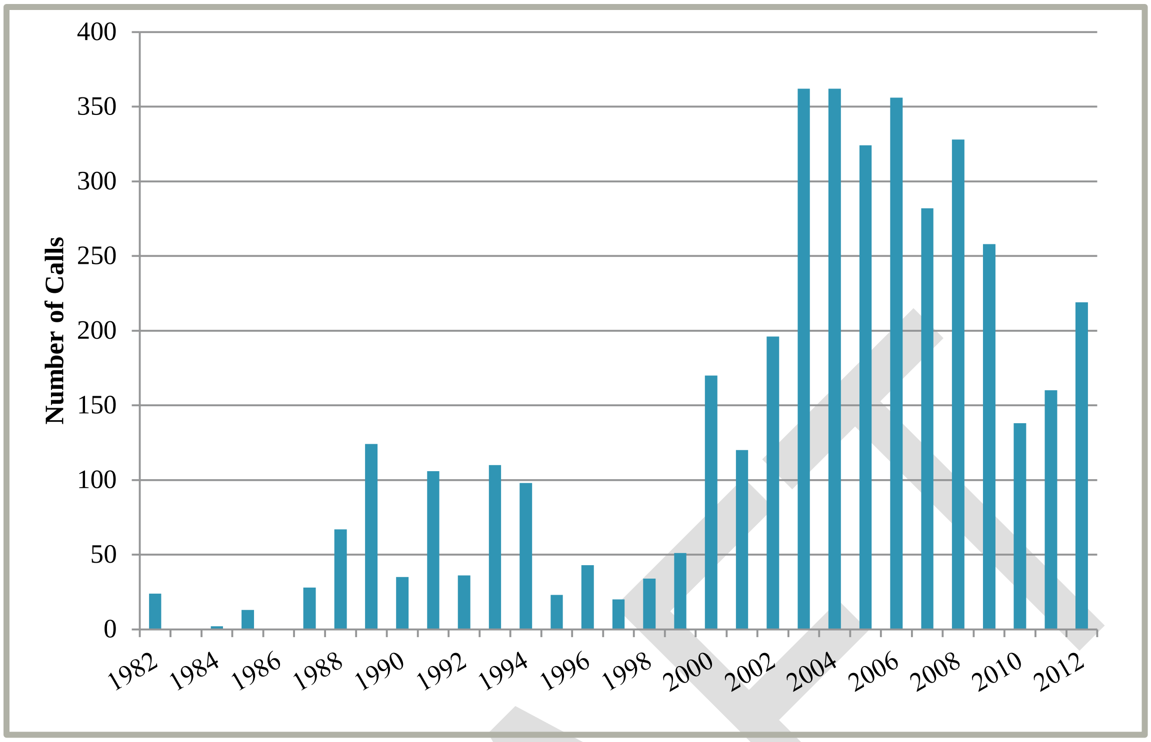

Figure 3-14. Days of Call per Irrigation Year in District 1

3.2.2.1.4 CALL REGIME OVER TIME: WATER DISTRICT 2 (SOUTH PLATTE BELOW DENVER)

In general, the recorded calls influencing Water District 2 operations above the Jay Thomas Ditch and the Burlington Ditch have become more junior over time due to the following:

Recorded storage calls have become more frequent and more junior over time. The senior 1860s direct flow calling rights (e.g., Brighton 1863, Duggan 1864, Fulton 1865, Meadow Island 1 and 2 1866) are frequent in the 1950s and 1960s but become less frequent after the mid- to late-1970s. The Burlington 1885 water right has also been recorded more often after and about the mid- to late-1970s after which there has been a general trend to more junior direct flow bypass call after the late 1970s.

3.2.2.2 TRIBUTARY WATER DISTRICT EVALUATION

3.2.2.2.1 WATER DISTRICT 3 (POUDRE RIVER)

Reference Documents

The following discussion is extracted from:

SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- Section 6.4.3.2 Tributary Water Evaluation

The acquisition of Water Supply and Storage Company (WSSC) water rights by the Cities of Thornton and Greeley and the Tri-Districts (North Weld County, Fort Collins-Loveland, and East Larimer County Water Districts) will result in return flows from imported water no longer being available where they historically returned below the headgate of the WSSC. In addition, new center pivot sprinkler irrigation using surface water will also reduce the amount of return flows that historically contributed to river flows in the downstream portions of the district. The reuse of fully consumable supplies by the municipal providers will increase over time, further reducing the amount of water that has historically benefited downstream water rights in District 3, 1 and 64.In the future, district 3 may also see calls returning to more senior levels.

A significant change in water supply occurred in Districts 2, 3, 4, 5, and 6 due to the transfer of ownership of C-BT water from agricultural to municipal control. In 1950, 85 percent of C-BT shares were owned and used by agriculture with the remaining 15 percent owned by municipalities. Currently, 34 percent is owned by agriculture and 66 percent is owned by municipal interest. In most years, the majority of the municipal water remains leased to agricultural interests.

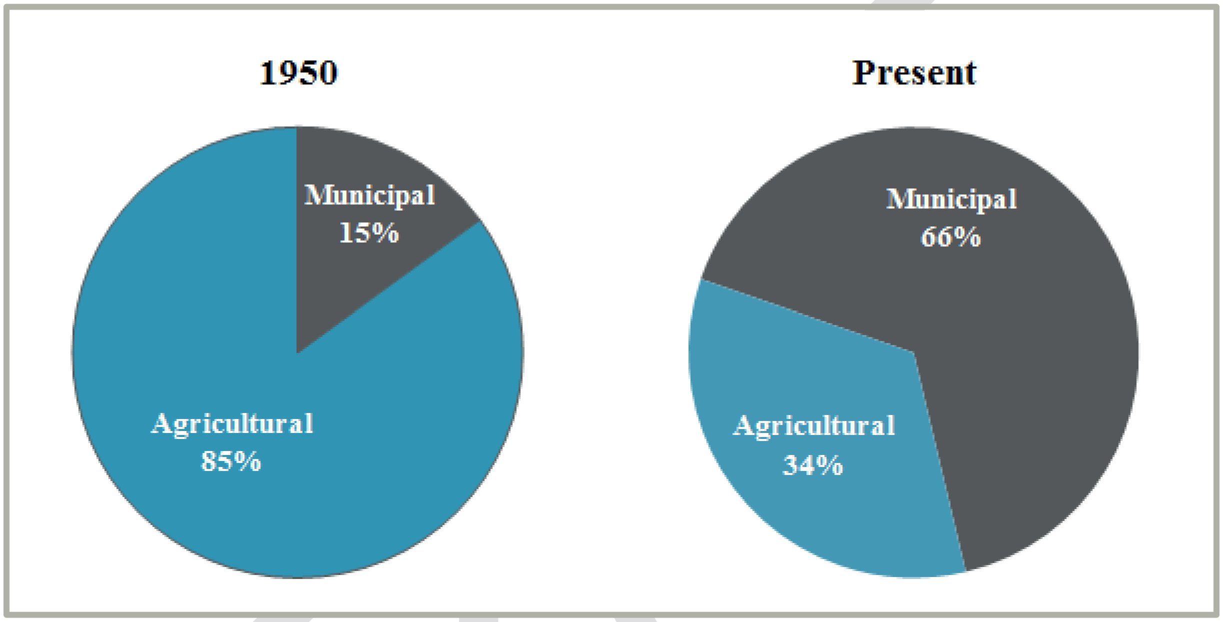

Figure 3-15. C-BT Units in 1950 to the Present (2014)

3.2.2.2.2 WATER DISTRICTS 4, 5, AND 6 (BIG THOMPSON, ST. VRAIN, AND BOULDER CREEKS)

The reuse of fully consumable supplies may increase over time by the municipalities in these districts; however, the impact to future changes in internal river calls may not be as great as that experienced along the mainstem and in Water District 3.

3.2.2.2.3 WATER DISTRICT 7 (CLEAR CREEK)

The Golden RICD poses the greatest impact on the reach of Clear Creek upstream of the City of Golden. RICDs, such as Golden's, that appropriate most of the unappropriated flow, can impact the development of water upstream and limit exchanges. Water needed to meet future growth upstream of Golden will likely come from transferred agricultural water rights or arrangements with the City of Golden and other downstream municipal water providers. Clear Creek County has developed the Clear Creek Water Bank to address the issue with the Golden RICD.

The reuse of fully consumable supplies may increase over time by the municipalities in District 7. However, reuse has been practiced for the past decade and may not have as great an impact on internal calls as that experienced along the mainstem and Water District 3.

3.2.2.2.4 WATER DISTRICT 8 (SOUTH PLATTE IN DENVER METRO AREA)

The reuse of fully consumable supplies from nontributary wells will increase over time by the municipalities in District 8. However, this may not have as great an impact on calls as that were experienced along the mainstem and in Water District 3 since this district is historically more affected by calls in District 2. The change in seniority of the river calls in District 2 will have some impact on District 8 water rights, including the Cherry Creek Reservoir.

3.2.2.2.5 WATER DISTRICT 9 (BEAR CREEK)

The reuse of fully consumable supplies may increase over time by the municipalities in District 9. This may not greatly impact calls as it has in other water districts. In addition, there may be limited exchange potential within District 9.

3.2.2.2.6 WATER DISTRICTS 23 AND 80 (SOUTH PLATTE UPSTREAM OF DENVER METRO AREA)

The change in seniority of the river calls in District 2 and possibly in District 1 will have some impact in the Districts 23 and 80's storage water rights that historically benefited from the calls becoming more junior in recent years and the direct calls occurring later over time.

3.2.2.3 CONSUMABLE RETURN FLOW REUSE

Many M&I providers, primarily within the Metro Basin, have existing consumable return flows which, in the future, will be reused to the maximum extent practicable. Consumable return flows are created when a water user does not consume their decreed amount of consumptive use water in a single use. The most typical sources of fully consumable supplies are transmountain water, which can be used to extinction (except for C-BT and Denver Moffat tunnel diversions), the historical consumptive use portion of water from a transferred agricultural water right (after historical return flows are made), and nontributary groundwater. Water not consumed is generally in the form of treated wastewater effluent or claims by municipalities for LIRFs. Agricultural water right transfers generate a consumable return flow if the first use by the municipality does not fully consume the consumable transferred amount; the municipality is entitled to use the transferred amount to extinction.

Reference Documents

The following discussion is extracted from:

SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- Section 6.4.4 Consumable Return Flow Reuse

The following are recent or planned direct and indirect uses of fully consumable supplies:

- Municipal recapture and reuse projects by Broomfield, Aurora, Denver, Westminster, Thornton, and nearly all of the SMWSA members including Arapahoe County Water and Sanitation District, Centennial, Castle Rock, East Cherry Creek Valley, Inverness, The Pinery, Stonegate, and many other providers in the basins
- Pump installation in Chatfield Reservoir to recover environmental releases from Strontia Springs Reservoir (30 to 60 cfs)
- Claims by several Denver Metro water providers and others to exchange or use reusable lawn returns (>15 cfs)

- New lined gravel pit storage downstream of Denver to pick up reusable supplies to exchange or use directly (estimated at over 100,000 AF within next 10 years)
- Calpine (Rocky Mountain Energy Center) 3,000 AFY for treatment plant (average 4 cfs)

Historically, not all of the consumable return flows have been utilized by water providers. Costs of treating water to nonpotable reuse standards and installation of a secondary nonpotable distribution system have been limiting factors in reusing these waters. With rising scarcity and costs of developing new water supplies, however, reuse is becoming more feasible and practical. Figure 3-16 shows the proportion of reusable Denver Water effluent that was reused at the Metro and Bi-City wastewater plants between 1995 and 2012. The figure shows reuse rates climbing since 1999.

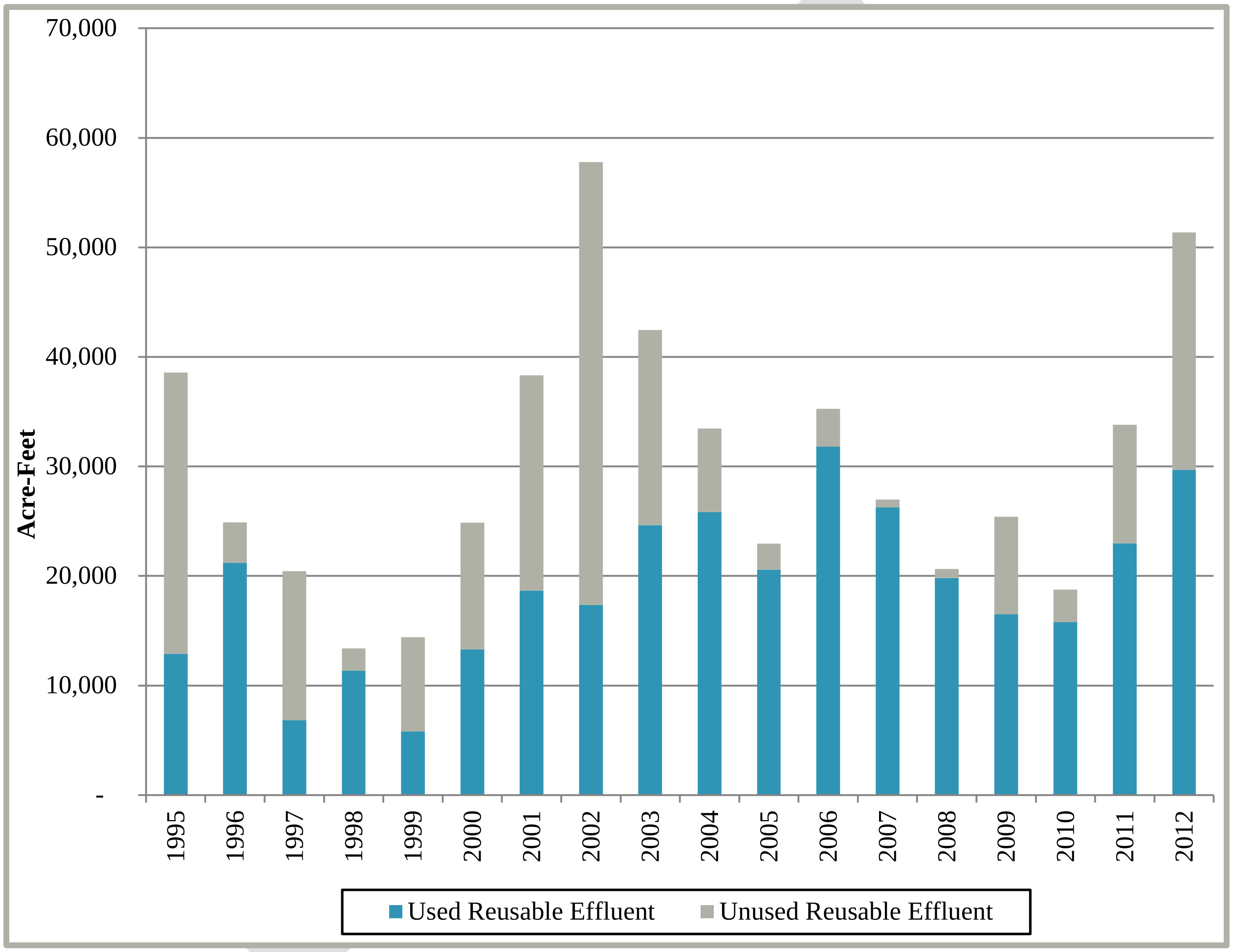

Figure 3-16. Average Daily Used and Unused Denver Water Reusable Effluent at the Metro and Bi-City Wastewater Plants (1995-2012)

3.2.2.4 UPPER MOUNTAIN COUNTIES AQUIFER SUSTAINABILITY

The Upper Mountain Counties Aquifer Sustainability Project was initiated to refine understanding of water demands and sustainable groundwater development potential in the mountainous areas of Clear Creek, Gilpin, Jefferson, and Park Counties within the South Platte watershed. The focus of the water availability study was areas served by groundwater from the crystalline bedrock aquifers that underlie the area.

The objectives of the study included:

- Current and future populations and land use types projected to 2050
  - Current and future population projections
  - Part-time population projections
  - Transient population analysis
- Current and future water demands to 2050
  - Current demands for community surveyed water providers (SWPs)
  - Future demands for community SWPs
  - Current and future demands for surveyed SWPs
- Water demands related to tourism outside of community SWPs
  - Recreational user demands
- Identify existing improved and unimproved plants outside of community SWPs to estimate buildout water demands
  - Privately held parcels outside of SWP areas
  - Water demand outside of SWP service areas
- Evaluate sustainable groundwater supply based on recharge rates
  - Recharge estimates on private lands
  - Estimate of potentially developable recharge
- Assess groundwater sustainability based on recharge and demands for current and future conditions
  - Sustainability summary based on lot size

As part of the study, population trends and future water demands were projected to 2050, including both resident and transient recreational requirements. The current permanent resident population of the Upper Mountain Counties study is estimated at 81,650, with approximately 5,450 part time residents. The population of this area is projected to increase to between128,000 to 148,000 people, with part time residents increasing to about 8,000 by 2050. A significant portion of the current and future water demand will fall outside of water provider areas and must be supplied by onsite wells producing from the crystalline bedrock aquifers. Demands outside of the service water provider areas are estimated to increase from 9,257 AFY (current), to 21,460 AFY in 2050.

The results of detailed studies conducted in the Turkey Creek watershed by the USGS and others were extended to the entire Upper Mountain Counties study area to estimate recharge to the crystalline bedrock aquifers. The Turkey Creek watershed is lower in elevation and has less precipitation than much of the current study area, which leads to some uncertainty in extending results across the entire area. Precipitation and snowmelt that infiltrates into the soil supports evapotranspiration and streamflow, in addition to recharging the deeper aquifer system. Much of the recharge subsequently discharges to streams shortly after a recharge event, and is thus not available to support reliable groundwater development, especially in areas farther from regional streams. Water that is pumped for onsite water supply is discharged to onsite waste disposal systems where some of this water infiltrates back to the deeper portions of the crystalline bedrock aquifer system. Estimates of native recharge to the privately held lands outside of water provider areas amounts to an annual average of about 60,000 AFY, of which only a portion would support sustainable groundwater development.

Analysis of regional stream baseflow, which is supported by discharge from the crystalline bedrock aquifer system, demonstrates that significant carryover storage is available during drought years. During drought years, if wells don't produce from the deepest portion of the aquifer, water levels may decline significantly causing individual wells to produce insufficient water to meet onsite demands in areas distant from regional streams. Two aspects of sustainability were considered: 1) maintaining a balance between recharge on individual parcels, and 2) maintaining water quality.

A demand ratio representing the ratio of pumping demand to the native component of recharge was assessed for both current and future conditions to understand sustainability. Because locations of future development are uncertain, the three alternative development densities, based on assumed minimum lot sizes, were applied to all remaining developable lands in order to provide decision makers with information to assess sustainability issues. Several maps within the Upper Mountain Study are useful planning maps and indicate areas where potential exists for aquifer sustainability issues depending on density of the development being proposed for rezoning or platting. In areas where there may be sustainability issues indicated based on the planning maps, it is recommended that site-specific studies be required to more accurately determine if aquifer sustainability can be reasonably assured.

3.2.3 Potential Impacts and Benefits of Water Management and Water Administration to Environmental and Recreational Attributes

Administration of water rights and water management along the South Platte River can impact environmental and recreational attributes. Many water rights can adversely impact environmental and recreational flows by reducing river flows and dewatering habitat. However, many water rights can enhance streamflows or create riparian or wetland habitat, benefitting environmental and recreational flows.

3.2.3.1 AGRICULTURAL WATER RIGHTS

Agricultural water rights within the basin are some of the most senior water rights and often place a call for water that brings water downstream through the focus areas, enhancing streamflows in various reaches and focus areas. Maintaining irrigated agriculture in the South Platte Basin assists with streamflows by continuing to call water through the focus areas. Agricultural water rights and the return flows and runoff from irrigated parcels (tailwater) associated with the agricultural rights often create or enhance riparian or wetland habitat.

3.2.3.2 EXCHANGE WATER RIGHTS

Exchanges that are operated along the South Platte River can be beneficial in optimizing water deliveries in a river reach, however, exchanges also reduce stream flows in that reach. Exchanges can operate so long as there is a live and flowing stream in the reach of the exchange, no intervening calling water rights, and the substitute supply downstream is adequate. If no instream flow water right exists within the exchange reach or existing exchanges are senior to the instream flow water right, then there is no guarantee of any specific historically available hydrological flows within the given reach when an exchange is operated.

3.2.3.3 SOUTH PLATTE RIVER COMPACT

There is an interstate compact on the South Platte River with Nebraska. However, the South Platte River Compact does not have a delivery obligation; therefore, there are no guaranteed flows at the Stateline in extremely dry years. The compact requires Colorado to curtail diversions in District 64 that are junior to June 14, 1897, when the streamflow at the State line is less than 120 cubic feet per second (cfs) during the irrigation season (April 1 and October). While at times the compact call may enhance streamflows in District 64, there is no specific requirement for water users outside of District 64 to curtail diversions due to the compact, nor would the curtailment likely induce streamflows to support environmental needs late in the irrigation season or during the winter.

3.2.3.4 RECHARGE WATER RIGHTS AND AUGMENTATION PLAN MANAGEMENT

As briefly mentioned above, there are many groundwater recharge projects operated in conjunction with augmentation plans along the South Platte River. These recharge projects have the potential to maintain or possibly enhance streamflows and wildlife habitat.

There are several examples of groundwater recharge projects that may enhance streamflow and benefit environmental flows and wildlife habitat. One example is the Tamarack Project that uses recharge ponds in the Tamarack State Wildlife Area to provide retimed streamflow for the benefit of the Platte River Recovery Plan also has provided benefits to nonconsumptive needs in the lower reach of the South Platte River. Additional examples are the many Ducks Unlimited recharge projects along the South Platte River that provide recharge water for augmentation uses, potentially benefiting local streamflows and creating wildlife habitat.

3.2.3.5 INSTREAM FLOW AND LAKE LEVELS

Instream flow water rights and lake level water rights can only be held by the CWCB. These water rights allow for the CWCB to hold a water right for a specific amount of instream flow within a specified reach or a specified lake level to assist in protecting the environment. Instream flow and lake level water rights are typically junior to large water right decrees that divert water from the river. However, instream flow water rights can also be donated to the CWCB and converted for instream flow use. The Colorado Water Trust is a non-profit organization that raises funds to buy water rights in identified reaches with needed flows that can be changed in water court and donated to the CWCB for instream flow purposes.

3.2.3.6 ENDANGERED SPECIES RECOVERY PROGRAMS AND OTHER SUCH COOPERATIVE PLANS CAN HELP ENDANGERED SPECIES RECOVERY PROGRAMS

Endangered Species Recovery Programs and other such cooperative plans can help water rights users to continue to use their water rights, while maintaining or enhancing habitat for threatened or endangered species.

The Platte River flows out of Colorado into Nebraska where it provides habitat for four species that are listed as threatened and endangered species under the Endangered Species Act. Those species include the whooping crane, piping plover, interior least tern, and pallid sturgeon. The Department of Interior along with Colorado, Wyoming, and Nebraska entered into the Three States Cooperative Agreement which addresses the issues related to these endangered species in an area of critical habitat in Nebraska. The goal of the agreement is a basin-wide, cooperative effort to improve and maintain habitat for the four listed species.

The PRRIP was developed to address the concerns for habitat for these species. Through protection of the threatened and endangered species' critical habitat, the PRRIP will enable existing Platte River basin water projects to continue operating as well as allow new water projects to develop in compliance with the Endangered Species Act. The Tamarack Recharge Project discussed above is one way in which Colorado addresses its PRRIP obligations into Nebraska while minimizing the impact to water users. Not only does the Tamarack Project help to meet Colorado's PRRIP obligations, the project helps to enhance flows in the South Platte River in Colorado as well as in warm water sloughs along the river in Tamarack State Wildlife Area.

3.2.3.7 MANAGEMENT PROGRAMS

There are other management programs that help to address environmental concerns related to agricultural production in the South Platte and Republican Basins. Some of those programs include the Conservation Resource Program (CRP), Conservation Reserve Enhancement Program (CREP), and the Environmental Quality Incentive Program (EQIP). These programs can remove agricultural lands from irrigation to benefit the environment.

3.2.3.7.1 CONSERVATION RESERVE ENHANCEMENT PROGRAM

CREP is a federal-state cooperative conservation program that addresses targeted agricultural-related environmental concerns. The CREP is a program of the Farm Service Agency (FSA) of the United States Department of Agriculture (USDA). The program provides financial incentives to remove cropland and marginal pastureland from agricultural production. Converting enrolled land to native grasses, trees and other native vegetation improves soil retention and water, air and wildlife habitat quality.

There are caps in place on amount of cropland per county that can enroll in these programs to ensure that there is not a detrimental economic burden placed on any county due to the programs. Some counties in Colorado have already reached the cap, however some work is being done to request additional lands be allowed to enroll in the program. [14, 15]

3.2.3.7.2 ENVIRONMENTAL QUALITY INCENTIVES PROGRAM

The EQIP is a voluntary conservation program administered by the USDA Natural Resources Conservation Service (NRCS). The program supports production agriculture and environmental quality as compatible goals. [16]

[14] Source: USDA/FSA Republican River CREP fact sheet.

[15] Source: USDA/FSA High Plains CREP fact sheet.

[16] Sources: NRCS Colorado

> *[EQIP is] a voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years in length. These contracts provide financial assistance to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air and related resources on agricultural land and non-industrial private forestland. In addition, a purpose of EQIP is to help producers meet Federal, State, Tribal and local environmental regulations.*[17]

The Republican River Water Conservation District has added to EQIP funding to incentivize producers in the Republican River Basin to cease well pumping to assist with compact compliance. In doing so, the program assists in water management and administration as well as helps environmental concerns in the vicinity of the previously irrigated fields.

3.3 Hydrologic Modeling for Water Availability

Section 3.3 was presented by the CWCB as optional. The South Platte and Metro Roundtables chose to not complete this section due to time constraints. For future work, hydrologic modeling should be done to compare or refine projects and methods. The refinement of a project could be used to optimize operations so that impacts are mitigated or the project can be operated to serve multiple purposes. Modeling could also be used to understand how projects and methods perform under various hydrological scenarios.

Hydrologic modeling could be used to determine the sufficiency of environmental and recreational projects and protections, and on daily or hourly intervals to assess peak and low flows in critical reaches. Hydrologic modeling will also need to be used in future phases to look at the tradeoffs between developing new higher quality water supplies versus developing lower quality sources in the South Platte and associated impacts with each.

3.4 Shortages Analysis

Per the State's Basin Implementation Plan Guidance (CWCB, 12/10/13), previous SWSI work computed M&I water supply gaps using only a firm-yield analysis and projects and methods were considered in relation to their ability to supply firm yield and reduce this gap. However, the State indicated that many stakeholders expressed interest in analyzing a water supply gap that considers the degree to which projects and methods that may provide additional supplies during average or wet years, in addition to safe yield. If these supplies can be "firmed" through storage, exchange, system interconnections or other methods, these opportunities could improve long-term M&I water supplies. Therefore, the State indicated that, for those BRTs that are including the optional: 1) Water Management and Water Administration and 2) Hydrologic Modeling tasks, they should also include a "shortage analysis" that summarizes needs under varying hydrology such as wet, dry, and average conditions. The State also indicated that, for those basins that do not conduct the optional tasks, the CWCB will assist in summarizing known shortages based on existing information and will develop basinwide and statewide shortage and gap analyses to include in the next SWSI update. In addition to the M&I gap, the gap analysis will identify agricultural and nonconsumptive shortages and gaps.

[17] http://www.nrcs.usda.gov/programs/eqip/.

3.4.1 Consumptive

<u>Placeholder</u>

Considering the current lack of comprehensive water allocation and yield analysis models in the South Platte Basin that can be readily applied, it's recommended that the Basin explore with the State the possibility of including an assessment for this section and/or suggestions for furthering this analysis after July 2014. As Projects and Methods are being considered leading up to the July 2014 submittal of the Draft South Platte BIP that have additional average and wet-yield supplies that might contribute to firm yield for M&I or Agricultural uses, it will be more useful for the South Platte Basin to focus on the degree to which these opportunities can be firmed while continuing to quantify basin-wide shortages in average and wet years.

3.4.2 Environmental and Recreational

Based on the environmental and recreational needs discussed in Section 2, a methodology was developed to determine where the environmental and recreational needs may have shortages or a "gap" of protection. The environmental and recreational needs in the South Platte basin are summarized in the focus areas that were the result of the work described in Section 2 and in detail in Appendix B.

In order to determine the gap in protections in place to address the environmental and recreational needs, the projects and methods must be analyzed in conjunction with the attributes and focus areas. The types of projects and methods reviewed are described in further detail in Section 4. The methodology used to review the projects and methods is described briefly in Section 2, and in additional detail in Section 4 and Appendix D.

The total reach lengths for each attribute within a Focus Area was used to determine the amount of each attribute (length and percent) by Focus Area in the South Platte Basin. These data can provide the existing amount of the attribute and to some extent the current protections and the possible amount of potential increase and the potential for future projects and protections. This potential is one measure of the environmental and recreational shortages.

In addition to the presence or absence of attributes and protections in focus areas, as well as various other items can impact the shortage or gap for environmental and recreational needs. The presence of an attribute in focus areas does not indicate that that the population of the species is robust. The presence of a protection in a focus area does not necessarily indicate that the attributes in that focus area are sufficiently protected. Sufficiency of those protections should be analyzed in the future to determine the adequacy of the protections. Changes in river conditions due to climate change or increased uses in the basin could result in reduced streamflows and further impair wildlife habitat. The trend of irrigated agricultural lands being dried up can impact the amount and location of environmental and recreational needs in the Basin.

3.5 Summary of Water Availability

The changes in calls in the lower and upper parts of Water District 2 are a result of many interrelated factors affecting the South Platte River, including variable hydrology, water supplies and water uses. It is difficult to identify direct relationships between the major water developments in the basin and changes in the call regime. In general, the periods of no call or free river continue to diminish with increasing demands of new appropriators.

Introduction of transbasin supplies in the mid-1950s from the C-BT project and in the mid-1960s from the Roberts Tunnel and the Homestake/Otero Pipeline introduced additional water into the basin. These projects have imported more water into the basin over time but distinct changes to the call regime corresponding with these events are not clearly identifiable in the historical record. Even though this water was brought into the system, it took years for the return flows from ditches in Water Districts 1 through 6 to impact the change in year round flows in each Water District and ultimately in Water District 64. Figure 3-17 shows the annual flow from 1927 to 2011 for the South Platte River at Henderson gage, located in Water District 2, approximately 10 miles downstream from the Metro Denver Wastewater discharge. This figure also includes the 10-year moving average and illustrates the increase in flow at this gage since the 1970s.

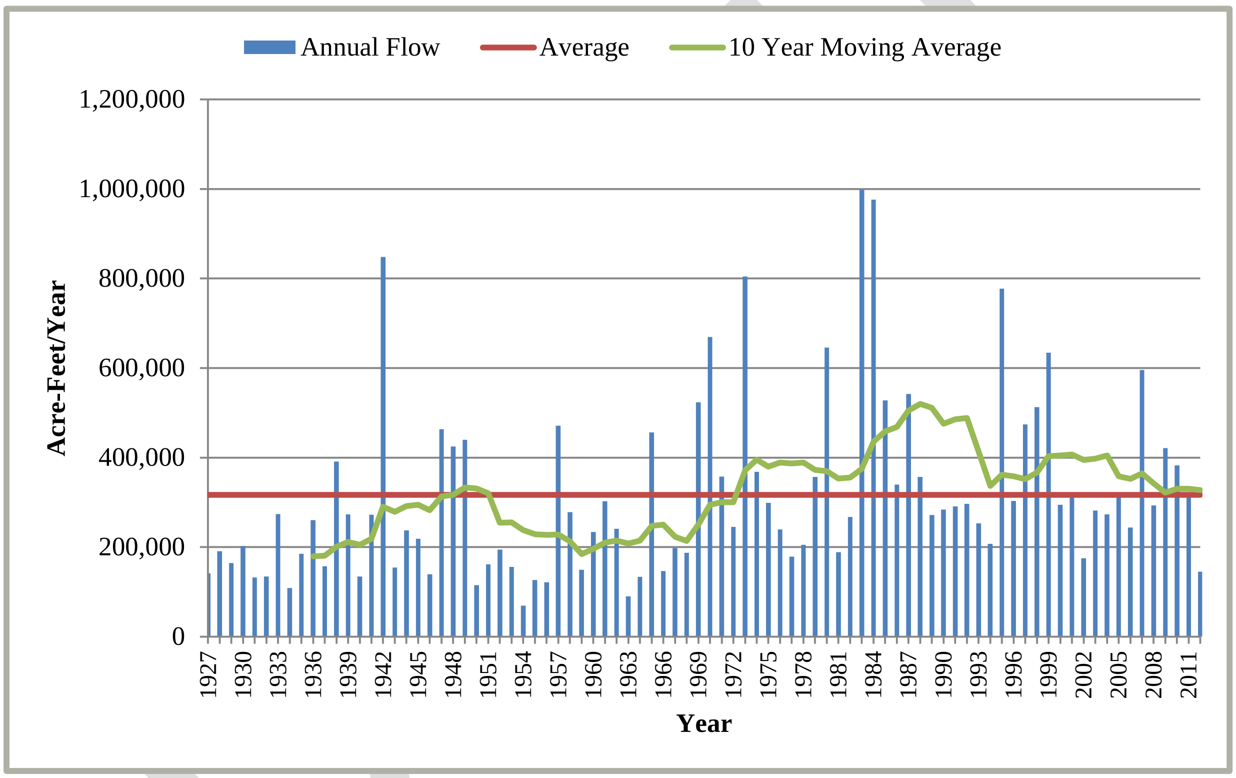

Figure 3-17. **Annual South Platte Flow for at Henderson from 1927 to 2011**

It is also difficult to identify the effects on calls of other developments in the Basin including more widespread tributary well use, construction of M&I reservoirs, and increased operation of the Denver Water exchange. As M&I users begin the reuse of fully consumable water supplies (including transbasin water, nontributary water supplies, and transferred agricultural water rights), less water will be available to downstream water rights. As previously shown in Figure 3-15, the average annual consumable effluent discharged and reused by Denver Water from 1995 to 2004. Denver will be increasing its reuse of consumable return flows through the expansion of its recently completed nonpotable reclaimed water system, development of gravel lake storage in Water District 2, and application for LIRF credits. Several Metro area municipalities have similar projects planned, including Aurora, Thornton, and others. The construction and lining of gravel pits for storage may block or change the timing of return flows that would have typically made it back to the South Platte River. Water conservation and reuse efforts will result in less water being needed to meet future growth. However, water needed to meet future growth has historically come from increased storage water, changed agricultural water rights, and transbasin water; return flows from these sources provided additional return flows for use by downstream irrigators.

The impact of more efficient irrigation practices such as center pivot sprinklers and the lining of ditches and laterals will not only impact the direct flow rights in the summer but also the winter storage rights and recharge projects that benefit from lagged return flows from flood irrigation. This transition may impact the lower reaches of the river more than any of the reuse of water by municipalities. This reduction in return flows will further impact future river calls. The reduction in return flows can also impact environmental and recreational attributes.

Impacts to recharge projects may also limit the ability to divert water sufficient to meet the augmentation needs of wells. The more senior recharge projects that have been constructed may also place additional calls on the river that will affect the more recently developed junior recharge water rights. More senior recharge projects upstream from Water District 64 may also experience lower yields in the future as a result of storage calls now being placed during the nonirrigation season. Junior storage rights and recharge projects may also be impacted by farmers who historically used wells early in the irrigation season, but are now diverting their direct flow water rights and placing calls earlier than has occurred since the mid-1970s.

3.6 South Platte Basin Water Supply Availability Conclusions

The future water supply gap in the Basins is an urgent problem that must be addressed with all due speed.

- Efficient use of all existing water supplies within the Basins is already happening to a large extent, and will increase in the future. However, existing water supplies combined with some incremental development of conditional water rights will not be sufficient to meet the basin's future needs.
- A large-scale dry-up of irrigated agriculture to meet future M&I water needs will cause significant negative economic and environmental impacts to the Basins and to the state as a whole.
- Both the Basins, and the State as a whole, must proceed with a sense of urgency to evaluate and develop all potentially available water supplies in order to meet the future consumptive needs of the Basins. Speedy completion of current studies of water availability in the Colorado River Basin, and studies of project concepts to develop and use available water statewide is imperative.

Several elements further complicating the growing gap include competing water supply projections, unappropriated water, changing river administration and consumable effluent reuse.

3.6.1 Competing Water Supply Projections

The Roundtables believe that there is a significant overlap in the projection of available future water supplies by many municipal water providers within the Basin.

1. Nearly two-thirds of C-BT units have already been acquired by M&I water users. The potential for meeting future M&I demand by C-BT acquisition is limited.

2. Although native agricultural water rights are generally more available, competition for those rights located close to M&I development will be severe.
3. Whether done through C-BT acquisitions or native water rights acquisitions, meeting future municipal demands by simply drying up irrigated lands poses significant risk for the Basins. Irrigated agriculture is a substantial contributor to the economy of both the Basin and the State, and large scale agricultural dry-up is an undesirable means for meeting future water demands.

3.6.2 Unappropriated Water

In general terms, the South Platte Basin is one of the most highly developed and efficient river basins in Colorado. An upstream water user diverts and uses water in accordance with their established water rights, then a portion of that water returns to the South Platte River or its tributaries and is subsequently available for use by the next most senior downstream water right owner. As a result, water is typically used and reused approximately 6 to 7 times between the Front Range headwaters and the state line.

1. In most areas in the upper portion of the Basin, there is no unappropriated water available in dry years. Even in locations where there might be small quantities available, the economics of building reservoirs to turn those wet year supplies into firm yield are questionable because of the large carryover storage requirements.
2. In the lower portion of the Basin, where some unappropriated water is available in some years, extensive efforts are already underway to develop and use that water. Many municipal water providers already have conditional water rights that are being developed. Many agricultural water users have developed significant recharge projects within the past 10 to 20 years to replace well depletions from irrigation wells. The roundtables believes that what water is available for development will be developed as part of existing projects either well along in planning or underway.
3. Therefore, unappropriated water will likely not be a significant source to meet future consumptive needs within the basin.

3.6.3 Changing River Administration

As a general matter, the increased demand for the limited supply in the Basin has tightened and decreased the availability of water from both existing water rights and the development of junior conditional water rights. Administration of the South Platte River has evolved due to changes in both supply and demand.

1. At the end of three decades of above average precipitation, the frequency and duration of river calls on the mainstem of the Platte River has increased significantly. The mainstem call season has expanded from primarily the direct flow irrigation season to year-round calls that include both storage and direct flow water rights.
2. Increasing levels of water conservation in the Front Range municipalities, combined with projects to reuse transmountain water return flows, will decrease the physical water supply that has been available along the mainstem for the past several decades.
3. Increasing use of sprinkler irrigation in irrigated agriculture is decreasing the amount of return flows available to satisfy downstream water rights.

4. These, and other interrelated factors (including potential climate change) mean that all but the most senior water rights in the basin will be under more pressure from priority calls of increased frequency and duration.

3.6.4 Consumable Effluent Reuse

Front Range municipalities are developing more programs to reuse and fully consume wholly consumable return flows that were previously allowed to flow downstream for use by other water rights.

3.6.5 Water Conservation Plans

Most municipalities within the basin have developed or are developing water conservation plans. Following the drought of 2002, water conservation has been prominent, and more conservation is expected to be implemented in the future. Although conservation will undoubtedly reduce the future water supply gap by some increment, it will not alone be sufficient to meet additional future water demands.

4

Projects and Methods

4 Projects and Methods

Key Points:

- A diverse array of projects and methods has been utilized to develop the SP-BIP. These include public involvement; watershed programs; review of environmental and recreational resources and needs; and technical analyses for M&I and agriculture water supply solutions.
- Public Involvement - The initial process included public open houses, and the southplattebasin.com website. From January to June 2014. BRT members conducted 21 presentations to water user and civic groups and the consulting team made 25 public presentations to the BRTs and subcommittees. A more extensive public outreach program will follow the submittal of this Draft SP-BIP to the CWCB on July 31, 2014.
- Watershed Programs - Several have been identified to help manage water resources and water quality.
- Strategies to Meet the M&I Water Supply Gap include: passive and active conservation, reuse, in-basin identified projects and processes (IPPs), trans-basin IPPs, alternative transfer methods (ATMs), improved storage, and new Colorado River supply options.
- Environmental and Recreational Needs - The implementation of M&I projects and methods must consider the impacts on other water uses including environmental, recreational, and agricultural needs. These projects could also benefit environmental and recreational attributes, if cooperative operational agreements can be put into place.
- Projected Gap Analyses - Gap analyses conducted for the South Platte and Metro Basins identified the largest M&I and SSI gaps by county for 2050
- The South Platte and Metro BRTs 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 (IPPs, conservation, reuse, and new Colorado River supply) plus storage" need to be simultaneously considered as the development of Colorado's Water Plan continues.
- The South Platte and Metro BRTs believe that the State should help to assure that, within the constraints of federal, state and local laws and regulations, potential future Colorado River supply options should be preserved to the maximum extent practical and should not be prevented through permanent federal, state or local land management designations, new water rights, or other measures.
- The vision of the South Platte and Metro BRTs is based on the implementation of a balanced, integrated plan for the overall benefit of Colorado. The BRTs do not support the "default plan" relying on the dry-up of productive irrigation acreage.

4.1 Education, Participation and Outreach

The following subsections summarize the education, participation and outreach efforts accomplished to date for the South Platte BIP, as well as those to be completed within 2014 and beyond.

4.1.1 Activities: January – July 2014

In January 2014, a communications plan was developed to provide South Platte Basin stakeholders and the general public with unified messaging, information, and opportunities for input regarding the BIP process. The program was conducted in collaboration with the Public Education, Participation, and Outreach (PEPO) Workgroup of the IBCC and the Basin Roundtable Education Liaisons.

In addition to online education tools, public open house meetings were conducted throughout the basin and presentations were made by Roundtable members at a variety of public meetings hosted by groups interested in South Platte Basin water planning.

A contact and comment management database was established to track outreach and participation among these groups. At the time of this writing, 820 individuals have been reached through the BIP process and are logged in the database.

4.1.1.1 PUBLIC OPEN HOUSE MEETINGS

One hundred and ninety individuals attended one of four public open house meetings in areas that represented all sub-regions of the Basin. The purpose of these meetings was to inform stakeholders about the BIP process and to solicit input.

Table 4-1. Public Open House Meeting Dates, Locations and Attendees

South Platte Sub-Region	Meeting Date	Location	Number of Attendees
Denver Metro	March 3, 2014	Tivoli, Metro State College of Denver Denver, CO	46
Northern South Platte	March 5, 2014	Southwest Complex Weld County Longmont, CO	55
Upper Mountains	March 19, 2014	Fairplay, CO	63
Lower South Platte	February 26, 2014	Fort Morgan, CO	26
TOTAL Attendees			**190**

Additionally, similar information was presented at the regularly scheduled meeting of the Republican River Water Conservancy District in Yuma, CO on April 10, 2014 to serve the High Plains/Republican sub-region.

Participants in these meetings represented a wide variety of interests including agriculture, municipal, industrial, business, recreation and environmental. Public comments were inventoried during the meetings and shared with the BRTs and the Nonconsumptive (environmental and recreational) Subcommittee.

Key issues raised by the public include:

- Importance of addressing agricultural water supply needs
- Preserving property rights associated with Colorado water administration
- Groundwater protection, storage and use
- Environmental and recreational concerns
- Municipal and industrial future needs

- Effects of transfers from agriculture to municipal use
- Environmental and recreational impacts
- Information gaps in SWSI 2010
- Renewable and sustainable energy and the use of water for hydraulic fracking in oil and gas field development
- Instream flow water rights in relation to transferring and managing water
- Opportunities to use West Slope water combined with Front Range aquifer storage and conjunctive use with other surface water supplies
- Possible sediment accumulation problems in reservoirs
- Variability of water supplies over time
- Protection of aquifers from contamination and over-pumping.

These meetings were promoted through email distribution lists and press releases to local media outlets including newspaper, radio and television.

4.1.1.2 SOUTHPLATTEBASIN.COM

www.southplattebasin.com was launched in March 2014 to help reach a broader audience within the Basin and to allow for additional public education and participation beyond the public meetings. The site featured the respective chairs of the Metro and South Platte Basin Roundtables and provided an overview of information presented at the public open houses.

Four hundred and sixty unique individuals visited the site, some of whom shared opinions on the most important water needs in the Basin. Those results are shown below.

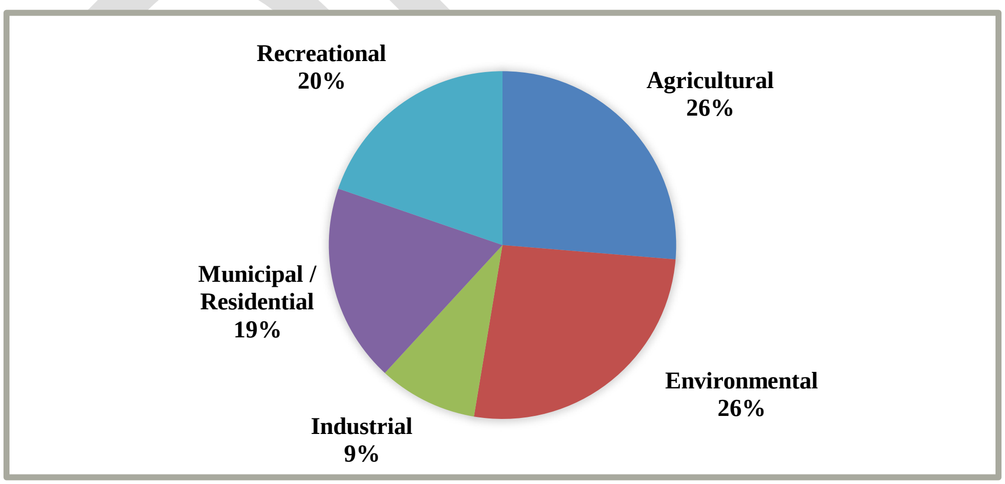

Figure 4-1. Most Important Water Needs*

**Results of the same survey distributed in hardcopy at the Fairplay meeting have been aggregated with the online survey results in the figure above.*

4.1.1.3 PRESENTATIONS BY ROUNDTABLE MEMBERS

A standard presentation was developed for use by all BRT members for presentation to local organizations. 21 presentations were made by BRT members as follows:

Table 4-2. Presentation by Roundtable Members

Date	Meeting	Location	Approx. Attendance
01.08.14	Metro BRT	Denver, CO	50-60
01.14.14	SP BRT	Longmont, CO	40-50
02.06.14	Morgan Conservation District Annual Meeting	Fort Morgan	30
02.11.14	SP BRT	Sterling, CO	50
02.12.14	Metro BRT	Denver, CO	30
03.05.14	KGNU Radio	Denver, CO	Unknown
03.06.14	Statewide Roundtable Summit	Golden, CO	200
03.11.14	SP BRT	Longmont, CO	50
03.12.14	Metro BRT	Denver, CO	30
03.12.14	Larimer County Agricultural Advisory Board Meeting		15
03.18.14	Progressive 15 Water Summit	Fort Morgan, CO	35
03.19.14	CU Water Law Class	Boulder, CO	50
03.19.14	Metro Mayors Caucus Water Committee	Denver, CO	8 Metro area mayors
03.21.14	St Vrain and Left Hand Water Conservancy District Water Users Meeting	Longmont, CO	75
04.08.14	SP BRT	Longmont, CO	50
04.09.14	Metro BRT	Denver, CO	30
04.11.14	Poudre River Runs Through It	Bellvue, CO	25
04.17.14	River Manager Workshop	Denver, CO	15
04.18.14	DU Water Law Review Seminar	Denver, CO	75
04.23.14	Arkansas River Basin Forum	LaJunta, CO	150
05.01.14	KSIR Radio (1010 Farm Radio)	Broadcast	Unknown 1,000+

4.1.2 Suggested Activities: July – December 2014

After the Draft South Platte BIP is submitted to the State at the end of July 2014, another round of education, participation and outreach will take place utilizing many of the same methods described in the previous section. The primary purpose of this second round of engagement will be to share the results presented in the Draft BIP. The table below provides an overview of activities, tools and intended audience.

Table 4-3. Engagement Tools and Intended Audiences for 2014 Activities

Activities and Outreach Tools	Intended Audience
Online Interactive	This tool is designed to take the public meeting directly into households and businesses throughout the basin.
Stakeholder Group Meetings	Several meetings are planned to address interests and concerns of agricultural, municipal, industrial, business, environmental and recreation stakeholders and interest groups.
Public Meetings	Several public meetings are suggested to present findings and gather face-to-face input from each sub-basin.
Updated Presentation(s) and Informational Materials	Standard presentation(s) and other materials will be developed for BRT members to present to their constituencies and other interested organizations.

4.1.3 Suggested Activities: 2015 and Beyond

The South Platte Basin is home to 80% of the State's population and provides 80% of the State's economy and tax base. It is an area with great diversity both economically and demographically and is facing 75% of the projected statewide municipal water supply gap. This Basin deserves and needs an intensive education, participation and outreach program designed to generate a lasting baseline of public awareness and support.

The focus of the 2015 Joint Strategic Communications Plan will be to maximize existing opportunities, avoid duplication of effort, and streamline Basin communication in a cost-effective way. Key elements of the plan may include the elements described below.

Develop Messages: This would build on messaging developed during 2014 outreach and continue to describe the water gap, detail all the efforts that have already taken place in the South Platte Basin, present key elements of the BIP, and provide opportunities for meaningful public engagement.

Leverage Existing Basin Resources: Many of the members of the Metro and South Platte Basin Roundtables represent organizations with on-staff communications professionals who manage a number of education and outreach activities that, taken collectively, have the potential to reach nearly every citizen in the Basin. This item of the plan will inventory the reach and methods of these groups and call for a Basin-wide partnership to provide consistent BIP messaging through existing communication mechanisms such as newsletters, bill stuffers, websites, newspaper inserts, and electronic communication

Complement Existing State Efforts: There are many education, participation and outreach efforts taking place throughout the state with regard to water. This element of the plan will leverage the PEPO representatives for both Roundtables to collaborate on the greater communication efforts for Colorado's Water Plan and work to provide consistent South Platte Basin messaging. Additionally, an inventory of other entities working on water education will provide opportunities for further collaboration.

Develop and Maintain Basin-Specific Tools and Approaches: A gap analysis will be done once the inventory of existing Basin and statewide resources is complete to determine areas of need for continued investment and focus. At a minimum, the southplattebasin.com site will be maintained and updated to function as the foundation of all education, participation and outreach activity and content. A possible outcome of the gap analysis might be the need to identify additional partnerships to assist with educational programming and outreach. Additionally, distinct approaches may be developed for outreach to specific stakeholder groups.

Establish Success Metrics: Tracking mechanisms such as polling, web analytics, and distribution analysis may be put in place to determine the reach and saturation of messaging for all demographics within the Basin. These benchmarks will be used to determine public awareness and support as well as fine-tune the strategies and tactics within the Strategic Communication Plan. The Joint Strategic Communications Plan will be updated annually.

4.2 Watershed Programs

The headwaters of the major South Platte River tributaries provide the essential raw water supply for towns and cities from Fairplay on the south to Fort Collins on the north and extending eastward beyond Greeley all the way to Nebraska. There is an increasing recognition of the importance of watershed health and water quality in this area considering that more than 3.5 million people currently reside in the South Platte River Basin and that there have been many recent examples where adverse hydrologic conditions and major forest fires have highlighted vulnerabilities to municipal and industrial water service disruptions. With the population of the basin expected to grow to more than 6 million people by 2050 (the planning horizon for the CWP), these concerns are expected to grow.[1]

4.2.1 Watershed Protection Projects and Methods

4.2.1.1 WILDFIRES MITIGATION AND TREATMENT

Wildfires dramatically reduce natural protection from erosion and sediment transport that healthy forests and watersheds provide to all types of raw water diversion, storage and conveyance facilities. High severity fires change soil composition, preventing water from being absorbed and causing precipitation to runoff and mobilize suspended sediment, ash and other debris. These contaminants block the flow paths to water systems, causing disruptions to water deliveries and degradation of water quality in all types of supplies.

Identifying watersheds that are an important source of drinking water and areas at risk of post-fire erosion is a critical part of the planning process. The upper watersheds of the South Platte River and its major tributaries, such as the Big Thompson, Cache La Poudre, Clear Creek, Boulder Creek, and Saint Vrain, are of particular importance because water from these watersheds provides raw water to many major water providers including Aurora, Boulder, Denver Water, Fort Collins, Greeley, and many others.

Fire suppression in recent years has led to excessive vegetation density, abundant fuel, and species declines, providing extensive fuel for wildfires.[2] Reducing vegetative competition and enhancing appropriate age and species diversity through forest management can reduce the risk of damaging wildfire in high priority watersheds. Management techniques vary by forest type and are largely accomplished by selective thinning to reduce tree stress and competition, but may include other options such as clear cutting or other forest restoration activities, depending on forest type and desired outcome[3]. Ponderosa pines typically grow in uneven-aged stands and have relatively thick bark and deep roots, making them

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[1] CWCB 2011. Colorado's Water Supply Future, SWSI 2010 South Platte Basin Report Basinwide, Consumptive and Nonconsumptive Water Supply Needs Assessments. CDM Smith, Denver, Colorado. June 2011. Medium Population Growth scenario.

[2] Martin, D. (2000). "Studies of Post-Fire Erosion in the Colorado Front Range Benefit the Upper South Platte Watershed Protection and Restoration Project".

[3] http://csfs.colostate.edu/pdfs/2013ForestHealthReport.pdf

ideal for coping with dry conditions and frequent, low-intensity fires; in these forests, selective tree harvesting often is the best strategy. Lodgepole pine, however, is a thin-barked tree with shallow roots that generally grows in even-aged stands adapted to more moisture and less frequent, more intense fires. In these stands, clearcutting is the best option.[3] Reducing fuel and implementing defensible space around homes and structures can significantly reduce the risk to people living on the wildlife-urban interface.

4.2.1.2 INSECT AND DISEASE

Colorado's forests are experiencing intense insect and disease activity. Affected trees create fuel for wildfires, increasing the chance of high intensity, sustained fires.

4.2.1.2.1 Mountain Pine Beetle

The infestation of Mountain Pine Beetles (MPB) in Colorado began in 1996 and has impacted 3.4 million acres statewide through 2013.[3] South Platte Basin counties that have seen the most impact are Larimer County (85,000 acres of MPB activity) and Boulder County (1,600 acres of MPB activity). However, recent studies show that the infestation statewide has been declining since 2008. As an example, the MPB infestation in 2013 only expanded by 8,000 acres, as compared to a 31,000 acre expansion in 2012.

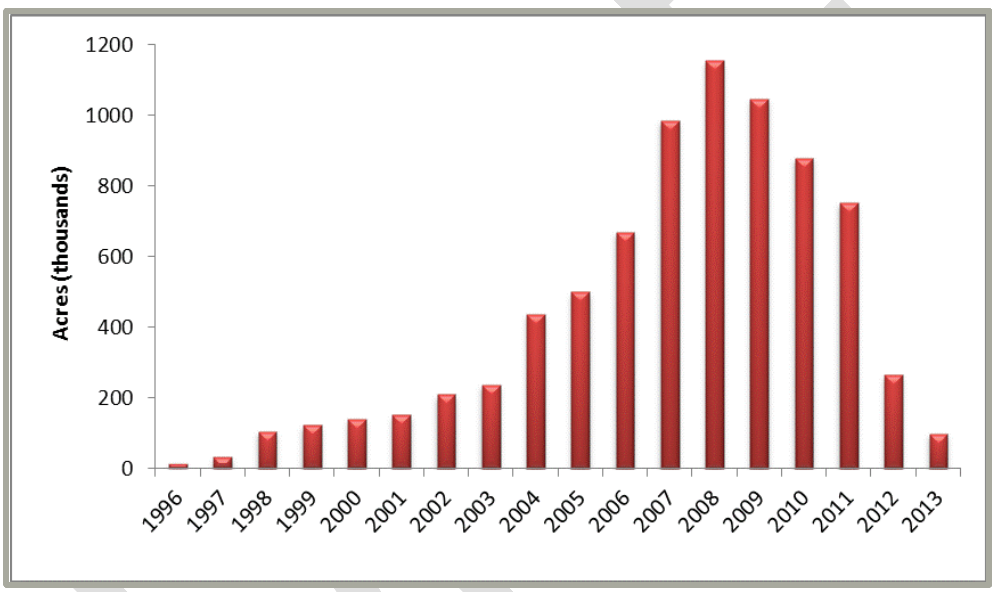

Figure 4-2. Annual Acres Affected by Mountain Pine Beetles in Colorado
Source: USDA, Rocky Mountain Region Forest Service

Although statewide the infestation is declining, in some areas along the Front Range (from Rocky Mountain National Park south to the I-70 corridor, and in the Geneva Creek Basin and portions of South Park) a substantial population of pine trees suitable for attack and brood development remains.

4.2.1.2.2 Spruce Beetle

Since the beginning of the Spruce Beetle infestation in 1996, Spruce Beetles have affected 1,144,000 acres in Colorado and have caused the most tree mortality in the Colorado forests in 2012 and 2013. [4] Of these, 216,000 acres are in areas not previously mapped as having spruce beetle activity (new acres).[5]

[4] Report on the Health of Colorado's Forests. 2013.

[5] U.S. Forest Service. Aerial Detection Survey: 2013 Colorado Highlights.

There are no significant areas of impact in the South Platte Basin, however new tree mortality from spruce beetle infestation is occurring in Larimer County.

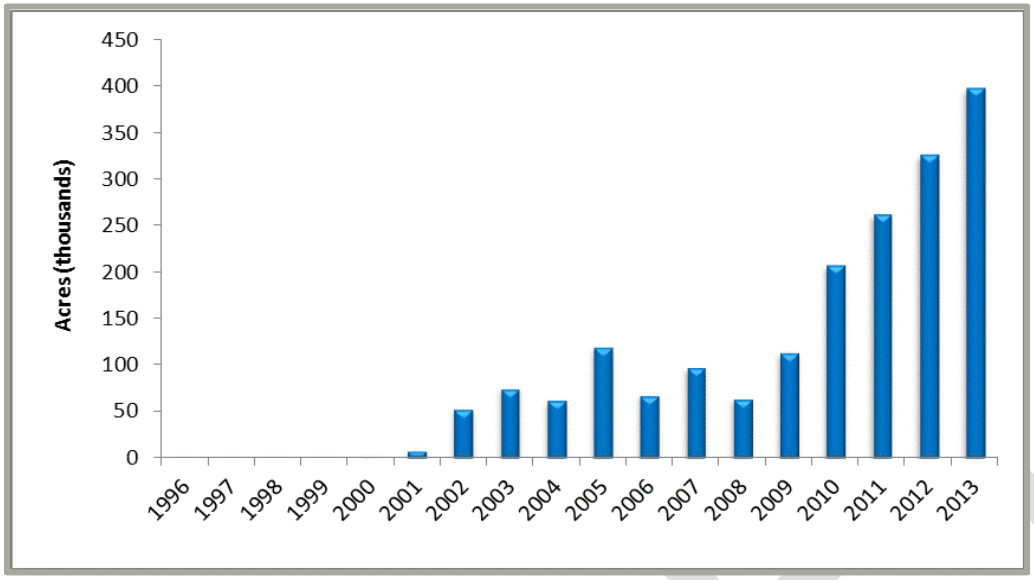

Figure 4-3. Annual Acres Affected by Spruce Beetles in Colorado
Source: USDA, Rocky Mountain Region Forest Service

4.2.1.2.3 INSECT MANAGEMENT

Once infestation has begun, management options to mitigate intensity and spread are limited.[6] Infested forests can be thinned to prevent the spread of beetle kill. Trees can be sprayed with carbaryl to prevent the infestation, however, this process is time consuming and expensive. There is no effective means of mitigation large areas of infected forests.

Although researchers originally thought the infestation of Colorado's forest would lead to negative impacts to water quality and quantity, multiple independent studies have found that water quality changes in watersheds infested by beetles are minor. This is due to beetles infesting only overstory trees and having no effect on plants other than large mature pines. Understory plants continue to promote the infiltration of runoff and nutrients into the soil, and respond vigorously as beetle killed canopies open and more water and nutrients become available. Bark beetle outbreaks promote diversity in species composition, age, and structure of the forest they infest, which may benefit forest health through increased resilience following future disturbance.[7]

The vast majority of beetle-killed forests are inaccessible to harvesting operations primarily because of steep topography, lack of road access, and weak timber market economics; the untreated forests that recover are likely to support a mixture of conifer species and an increased amount of subalpine fir compared to harvested areas. The limited amount of post-bark beetle treatment and salvage harvests should be targeted at stands that pose the greatest risk as fuels for wildfire.

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[6] CSFS. (2010). Colorado Statewide Forest Resource Assessment.

[7] US Forest Service Rocky Mountain Research Station. (2012). From Death Comes Life: Recovery and Revolution in the Wake of Epidemic Outbreaks of Mountain Pine Beetle.

4.2.1.3 POTENTIAL CLIMATE CHANGE IMPACTS TO WATERSHED HEALTH

Many of the watershed health problems in the past 20 years, including increased wildfire severity and scale, extensive insect and disease infestations, and flooding may have, in part, been driven by climate change[8]. The year 2002 was a record setting wildfire season and the current mountain pine beetle epidemic has been identified as impacts of the changing climate[6]. Mountain ecosystems are expected to experience the most severe ecological impacts from climate change and/or other causes of more severe variability in temperature and the timing and magnitude of rain and snowfall.

4.2.2 Cooperative Basin Watershed Health

Currently, multiple water providers, organizations, governmental groups, and public groups participate in watershed health programs in the South Platte Basin. However, the Basin is not only reliant on the watershed health in the South Platte basin but also on other Colorado basins' watershed health due to transbasin diversions. Watershed health assessments should be considered at a statewide level that will involve collaboration between basins to achieve statewide watershed health.

The Arkansas Basin is formulating a Watershed Health Basin Plan Working Group and the Metro and South Platte Basin Roundtables have agreed to review their work. This working group would:

- Invite state, federal, and non-governmental organizations to actively participate in the process of formulating watershed health plans
- Summarize post-fire mitigation and recovery in Colorado
- Develop a common technical platform that provides full integration of the non-consumptive needs of each basin, including prior assessments, in its watershed health plan

The group proposes to deliver manuals on post-fire mitigation, forest health and other watershed health incentives like wetland construction for water quality. These manuals will be based on current best management practices (BMPs) of local, state, and federal agencies that have substantial experience in these critical watershed health issues.

4.2.3 Water Quality Overview

Watershed resources management includes stormwater and flood control. Innovative projects are being developed in the Basin that provide water quality and flood control benefits. In addition, numerous studies have dealt with water quality characterization and/or management for large parts of the South Platte River Basin or for the entire Basin. One primary example is the U.S. Geological Survey's study of the Basin's water resources under the auspices of its National Water Quality Assessment (NAWQA) Program.

There are a wide range of water quality monitoring data and related information available for various subareas of the South Platte Basin. A number of the subareas surrounding the Denver metropolitan area, including plains and mountain tributaries, have watershed plans, monitoring reports, source water protection plans, and other investigation reports describing specific issues of concern in water quality or

[8] CSFS. (2010). Colorado Statewide Forest Resource Assessment.

watershed health. The concept of sustainable watershed water resources management underlies many of the watershed or subarea-based studies cited in this review.

Sustainable management for these attributes is interrelated with water supply complexities and land use changes affecting water quality and land cover, the latter factor being especially critical in the forested, mountain tributary streams flowing into the South Platte River. In this respect, institutional consideration (e.g., Federal vs. private land ownership) plays a role. The role of land management Federal and State agencies, as well as the water resources and environmental protection agencies requiring compliance with the NEPA, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the Clean Water Act (CWA) regulations is critical to the goal of sustainable water resources management.

From a water quality perspective in the South Platte Basin, the following examples demonstrate the diversity of concerns relative to current and future Statewide planning:

1. Water quality changes, generally beneficial, due to West Slope transfers of water into the Basin.

2. The occurrence and areal extent of agricultural related chemicals (nitrogen or phosphorus compounds, herbicides and insecticides) affecting shallow groundwater resources and eventually downstream streamflow quality.

3. Mountain communities relying upon bedrock wells, providing limited supplies and impacting in some areas by cross-contamination from individual wastewater treatment systems.

4. The threat of emerging contaminants (including pharmaceuticals and personal care products, so-called PPCPs) being only partially removed by current state-of-the-art wastewater technologies and potentially being introduced into water bodies downstream of wastewater treatment facility discharges. To date, these types of contaminants remain unregulated. However, water supply providers in the Basin are beginning to gather baseline information on these substances.

5. Forested areas of mountain tributaries of the South Platte Basin are being impacted by diseases and disturbances affecting trees. This degradation of forested lands is resulting in increased wildfire potential, contribution of organic decomposition and nonpoint source nutrients, and challenges in tree-kill diseases and control of wildfires and increased nutrients.

6. A few of the mountain tributaries have been impacted by historical mining and mine-related activities. These cases (primarily involving the North Fork of the South Platte River, Clear Creek, Boulder Creek, and St. Vrain Creek watersheds), along with the presence of a mineralized zone transecting these watersheds, result with concerns of trace metals concentrations and controls to reduce these through various forms of remedial actions.

7. Water supplies provided by municipal water utility entities are regulated by the U.S. Environmental Protection Agency (EPA) and in recent years, these entities have been required to document the water quality of these supplies in annual reports. These reports are important, in that, from year to year, supply sources may well vary, depending on both surface water and groundwater sources.

8. Water resources management includes groundwater resources in the Basin, both alluvial systems interactive with streams and deeper groundwater systems. Bedrock aquifers of the Denver Basin are a key part of overall supplies in the Denver metropolitan area. Bedrock aquifers in mountainous areas of the Basin provide sufficient supplies for individual wells. Water quality concerns with these groundwater sources may exist and should be taken into account.

9. Wastewater treatment and reuse are important facets of the Basin's water supplies. Innovative systems are being developed in the Basin to increase water availability for various beneficial uses.

10. Stormwater controls, the need to integrate Clean Water Act (CWA) and Safe Drinking Water Act (SDWA) requirements, and impacts from individual sewage disposal systems (septic systems) are also concern that merit future consideration.

Appendix E contains several specific examples of the types of water quality concerns in the South Platte Basin listed above as well as a brief overview of 303d waters (impaired and threatened waters). This information is a starting point to promote deliberations involving these topics, to help to prioritize future investments in maintaining or improving the water quality and watershed health of the South Platte Basin, and to contribute to the overall Statewide water planning process.

4.3 M&I Projects and Methods

The following projects and methods have been identified by M&I providers to meet their future water demand gap. In this section, IPP yields are presented at 100 percent success.

4.3.1 Conservation Projects and Methods

4.3.1.1 PASSIVE AND ACTIVE CONSERVATION

Passive savings, defined in SWSI 2010, are those water savings that result from the impacts of plumbing codes, ordinances and standards that improve the efficiency of water use, such as high efficiency water fixtures and appliances. For the SWSI 2010 analysis, passive water savings were calculated to occur as a result of retrofitting housing stock and businesses through the replacement of washing machines, toilets, and dishwashers

The calculations based on these assumptions were used to estimate a range of future passive water savings in each county for each year starting in 2000 and continuing until 2050. The total range of savings expected from passive conservation through 2050 is 19 to 33 gallons per capita per day (gpcd). In SWSI 2010, the upper range of these savings were applied to the county level baseline estimates described above to assess 2050 demands on a low, medium, and high basis with passive conservation. As stated in the SWSI Conservation Levels Analysis Report there are three major reasons for applying the high passive conservation savings:

1. Water and energy savings will become increasingly important to water customers as water and fuel costs rise. As water customers seek more efficiency in their homes and businesses,

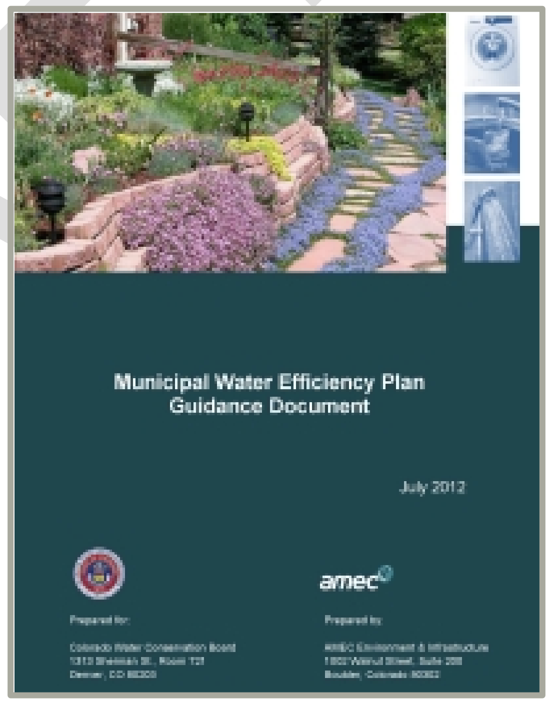
high efficiency fixtures and appliances will become increasingly efficient as technology improves and customers strive to reduce their variable costs related to water and energy.

2. Substantial permanent water demand reductions could be realized if appropriate regulations and ordinances are developed to address water use in existing and new construction in the future.

3. The impact of commercial retrofits (e.g., restaurants, motels, ski area condominiums, centralized laundries, commercial laundries, bars, etc.), is not well captured in the passive savings analyses since information regarding numbers of and ages of individual types of commercial properties were not available.

Active conservation savings are simply conservation savings that are not considered passive. Such programs may include, but are not limited to, education programs, incentives and rebates, fixture replacement programs, audits, and conservation rates and surcharges. Emergency conservation programs and drought-response restrictions are not included as long-term water conservation programs.

4.3.1.2 MUNICIPAL CONSERVATION PLANS



The Water Conservation Act of 2004 requires covered entities that seek financial assistance from either the CWCB or Colorado Water Resources and Power Development Authority (CWRPDA) to submit a Water Conservation Plan. Covered entities are defined as "each municipality, agency, utility, including any privately owned utility, or other publicly owned entity with a legal obligation to supply, distribute, or otherwise provide water at retail to domestic, commercial, industrial, or public facility customers, and that has a total demand for such customers of 2,000 AF or more."

As outlined in CWCB's Municipal Water Efficiency Plan Guidance Document, the nine required elements of a Water Conservation Plan include[9]:

1. Profile existing water system
2. Characterize water use and forecast demand
3. Profile proposed facilities
4. Identify conservation goals
5. Identify conservation measures and programs
6. Evaluate and select conservation measures and programs

[9] Municipal Water Efficiency Plan Guidance Document, CWCB, July 2012, AMEC Environment & Infrastructure

7. Integrate resources and modify forecasts
8. Develop implementation plan
9. Monitor, evaluate and revise conservation activities and the conservation plan

4.3.1.2.1 FOUNDATIONAL ACTIVITIES

Water Rates & Tap Fees - Water efficiency pricing has been one of the most effective methods in influencing customer behavior and reducing water use. A common water efficiency pricing structure consists of inclining block rate structures (also known as individualized, goal-based, customer specific rates, or water budget-based water rates) that discourage excessive customer water use. Customers are charged more money per gallon as they use more water. According to C.R.S. 37-60-126(4), a water efficiency oriented rate structure shall be fully evaluated for implementation during the water efficiency planning process. In order for a block rate structure to be effective and considered a demand management activity, there must be noticeable difference in the pricing rates of each block to incentivize efficiency water use.

SWSI 2010 also states that tap fees may be used as a means to reduce water usage for new development. Various incentives could be attached to the tap fee to encourage efficient water use. For instance, new homes outfitted with water efficient fixtures and appliances could receive a discount on their tap fee.

System Loss Management and Control - Leaks in water distribution systems can reduce the system's effectiveness and impact overall profitability. Effective leak detection and repair is critical to a provider's overall water resource management program. However, in Colorado some small utilities and water companies have reported losses as high as 50%. These losses are a combination of apparent and real losses (non-revenue water).

C.R.S. 37-60-126 (4) requires providers to fully evaluate leak detection and repair for implementation. As general maintenance protocol, providers should have a reliable leak repair program. System-wide audits assess real and apparent losses thus defining how much loss is from physical leaks, rather than metering inaccuracies or data errors.

Data Tracking – While metering and data collection may not directly result in water savings, it makes sense from a practical business perspective to initially invest in a means to track water usage and identify areas where water efficiency can be improved. These areas can then be targeted with other demand management activities.

The majority of Colorado's municipal water supply systems are now metered. However, meter testing as well as meter upgrades can be an important component to managing water use. Large multi-family units and raw water systems (non-treated water for irrigation purposes) are often not metered and are an area for improvement. Additionally, metering not only provides information on customer usage, but is also essential for measuring non-revenue water. Data to be tracked includes total annual and monthly production, total annual and monthly retail sales, monthly tabulation of number of connections and/or customer accounts, annual and monthly water use by customer and customer type, monthly non-revenue water use by provider. All of this information will support analysis for targeted programs.

Targeted Technical Assistance and Incentives – A collection of activities that rely on indoor water efficient technologies and water-wise outdoor practices. These activities may be implemented on three levels based on the following type of targeted customers: 1) provider/municipality facility water efficiency; 2) customers with the largest water use; and 3) management of remaining customer demands.

Ordinances and Regulations - A series of ordinances and regulations that promote or enforce water efficiency. Similar to the Targeted Technical Assistance and Incentives, Ordinances and Regulations may be implemented on three levels based for the following targeted groups: 1) existing service area; 2) ordinances for new construction; and 3) ordinances for point of sale of existing building stock.

Educational Activities – A variety of techniques and venues to convey water efficiency information to the public. These activities may include: Level 1, one-way education; Level 2, one-way education with feedback; or Level 3, two-way education. Stakeholder steering committees where information from the public is used directly for implementation of water efficiency activities is an example of the Level 3, two-way education.

4.3.1.3 CONSIDERATIONS REGARDING CONSERVATION PLANS

There are currently 45 water providers within the South Platte Basin with formal conservation plans filed with the CWCB. Each plan is tailored to conditions specific to the entity. Revising and adjusting focus will occur as an entity's program success becomes evident. Water budgets, tap fees and rates are powerful tools to encourage conservation savings but may introduce unintended consequences to the hydraulic and financial performance of the water provider. Specific themes of these plans are:

- Population Density
- Lot size
- Size of industry in relation to population
- Return flows

4.3.1.4 METRO AND SOUTH PLATTE CONSERVATION SUCCESSES

The Metro and South Platte Basin have already implemented conservation practices that are nationally known for their rigor. Since the first SWSI report in 2000, water demand in the Metro Basin has declined by approximately 100,000 acre feet. During this time, the Metro's gpcd has declined from 191 gpcd to 155 gpcd.[10] The Metro Basin supplies nearly half of the state's population and conservation has been an integral part of most water provider's water resource management programs as they serve an increasing population and growing economic base. Like Metro, water demand in the South Platte Basin has also declined dramatically since 2000. The 2010 SWSI report values show a decline of 15% in those years. Table 4-4 illustrates both basins' conservation successes.

[10] *Updated Metro Roundtable Conservation Strategy*

Table 4-4. South Platte and Metro Basin Conservation Totals

Measure	Metro			South Platte		
	2000	2010	Total Reduction (%)	2000	2010	Total Reduction (%)
TOTAL GPCD	**191**	**155**	**19%**	**220**	**188**	**15%**

Source: ***Updated Metro Roundtable Conservation Strategy* , *Updated South Platte Roundtable Conservation Strategy***

4.3.1.5 UPDATED SOUTH PLATTE AND METRO CONSERVATION LEVELS

The South Platte and Metro Roundtables have presented separate estimations of potential future water demand reductions which each basin can reasonably expect by 2050 based on current and future water conservation programs and improved water use efficiencies.[11] In keeping with SWSI and other state water conservation policy efforts, estimated demand reduction relates to three basic processes or influences on water use:

- Passive saving reductions related to the natural replacement of customer water using efficient fixtures and appliances
- Other changes in water use behaviors (e.g. state legislation, changes in land use, drought impacts)
- Active water conservation program impacts related to implementation of water conservation programs sponsored by water providers and special districts.

Metro and South Platte Basin Roundtables do not agree with "low, medium, and high" terms used in SWSI 2010 to define conservation levels because it doesn't convey the conservation accomplishments of the Basin. The South Platte and Metro Basins are currently leaders in conservation and are pursuing even more aggressive conservation levels. These terms can equate to good, better, and best, but for the purpose of consistency, "low, medium, and high" will be used in this section.

The Metro and South Platte Basins will differ in their conservation savings due to differences in current water users and types of development that are expected to exist in the future.

Residential Indoor Use: Both Roundtables have determined that the SWSI 2010 residential indoor conservation goals are extremely aggressive. For instance, passive savings, such as all toilets being 1.0 gallon per flush, may not be realistic. Currently the Metro basin is among the lowest in indoor residential use at 44 gpcd; the statewide average is 51 gpcd.

The Metro Roundtable concluded that a realistic goal for their area is the SWSI 2010 identified medium strategy which still requires water providers to actively pursue new ordinances or legislation. The estimate of current indoor use from SWSI 2010 is 60.1 gpcd. South Platte Basin water providers envision

[11] Updated Metro Roundtable Conservation Strategy – 11-14-11, Updated South Platte Roundtable Conservation Strategy

further reducing demand by 33% from the current 60.1 gpcd to the SWSI 2010 report value of 40 gpcd by 2050.

Non-residential Indoor Use: There may be fewer opportunities to save water in non-residential indoor use. As the Metro and South Platte areas continue to grow their economy, water needs will grow as well. The non-residential customer base is a diverse group of customers that have had varying degrees of success reducing water use. Less is known about this group of customers as the last Water Research Foundation study was done in the early 1990s.

Many Metro water providers offer programs to improve efficiency in commercial, industrial and institutional water uses. As stated in the Metro Roundtable Conservation Strategy, increasing business productivity and economic growth can mask achieved efficiencies.[12] As an example, Denver Water's industrial class of customers has reduced their use by 2 percent since 2000, while the residential class has reduced their use by more than 20 percent. Denver Water has entered into several contracts with industrial customers to improve efficiency. The results have shown that companies are using water more efficiently and productively but corresponding increases in output have diminished the total water savings.

Economic growth will continue and water use will increase to meet those growing needs. Efficiencies will be gained through replacing bathroom fixtures, changing industrial processes and reducing cycle concentrations on cooling towers. Water providers can offer a variety of programs including audits, education and incentives. Additionally, rules for new developments are being implemented in an increasing number of Metro communities.

Outdoor Use: Appendix L of the SWSI 2010 report specifically recognizes that residential and commercial densification will contribute to marginal reductions in water demand. In the Metro Basin, the densification process is expected to continue as population increases. In contrast, while some densification may occur, the remainder of the South Platte area will continue to have a higher percentage of single family type dwellings. Many South Platte providers also provide water to less developed rural domestic areas with larger lot sizes. In general, outdoor use in the South Platte Basin will continue to be higher than in the Metro Basin.

The Metro and South Platte Basin has seen outdoor use change over the last ten years. Many customers have lowered their water use for their lawns with an increase in conversions from bluegrass to low water using landscapes. There are still opportunities to save water by targeting inefficient users and capitalizing on a willingness to change landscapes.

There is some risk of losing outdoor savings. Many Metro providers have seen a sharp decline in outdoor use in the past three years, particularly in the residential sector. Some of this could be due to the economic decline and, as the economy recovers, water use could rebound as homeowners recover lawns and landscapes

Water Loss: Water providers in both the Metro and South Platte Basins recognize that enormous costs may be incurred in the future to repair and maintain water infrastructure as it ages. Water distribution leaks and other water loss may increase significantly if appropriate best management practices are not implemented. Due to distribution systems spread over large geographic areas, many South Platte providers (especially rural and domestic) will maintain more miles of pipe per costumer leading to larger

[12] Updated Metro Roundtable Conservation Strategy. November 2011.

per capita losses in water than the Metro Basin and many other areas in the state. Goals to improve water loss will involve better management practices, and system wide water audits.

South Platte and Metro Conservation Future Goals:

Regardless of past water conservation acheivements, additional water supply will be needed to meet the 2050 projected water demand. The Metro and South Platte Basin attempted to identify water demand reductions that can be reasonably expected based on current trends and programs – independent of new future regulation, substantial changes in land use, and other influences beyond the control of our water providers. The Metro Basin Roundtable recommends that it pursue conservation programs that would reduce per capita water use from a baseline of 155 gpcd in 2010 to 129 gpcd by 2050. South Platte Roundtable recommends conservation programs that would reduce per capita water use from a baseline of 188 in 2010 to 146 gpcd by 2050. Table 4-5 shows each basin's future conservation goals. The revised conservation goals are aggressive given contemporary best management practices and conservation beyond these levels will likely require societal changes.

Table 4-5. 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 GPCD	**155**	**129**	**17%**	**188**	**146**	**22%**

Source: ***Updated Metro Roundtable Conservation Strategy, Updated South Platte Roundtable Conservation Strategy***

4.3.1.6 UPDATED WATER DEMAND LEVELS

If the South Platte and Metro Basins achieve the 2050 conservation levels, as defined in the Metro Roundtable Conservation Strategy and the Updated South Platte Conservation Strategy, M&I demands will be lower than shown in SWSI 2010. The potential changes in M&I demands, shown in Table 4-6, were calculated by applying the gpcd as defined by the Metro and South Platte Basin Roundtables to the 2050 medium population projection. The equation used is presented below:

$$\boxed{\begin{array}{l} \mathit{Updated}\ 2050\ \mathit{M\&I\ Demands\ with\ Conservation\ Strategy\ gpcd} = \\ \mathit{Conservation\ Strategy\ gpcd}\ \times 2050\ \mathit{Medium\ Population} \end{array}}$$

If conservation levels are accomplished, the reduction in water demands would be 220,000 AFY for the Basin under the medium demand scenario as shown below. Conservation goals were not applied in the Net Gap Analysis presented in Section 4.7.

Table 4-6. Updated M&I Demands with South Platte and Metro Conservation Levels

Basin	2050 Medium Population	Baseline SWSI 2010 gpcd	Conservation Strategy gpcd	SWSI Baseline Medium Demands	SWSI Medium 2050 Demands w/Passive Conservation	Passive Savings	Updated 2050 Medium Demands with Conservation Strategy gpcd	Reduction in Demands
Metro	4,144,000	155	129	710,000	630,000	80,000	599,000	111,000
South Platte	1,902,000	188	146	410,000	380,000	30,000	311,000	99,000

4.3.2 Reuse

Many M&I users have existing consumable return flows that may be reused to the maximum extent practicable. 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. They include:

- **Nonnative water:** In general, water imported into a basin through a transbasin diversion can be reused to extinction. Transbasin diversions account for a substantial portion of the total reusable supply within the South Platte Basin. Note that diversions under the C-BT Project may only be used once due to limitations enacted prior to its construction. Similarly, most of the water diverted through Denver Water's Moffat Tunnel system is legally not reusable by contract.

- **Agricultural-municipal water transfers:** Agricultural transfers are generally available for reuse which is limited to historic consumptive use of the original agricultural water right decree. Reuse is applicable for water from traditional purchase of agricultural water rights and alternative transfer methods (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.

One common application of reuse is through the operation of a river exchange system. In general terms, a river exchange is operated by diverting water from a river at an upstream municipal intake in trade or "exchange" for reusable return flows provided to the river at a downstream location. Usually the exchange is a one-for-one trade in the amount and timing of water. Reusable return flows can also be recaptured and stored for later release to operate a river exchange.

There are several factors that may limit the ability to operate a river exchange. The stream flow that is physically available for upstream diversion, commonly referred to as "exchange potential", is perhaps the most important factor. River exchanges are limited in dry years because of lack of available river flow to divert and in wet years by not having senior downstream calling rights with which to exchange water. Water quality considerations can also limit river exchanges.

Reusable return flows can also be used in augmentation plans for replacing out-of-priority diversions that are used to irrigate parks, golf courses, and other green spaces.

4.3.2.1 REUSE IDENTIFIED PROJECTS AND PROCESSES

In the Metro Basin, reuse is being pursued by many water providers that own reusable supplies. The potential for future water rights exchanges of effluent will be considerably less in the Denver and South Metro areas as most of the exchange potential has already been allocated by existing exchange water rights applications. These exchanges, however, will continue to be made when and where feasible.

Direct reuse of effluent is largely focused on nonpotable uses, such as irrigation of parks and golf courses, though other nonpotable uses are becoming more prevalent (e.g., power plant cooling water supply). Return flows from Aurora Water and Denver Water will be delivered to members of the South Metro Water Supply Authority through the WISE Partnership utilizing Aurora's Prairie Water's Project and Binney Water Purification Facility at Aurora Reservoir. Yields from WISE will go towards meeting the participating member's of SMWSA reusable water supply goals to offset their current unsustainable groundwater gap. Prairie Waters was completed in 2010 and includes: riverbank filtration wells off of the South Platte River; and a 34 mile pipeline from the South Platte River to Aurora Reservoir; three pumping stations to convey return flows back to the city for subsequent treatment at Peter Binney Water Purification Facility and reuse after blending with high quality mountain supplies. Expansions of the Prairie Waters system are planned through 2050, including possible storage.

Other notable reuse projects include Denver Water's Reclaimed Water Treatment Facility, Westminster's Reclaimed Water facility (used for irrigation in parks, golf courses, and other large greenbelt sites), and the Town of Castle Rock's planned reuse.

Table 4-7. South Platte and Metro Provider's Reuse IPPs

Basin	Providers	Project	Estimated Yield (AFY)	Estimated Completion Date
Metro	Aurora	Prairie Waters Project Expansion & Storage[1]	TBD	2050
Metro	Northglenn	Northglenn Reuse Plan	700	
Metro	Thornton	Thornton Reuse	2,000	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	2,500	
Metro	Castle Rock	Plum Creek Diversion & WPF Upgrades	4,100	
Metro	ACWWA	Reuse of ACWWA Flow Project Deliveries	3,520	
Metro	City of Brighton	South Platte and Beebe Draw Well	3,200	
Metro	SMWSA, Denver Water, Aurora	WISE	7,225	2021
South Platte	Erie	Erie Reclaimed Water	5,390	
		TOTAL	58,135	

[1] *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.*

4.3.2.2 LIMITATIONS OF REUSE

On a local level, reuse can increase supply. However, on a larger basin scale, perhaps not. In an over appropriated system such as the South Platte Basin, downstream users rely on upstream return flows for their supply. Increased supply of one entity through reuse is done at the expense of the downstream user. Reuse then does not increase supply, just reallocates supply.[13]

Technical factors that limit the reuse of water include:

Infrastructure capacities – facility sizes can limit the amount of reusable return flows that can be captured, stored, released, treated, or used.

Losses within water supply systems and losses within the reclaimed water collection, treatment, and distribution systems all reduce the amount of available reusable return flows. Following are examples:

- River transit losses – The State Engineer's Office assesses river transit losses. Reusable return flows are often transported in rivers. The State Engineer's Office assesses river transit losses and losses may occur are from an upstream reservoir to the river intake for a water treatment plant, and or from the wastewater discharge to a storage area or downstream point of diversion.
- Reservoir seepage and evaporation.
- Losses from river diversion systems and from leaks in pipes that transport water to water treatment plants.
- Reclaimed water treatment plant losses.
- Reclaimed/reuse water distribution system losses and leaks.
- Losses in ditches, pipes, and gravel pits that collect and store reusable return flows.

Supply and demand timing. The timing of supply of reusable return flows does not always match up with potential uses. The potential for reuse is much less in the winter as the demand for outdoor irrigation is minimal. Without additional capture, storage, and delivery facilities, full reuse of reusable return flows in the winter may not be possible because outdoor irrigation is minimal.

Water Quality. Water from reuse projects may need to be blended with higher quality water before it can be reused. The lack of high quality blending water can limit reuse of lower quality supplies. Water quality standards such as temperature or total nitrogen can result in the need for wastewater reclamation utilities to implement treatment technologies that result in significantly higher consumptive use than typical advanced or tertiary treatment. For example, total nitrogen stream standards that require membrane filtration or reverse osmosis treatment can result in a loss of up to 20% of the treated water. Additionally, the lack of high quality blending water can limit reuse of lower quality supplies.

[13] Lusk, Kevin. Colorado Springs Utilities. *Sustainability Conflicts in Water Reuse and Reclamation Practices.* Colorado Sustainability Conference. November 2011.

Treatment Costs and Brine Disposal. Higher quality water sources are essentially fully tapped and municipal water suppliers are facing the challenges of using lower quality, more distant water sources. They are meeting this challenge through technological innovation; shared risk through collaborative projects, programs and research and, in some cases, significant impact to their rate structures and customers. After current IPPs are implemented, greater use of the lower quality water sources may be significantly constrained depending on whether the industry's technological advancements satisfy regulatory requirements for disposal of highly concentrated waste streams from advanced water treatment processes. In some cases, water agencies with adequate volumes of higher quality water may be able to blend them with lower quality supplies for their next major increment of water supply and avoid the advanced treatment technologies that result in concentrated brine streams. The challenges of inland bring disposal could be a major issue for South Platte Water suppliers both due to financial challenges and potential future regulations.

Regulatory requirements. The Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Division (WQCD) updated its Regulation No. 84 on Reclaimed Water Control Regulations in July of 2013. This regulation is applicable for reclaimed water, which is defined by CDPHE 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 approved uses."

There are two ways in which different source types can be reclaimed for reuse:

> **Direct Nonpotable Reuse*:*** This is the process in which the return flows from the various supplies are physically reclaimed for nonpotable uses. An example of this can be found in such as Aurora's Sand Creek Water Reuse Facility.
>
> **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.

Regulation 84 currently does not address reclaimed water uses for supplementing potable water systems, such as indirect potable reuse (IPR) and direct potable reuse (DPR). IDR is the augmentation of drinking water sources with purified water through groundwater recharge or surface water additions. DPR is the practice of introducing purified water directly into a potable water supply distribution system or into the raw water supply immediately upstream of a water treatment plant. Current Colorado regulations would have to be modified for these IPR or DPR to become viable options.

Generally, acceptable reclaimed water quality is achieved by reducing or eliminating pathogen concentrations in the reclaimed water, controlling chemical constituent concentrations in the reclaimed water, and if necessary, determining appropriate levels of limiting public exposure to the reclaimed water.

The ways in which this reclaimed water can be used are described within. In accordance with Regulation 84, the reclaimed water is placed into one of three categories based on the level of treatment necessary to which the reclaimed water is subjected. Category 1 requires secondary treatment with disinfection. Category 2 requires secondary treatment with filtration and disinfection. Category 3 requires secondary treatment with filtration and disinfection and incorporates more stringent requirements for pathogenic contaminants. Table 2-1 provides a summary of the approved uses under Regulation 84.

Table 4-8. Approved Uses for Reclaimed Water

Industrial	Category 1	Category 2	Category 3	Additional Conditions
Evaporative Industrial Processes (includes make-up water, cooling tower use and gas and odor adsorption	Allowed	Allowed	Allowed	Signage regarding exposure to aerosols
Washwater Applications	Not Allowed	Allowed	Allowed	Containment of runoff; minimize ponding; prevent exposure to aerosols
Non-Discharging Construction and Road Maintenance	Allowed	Allowed	Allowed	Minimize ponding; prevent exposure to aerosols
Non-Evaporative Industrial processes (includes closed loop cooling systems, uses where the water is incorporated into a product that is not intended for personal contact or ingestions, concrete make-up water, boiler feed water, lime slaking, industrial process make-up water).	Allowed	Allowed	Allowed	Prevent exposure to aerosols
Landscape Irrigation	Category 1	Category 2	Category 3	Additional Conditions
Restricted Access	Allowed	Allowed	Allowed	
Unrestricted Access	Not Allowed	Allowed	Allowed	Minimize ponding; No above grade outlets for reclaimed water at residences
Resident-Controlled	Not Allowed	Not Allowed	Allowed	Minimize ponding; No above grade outlets for reclaimed water at residences; public education program
Source: *Regulation No. 84 Reclaimed Water Control Regulation*				

Below is a list of other technical factors that may impact reuse capabilities. The Metro Roundtable Reuse Paper did not determine the effects of these other limitations. Therefore, the reuse capabilities may be overestimated.

- Conservation methods may affect the quantity of reusable return flows
- Drought restrictions reduce wastewater flows and decrease reuse potential
- A warmer and/or drier climate could substantially reduce supplies and increase water use which impacts the ability to operate river exchanges

For the Metro water providers, most of the river flow available for use in river exchanges has been appropriated or will be in the near future. Therefore, most future reuse will require capturing, treating, and delivering the reusable returns. This makes future reuse much more expensive and requires more energy use than current reuse done through river exchanges.

For the South Platte water providers, opportunities for future reuse are constrained due to the lack of reusable return flows. The majority of water providers already have or are in the process of implementing reuse projects and programs and do not consider reuse as a significant means for meeting future demands. It is generally understood that water is used perhaps seven times before it leaves Colorado at the

Nebraska state line. This degree of successive downstream water uses constrains the ability to either exchange water upstream or to convey it back upstream for future water needs.

4.3.3 Agricultural Transfers Projects and Methods

4.3.3.1 IDENTIFIED PROJECTS AND PROCESSES

There are a number of agricultural transfers planned within the Basin including:

- The cities of Longmont and Loveland plan on obtaining additional yields from agricultural transfers through water rights dedication policies
- The City of Greeley plans to pursue acquisition of Cache la Poudre Basin agricultural water rights
- The City of Arvada will acquire irrigation water rights in various ditches in the Clear Creek and Ralston Creek basins
- The Lower South Platte region will rely on existing rights and agricultural transfers for well augmentation.

It is likely that the actual yield anticipated from agricultural transfers is higher, but many water providers have captured agricultural transfers in IPPs falling in other categories such as regional in-basin projects or firming in-basin water rights. Some entities also own agricultural water rights that are presently being leased back to agricultural water users. Future M&I use of these supplies may be categorized as "growth into existing supplies".

Table 4-9. South Platte and Metro Provider's Agricultural Transfer IPPs

Basin	Providers	Project	Estimated Yield (AFY)	Estimated Completion Date
Metro	Arvada	Clear Creek Agricultural Transfer	450	2016
Metro	City of Brighton	South Platte and Beebe Draw Well Project – Agricultural Transfer	3,500	
Metro	City of Northglenn	Agricultural Transfer	500	
Metro	Town of Parker	South Platte Farms and South Platte Co-op Agricultural Transfer	500	
South Platte	City of Greeley	Water Rights Acquisition	9,000	2030
South Platte	Longmont	Agricultural Transfer, Water Rights Dedication Policy	1,700	
South Platte	Loveland	Agricultural Transfer, Water Rights Dedication Policy	3,150	
South Platte	Fort Collins	C-BT. Agricultural Water Rights Acquisition, & Annexation Dedication Policy	1,100	2017
		TOTAL	19,900	

4.3.3.2 ALTERNATIVE TRANSFER METHODS

To provide incentives for M&I water providers to consider alternative methods for their water supply options, the 2007 Legislature authorized the CWCB to develop a grant program to facilitate the development and implementation of ATMs. This incentive-based program promotes ATMs within the confines of Colorado Water Law and is respectful of private property rights.

According to the SWSI 2010 report, ATMs are meant to "minimize the impact on the local economy, provide other funding sources to the agricultural user, and optimize both the agricultural and nonagricultural benefits of the remaining lands. While any transfer method is likely to reduce the yield or number of irrigated acres, exploration and implementation of alternative transfer methods may lessen the effect of the transfer within a defined geographic location and may help sustain agriculture by providing additional revenue sources to the agricultural user."

Some of these alternative transfer methods could include rotational fallowing, ISAs, water banks, purchase and leasebacks, deficit irrigation, and changing crop types. Through the implementation of ATMs, the agricultural producer can view their water rights as a "crop" and cities may view the cornfields as "reservoirs" holding water supplies for times of shortage.

With the exception of purchase and lease-backs and some short-term fallowing-leasing agreements, these alternative ATMs are just beginning to be explored as viable options for meeting other water demands. While promising, there are numerous technical, legal, institutional, and financial issues associated with ATMs that need further study. ATMs are currently undergoing experimental pilot projects and research but the contribution to meeting the M&I gap is still unknown. Some of the potential benefits and challenges to ATMs are listed in Table 4-10.

Table 4-10. Potential Benefits and Challenges of ATMs

ATM Benefits	ATM Challenges
Relationships between irrigators and municipalities—water sharing	Municipalities are seeking a permanent water supply. Temporary or short term supply could be undesirable.
Provides irrigators with needed capital to upgrade farm or irrigation system equipment or infrastructure	Lack of storage and infrastructure in many locations that would allow the saved water to be transported to water treatment plants. Cost and practicality of installing infrastructure in these locations will need to be considered.
Provides irrigators with a temporary increased income that may be used for payment of debts or increased disposable income	Decrease overall agricultural production
Helps to optimize the use of limited water resource	Lack of long term uncertainty for agricultural producer and new user
Sustain rural agricultural communities and economies	Contribution to M&I gap is unknown
Preserve productive agriculture open spaces	Practical, financial, and legal obstacles associated with implementation of ATMs
Provide for greater food security than if agricultural lands are taken out of production	Need to develop specific methodologies for measuring, calculating, and monitoring the amounts of water that can be made available without injury to other water rights
Provides wildlife habitat	Potentially high transaction cost associated with water rights transfers
	Water rights administration and accounting uncertainties

The CWCB, IBCC ATM subcommittee, and Basin Roundtables are currently exploring ways to address these issues utilizing incentives to gain greater awareness, interest, and participation from agricultural water users and municipalities with alternative agricultural water transfers while still being careful to protect other water rights. Many of these efforts have been funded by CWCB's Alternative Agricultural Water Transfer Methods Grant Program. The ATM grant programs that are occurring in the South Platte basin are listed in Table 4-11.

Table 4-11. ATM Grant Programs in the South Platte Basin

Northeast Colorado Cooperative	Parker Water & Sanitation District and Colorado State University
The Lower Arkansas Valley Super Ditch Company	Colorado Corn Growers Association Second Grant
Colorado Corn Growers Association (CCGA)	Farmers Reservoir & Irrigation Company (FRICO)
Ducks Unlimited and Aurora	East Cherry Creek Valley Water and Sanitation
Colorado Water Innovation Cluster	Colorado Water Institute-CSU
Parker Water & Sanitation District	

The findings of these programs suggest that combinations of ISAs, shared water banking and fallowing are likely to find success in Colorado. ISAs and rotational fallowing appear particularly suited to areas in the lower South Platte Basin where there is extensive irrigated land and less pressure from urbanized development. Shared water banking may be viable at the interfaces of urban and rural areas as the FRICO study has indicated. At some scale, ISA, rotational fallowing and/or shared water banking or other practices may allow some irrigated lands to remain in agricultural production in these areas and to provide a valuable open space buffer area between developments.

Through these projects, an emphasis has been placed on finding solutions to overcome barriers that complicate or preclude the development of ATM projects. One major impediment to ATM success is the potentially high transaction costs associated with water court processes including engineering and legal fees. Current law in Colorado allows certain types of ATM projects such as ISAs but limits leasing to no more than 3 out of 10 years. Municipalities are generally reluctant to make significant expenditures for water supplies that are not guaranteed in the long term. At an IBCC ATM subcommittee meeting on February 21, 2012, there was interest in the continued exploration of using conservation easements coupled with interruptible water supply agreements as a mechanism to provide certainty for municipal dry-year or drought recovery supplies while ensuring that the lands stay in agricultural production in perpetuity. In line with the CWCB, the ATM subcommittee has indicated that certainty of water supply for municipalities, infrastructure/storage and economics and finance are all critical issues that must be dealt with regarding ATMs.

As identified by CWCB, the ATM subcommittee and the sponsors of the grant-funded projects, some specific areas where water court processes could be streamlined and transaction costs could be lowered are as follows:

- 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[14]

In the CWCB's 2012 Projects Bill, there is a request for $1 million to continue the grant program. While some projects may further address the barriers identified above, it is hoped that pilot projects will be developed to test some of the concepts that have been developed to date.

4.3.4 In-Basin Identified Projects and Processes

There are numerous in-basin projects identified in the South Platte including:

- The Chatfield Reallocation Project will supply multiple providers in the South Platte Basin

- The NISP, applied for by the Northern Colorado Water Conservancy District acting on behalf of numerous participating water providers and presently undergoing NEPA review, will contribute to meeting the future needs of Northern South Platte M&I users

- The Halligan Reservoir Enlargement Project will be used by the City of Fort Collins to increase its firm yield and storage reserve

- Greeley's Milton Seaman Reservoir enlargement project will store change irrigation water rights as well as water stored under the reservoir's priorities. Fully consumptive use water from the project will be reused for non-potable purposes

- Arvada will utilize a single impoundment or series of lakes created by the evacuation of gravel

[14] Colorado's Water Supply Future: Alternative Agricultural Water Transfer Methods

Table 4-12. South Platte and Metro Provider's In-Basin IPPs

Basin	Providers	Project	Estimated Yield (AFY)	Estimated Completion Date
Metro	City of Brighton	Westminster Agreement	2,000	
Metro	City of Thornton	Thornton Northern Project	13,500	2030
Metro	City of Northglenn	New Storage Projects	1,500	
Metro	Westminster	Westminster Gravel Storage		
Metro	Town of Castle Rock	ASR Pilot Phase Storage		
Metro	Town of Castle Rock	ASR Future Storage		
Metro	Denver Water	Chatfield Pump Station	3,000	
Metro	Denver Water	South Platte Protection Plan		
Metro	Arvada	Highway 93 Lakes	500	2020
Metro	Parker WSD, Town of Castle Rock, Castle Pines North, Stonegate	Rueter Hess Reservoir Enlargement	14,810	Completed
Metro	ECCV	ECCV Northern Expansion	12,700[1]	
Metro	ACWWA, SMWSA	ACWWA Flow Project	4,400	
South Platte	Various Participants	Northern Integrated Supply Project	40,000	2023
South Platte	Longmont	Union Reservoir Enlargement	1,770	
South Platte	Various Participants	Chatfield Reservoir Storage Reallocation Project	8,500	2024
South Platte	City of Greeley	Milton Seaman Reservoir Enlargement	6,600	2035
South Platte	City of Fort Collins	Halligan Reservoir Enlargement	7000	
		TOTAL	116,280	

[1]3,300 AF of this project is firm yield, 9,400 average yield

4.3.5 Transbasin - Identified Projects and Processes

The Windy Gap Firming Project, applied for by the Northern Colorado Water Conservancy District acting on behalf of numerous participating water providers, is presently undergoing NEPA review, and will contribute to meeting the future needs of Northern South Platte M&I users.

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

Aurora is also planning Box Creek reservoir in Lake County which would utilize existing exchanges, involving no new water rights. The Box Creek project is in the initial permitting process and partnership discussions are on-going.

Denver Water and Arvada have partnered for the Moffat Collection System project. Denver Water is also planning for the Upper Colorado Cooperative Project to meet apart of their future needs.

Table 4-13. South Platte and Metro Provider's Transbasin IPPs

Basin	Providers	Project	Estimated Yield (AFY)	Estimated Completion Date
South Platte	Various Participants	Windy Gap Firming Project	30,000	2020
Metro	Aurora	Eagle River MOU	10,000[1]	2030
Metro	Aurora	Box Creek Reservoir		2030
Metro	Denver Water, Arvada	Moffat Collection System Project	18,000	2021
Metro	Denver Water	Upper Colorado Cooperative Project		
		TOTAL	58,000	

[1] Total Project estimated yield is 30,000 AF. Aurora and Colorado Springs will receive an average annual yield of 10,000 AF and while west slope partners (Eagle River WSD, and Upper Eagle Regional Water Authority) will receive annual firm yield of 10,000 AF.

4.3.6 Environmental and Recreational Impacts from M&I Projects and Methods

The implementation of M&I projects and methods, whether represented as IPPs or other projects, increasingly must consider the impacts on other parts of the water system, including environment, recreation, and agriculture. Increased M&I uses can potentially impact flows in streams as well as water quality. Additional diversions can reduce flows in focus areas potentially creating additional or increased areas needing projects or protections to sustain or enhance environmental and recreational attributes. M&I growth into existing supplies, including the perfection of conditional water rights, has the possibility of reducing streamflows in various locations throughout the basin. Additional storage in the Basin could also potentially impact streamflows, as well as impact other wildlife habitat due to disturbances of that habitat. These projects could also benefit environmental and recreational attributes, if cooperative operational agreements can be put into place.

Increased conservation measures in the South Platte Basin can result in reduced return flows at municipal wastewater treatment plant outflows. These reduced return flows can impact the streamflows and water quality below the outfall. Decreased return flows can concentrate the levels of contaminants in the water including emerging contaminants which are not currently regulated, such as pharmaceuticals. These potential impacts on environmental and recreational attributes should be considered when considering more aggressive water conservation measures. A framework for assessing the potential impacts of increased conservation measures on environmental and recreational attributes is described in Appendix D.

Increased reuse in the South Platte Basin can result in reduced return flows at municipal wastewater treatment plant outflows. Similar to the impacts discussed when addressing the increased conservation measures, reduced return flows from M&I uses or reuse can impact the streamflows and water quality below the outfall. Decreased return flows can concentrate the levels of contaminants in the water including emerging contaminants which are not currently regulated, such as pharmaceuticals.

These potential impacts on environmental and recreational attributes should be considered when considering M&I projects. A framework for assessing the potential impacts of these projects on environmental and recreational attributes is described in Appendix D.

4.4 Agricultural Projects and Methods

M&I providers have identified projects and processes described above to help meet their future water needs, but will not be able to meet the gap even if success is 100 percent. In addition, many of these projects are in the federal permitting process with no guarantee of success. If these projects and new Colorado River supply projects are not successful, future water demand will have to be mostly met through a combination of permanent agricultural transfers, reuse and conservation.

Traditionally, M&I providers in the basin have acquired agricultural rights through agricultural transfers resulting in the dry-up of irrigated land. As this method may play a role in addressing the M&I water supply gap, there are negative economic and environmental impacts associated with the buy and dry method. It is understood that some level of traditional agricultural transfers may take place as urban areas expand into irrigated agricultural land. However, due to agriculture being a large contributor to the South Platte Basin's economic value, these types of agricultural transfers should be minimized.

The following are critical to maintain a healthy agricultural economy in Colorado: the success of IPPs, new storage and infrastructure, multipurpose projects, M&I conservation, and new Colorado River supply projects. ATMs are also being explored as an alternative to buy and dry.

4.4.1 Agricultural Specific Projects and Multipurpose Projects Benefitting Agriculture

A signification reduction in the yield from projects and processes identified will likely lead to much greater increases in agricultural transfers as a means to meet future demands. For a sustainable agricultural economy in the South Platte Basin, the success of provider-specified IPPs is critical. Municipal conservation should also continue to be aggressively pursued. Planned agricultural specific and multipurpose projects will help lessen the potential for additional buy and dry.

Agricultural and multipurpose projects will most likely involve new Colorado River supplies due to the limited amount of unappropriated water within the South Platte Basin. Without the development of new Colorado River supplies, agricultural transfers will continue to be the primary method for meeting future municipal demand.

Furthermore, additional agricultural surface storage projects, such as the Chatfield Reallocation Project described in Section 4.6.1, will provide a degree of operational flexibility and significant water supply volumes that cannot be provided by other management actions. New storage would allow agricultural users to capture wet year flows and store them as drought reserve. Future work should include the identification of the location of storage facilities that would best benefit agricultural producers.

4.4.2 Environmental and Recreational Impacts and Benefits from Agricultural Projects

Environmental and recreational attributes are closely tied to agricultural uses. Reductions in irrigated agricultural production can result in decreases in streamflows and reduction in wildlife habitat.

4.4.2.1 AGRICULTURAL DRY-UP

The traditional “buy and dry” method entails the permanent dry-up of irrigated acres which can adversely impact environmental and recreational attributes in the South Platte Basin. Dry-up can result in a net reduction in return flows to the stream impacting environmental and recreational attributes. While agricultural transfers are required to replace historical return flows in place, time and amount, this is typically only required during the time when there is a call from a downstream senior water right. During free river conditions, historical return flows often do not need to be maintained. In addition, historical return flows do not need to be replaced in the same location as historical return flows when the calling water right does not originate within the historical return flow reach. Whenever the historical return flows are not replaced, the stream reach downstream of the historical point of accretion is no longer conveying the same return flows that occurred historically, resulting in a reduction of flow.

The permanent dry-up of agricultural lands also decreases wetland and other wildlife habitat. Irrigated crops serve as a food source for waterfowl and provide habitat for other wildlife. Additionally, small local wetlands adjacent to irrigated fields rely on irrigation runoff. The dry-up of agricultural lands significantly impacts these habitats which are not only important environmental resources, but are also important for recreation. For example, the hunting of water fowl is an important economic and recreational resource in local areas of the South Platte Basin.

4.4.2.2 ALTERNATIVE TRANSFER METHODS

ATMs have the potential to reduce the amount of irrigated acres permanently dried up through the traditional “buy and dry” method. This can reduce the adverse recreational and environmental impacts associated with permanent dry-up. Additionally, mechanisms can be included with ATMs to provide further environmental and recreational protections. For example, agricultural conservation easements can be used to provide further insurance that agricultural lands will remain in production. Off channel regulating reservoirs, needed for some ATMS, may be designed and operated in a manner to provide fishery, habitat, wildlife and recreational benefits.

4.4.2.3 AUGMENTATION/RECHARGE

The augmentation of out-of-priority groundwater pumping has increased since stricter groundwater administration in the South Platte Basin began due to court decisions in 2002. Recharge facilities are increasingly being used in the basin to recharge the underlying alluvial aquifer with augmentation replacement supplies. While additional diversions to recharge can negatively impact streamflows, recharge can be an effective means to maintain instream flows by replacing historical return flows, out-of-priority groundwater pumping depletions, etc. Recharge facilities can also be designed to provide environmental benefits. Ducks Unlimited has partnered with a variety of entities in designing recharge wetlands to serve as recharge facilities and also provide wetland habitat.

Some potential impacts from recharge projects are the reduction in large flows that provide benefits including sandbar scouring and reconnection of slough habitat.

Additional discussion of the impacts of agricultural dry-up on environmental and recreational attributes and focus areas can be found in Appendix C.

4.5 Environmental and Recreational Projects and Methods

For environmental and recreational needs, the CWCB has conducted an outreach effort with the environmental and recreational communities and the basin roundtables to identify environmental and recreational projects and methods similar to the identification of M&I consumptive IPPs. Based upon the methodology briefly described in Sections 2 and 3 and detailed in Appendix D, focus areas that do not have projects or methods can be assessed. A focus area without an associated project and method does not necessarily indicate that the area needs a protective project or method. In addition, the sufficiency of the projects and methods in each reach cannot necessarily be determined from the data or the methodology. Additional work after this draft plan will be needed to assess the sufficiency of the protections in place and the sufficiency of other planned and new projects. Appendix D also describes further work that should be done to address the sufficiency of protections in the focus areas.

4.5.1 Discussion of Methodology

Based on the environmental and recreational needs discussed in Section 2, a methodology was developed to determine where the environmental and recreational needs may have shortages or a "gap" of protection. The environmental and recreational needs in the South Platte basin are summarized in the focus areas that were the result of the work described in Section 2 and in detail in Appendix B.

In order to determine the gap in protections in place to address the environmental and recreational needs, the projects and methods can be analyzed in conjunction with the attributes and focus areas. The methodology used to begin to review the projects and methods is described briefly in Section 3 and in detail in Appendix D.

The total reach length for each attribute within a Focus Area was used to determine the amount of each attribute (length and percent) by Focus Area in the South Platte Basin. These data can provide the existing amount of the attribute in the Focus Area. In addition, the data contains some information regarding the current protections in the Focus Areas, although more information is needed. Analyses to determine where the focus areas, attributes and projects overlap can allow for the possible determination of the amount of potential increase for a given attribute and the potential for future projects and protections.

For example, Focus Area 12 has the descriptive label "all mountain tributaries with greenback cutthroat trout". These tributaries include 122 miles of streams. Greenback cutthroat trout are present in 89 miles (69%) of the Focus Area. Protections in the Focus Area include CWCB instream flow (ISF) protections. There are 56 miles (45%) of the Focus Area protected by CWCB ISF.

The data for each Focus Segment can be used in the future to set more specific measurable goals and outcomes for attributes in the South Platte Basin based on the priorities of the BRT. The data for the occurrence of each attribute by Focus Segment can be used to quantify each attribute. One goal in the South Platte is to maintain the attributes at their present levels and if possible increase the attributes. It is not the intent of the SP-BIP, however, that the Focus Areas take on independent regulatory significance in the context of project permitting efforts. Table 4-14 shows the percent occurrence in the basin by attribute, based upon the data available in the GIS shapefiles.

Table 4-14. South Platte Basin – Percent Occurrence by Attribute

State Endangered, Threatened, and Species of Concern		
	Greenback Cutthroat Trout	5%
	Brassy Minnow	47%
	Common Shiner	27%
	Iowa Darter	47%
	Lake Chub	3%
	Northern Redbelly Dace	14%
	Plains Orangethroat Darter	8%
	Plains Minnow	7%
	Suckermouth Minnow	8%
	Stonecat	8%
	Boreal Toad	4%
	Bald Eagle Active Nest Sites	3%
	River Otter Confirmed Sightings	2%
	Yellow Mud Turtle	2%
	Common Garter Snake	10%
	Preble's Meadow Jumping Mouse	53%
	Northern Leopard Frog	19%
	Northern Cricket Frog	4%
	Plains Leopard Frog	3%
	Wood Frog	1%
Rare Plants and Significant Plant Communities		
	Rare Plants	20%
	Significant Plant Communities	49%
Special Value Waters		
	Colorado Outstanding Waters	5%
	Eligible/Suitable Wild and Scenic	12%
	CWCB Instream Flow Water Rights	27%
	CWCB Natural Lake Level Water Rights	4%
	Wilderness Area Waters	6%
Whitewater and Flatwater Boating		
	Whitewater Boating	20%
	Flatwater Boating	1%
	Recreational In-Channel Diversion Structures	0%
Important Cold and Warm-Water Fishing		
	Gold Medal Streams and Lakes	4%
	River and Stream Fishing	21%
	Reservoir and Lake Fishing	2%
Waterfowl Hunting/Viewing		
	Audubon Important Bird Areas	3%
	Waterfowl Hunting/Viewing Parcels	14%
	Ducks Unlimited Projects	20%
High Recreation Areas		
	High Recreation Corridors	4%

4.5.2 General Projects

There are various types of projects which protect or enhance environmental and recreational attributes. These projects include CWCB instream flows, channel restoration, stewardship, species re-introductions, and cooperative or multi-purpose projects.

4.5.2.1 INSTREAM FLOWS AND LAKE LEVEL WATER RIGHTS

Instream flow water rights and lake level water rights can only be held by the CWCB. These water rights allow for the CWCB to hold a water right for a specific amount of instream flow within a specified reach or a specified lake level to assist in protecting the environment. An ISF water right is a relatively junior water right that can call for water to benefit instream flows within a specified reach. However, instream flow water rights can also be donated to the CWCB and converted for instream flow use. The Colorado Water Trust is a non-profit organization that raises funds to buy water rights in identified reaches with needed flows that can be changed in water court and donated to the CWCB for instream flow purposes. The presence of an instream flow right in a reach does not guarantee streamflows, however, and does not necessarily translate into adequate protection in the reach.

4.5.2.2 CHANNEL RESTORATION

Channel restoration projects can benefit both in-stream aquatic habitat and species as well as riparian species such as wetlands and significant plant communities. In addition stream restoration can also benefit recreational uses such as fishing, flatwater boating, and kayaking. Channel restoration projects can also help to improve water quality in certain areas.

4.5.2.3 STEWARDSHIP PROJECTS

Stewardship projects have protections that include areas near stream riparian areas and protect stream attributes for multiple uses. Examples of stewardship projects include areas protected by federal or state agencies, landowner agreements, and non-governmental organizations (NGOs). These protections cover multiple attributes in the areas where they are in place.

During the SWSI 2010 process, CWCB incorporated data from the Southwest Regional Gap Analysis Project (SRGAP) 315, coordinated by USGS into the projects and methods database. The SRGAP created GIS data layers of land cover, native terrestrial vertebrate species, land stewardship, and management status values. The management status values quantify the relationship between land management and biodiversity throughout the state of Colorado. The four management status values are described in detail in Appendix D.

4.5.2.4 SPECIES REINTRODUCTION

Species reintroduction projects allow for species to be reintroduced to habitat areas where their numbers may have declined. At times additional projects are needed to ensure protection along with species reintroduction projects. Examples of species reintroductions in the South Platte Basin include reintroductions of the Boreal toad, cutthroat trout, and plains fish species.

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[15] United States Geological Survey. 2010. Southwest Regional Gap Analysis Project. http://fwsnmcfwru.nmsu.edu/swregap/Stewardship/Categorization.htm

4.5.2.5 COOPERATIVE AND MULTI-PURPOSE PROJECTS

There are various other types of projects that can assist in protecting or enhancing environmental and recreational attributes. Many of these projects include multipurpose projects and partnerships which can assist in the cooperative operation and construction of projects. Project proponents of M&I projects and new Colorado River supply projects can work with environmental and recreational interests to potentially identify additional funding sources to construct projects that enhance attributes in the project area. Irrigation of agricultural lands and return flows from such irrigation often provide habitat or streamflows that can benefit environmental and recreational uses. Opportunities also exist for cooperative operation, optimization and enhancement of infrastructure to assist in enhancing environmental and recreational attributes. Some examples of cooperative or multi-purpose projects include:

- Recharge projects which provide wetland areas and wildlife habitat, specifically various Ducks Unlimited programs throughout the basin.
- Environmental or recreational pools or cooperative agreements with respect to storage reservoirs, providing streamflows that enhance or protect recreational or environmental instream flow needs.
- Diversion structure modification to continue operations benefiting the consumptive use, while maintaining flows or connectivity for environmental and recreational attributes near the diversion structure.

4.5.2.6 SUFFICIENCY OF PROJECTS

The sufficiency of the protections for many projects is unknown. The protection for a specific project and the attribute targeted is not included in either the GIS database or MS Access database. It appears from the previous work on SWSI 2010 and recent work completed by the CWCB contractors that the terms “projects” and “protections” were considered synonymous. If a project is present in a Focus Area then it is assumed that a protection was in place. An example of this is the attribute of CWCB instream flow, which can also be considered a protection. The sufficiency of the protection from the ISF is directly related to whether it can protect the streamflows during times of low flow. If there are water rights on the same stream reach that are senior to the ISF, they may legally reduce flow below the specified minimum and therefore the ISF would not result in a physical protection of flows. Evaluation of these types of protections requires an analysis of streamflows at specific locations in the focus area. The analysis of the sufficiency of the protection could be done in specific reaches with significant additional resources, but cannot currently be determined with the existing data.

4.5.3 Project Examples

The proposed methodology was applied in a limited manner to determine example projects in each geographic area to illustrate how the attributes (or categories) and projects can meet the over-arching environmental and recreational goals. Additional discussion of the project examples is included in Appendix D.

The following sections include examples demonstrating a range of projects that have the potential to maintain or enhance environmental and recreational attributes in the candidate focus areas. Some of the data needed for a complete analysis and evaluation are missing; however, professional judgment was used to review some of the examples to illustrate the process for environmental and recreational benefits.

Additional examples will be analyzed in the future with specific direction from the subcommittee and BRTs.

4.5.3.1 HEADWATER AREAS (UPPER MOUNTAIN AREA)

There are seven Focus Areas in Park County as shown in Figure 4-4. The rationale for inclusion of many of these Focus Areas is the presence of significant, imperiled and rare/wetland plant species and plant communities. These plant communities are the result of the natural stream systems in the area, topography, and geology. There are also areas with recreational attributes including boating, fishing and Gold Medal fisheries. There are a total of 325 miles of the South Platte Basin with the rare plant communities attribute present and a total of 156 miles in the Park County Focus Areas. Projects including CPW, CWCB, NCNA interviewed, stewardship, and ISF in Park County are present in most of the Park County Focus Areas, however the sufficiency of these projects for protecting the attributes has not been assessed.

These projects may provide protection for the rare plants and significant plant communities attributes in the following ways. Future projects that can provide protections to these plant communities include maintaining the hydrologic conditions that formed and support these plant communities. These protections include continued irrigation on parcels where the plant communities may be irrigation-dependent due to lowering groundwater tables in the area and maintaining the natural surface water – groundwater interactions where those natural characteristics protect the plant communities. These types of projects can also provide benefit to recreational uses in the area, including fishing and boating.

Some examples of current projects that currently provide some protections to these plant communities include stewardship programs in the area, instream flow water rights, stream restoration projects (including Lower Tarryall Creek, Middle Fork at Buffalo Peaks State Wildlife Area, and Five-Mile Creek), and the South Platte Protection Plan. There are other similar planned projects in the area.

These types of projects address the goals of maintaining and enhancing important wetland and riparian plant communities. Figure 4-4 shows the environmental and recreational focus areas and locations of the rare aquatic-dependent plants in Park County.

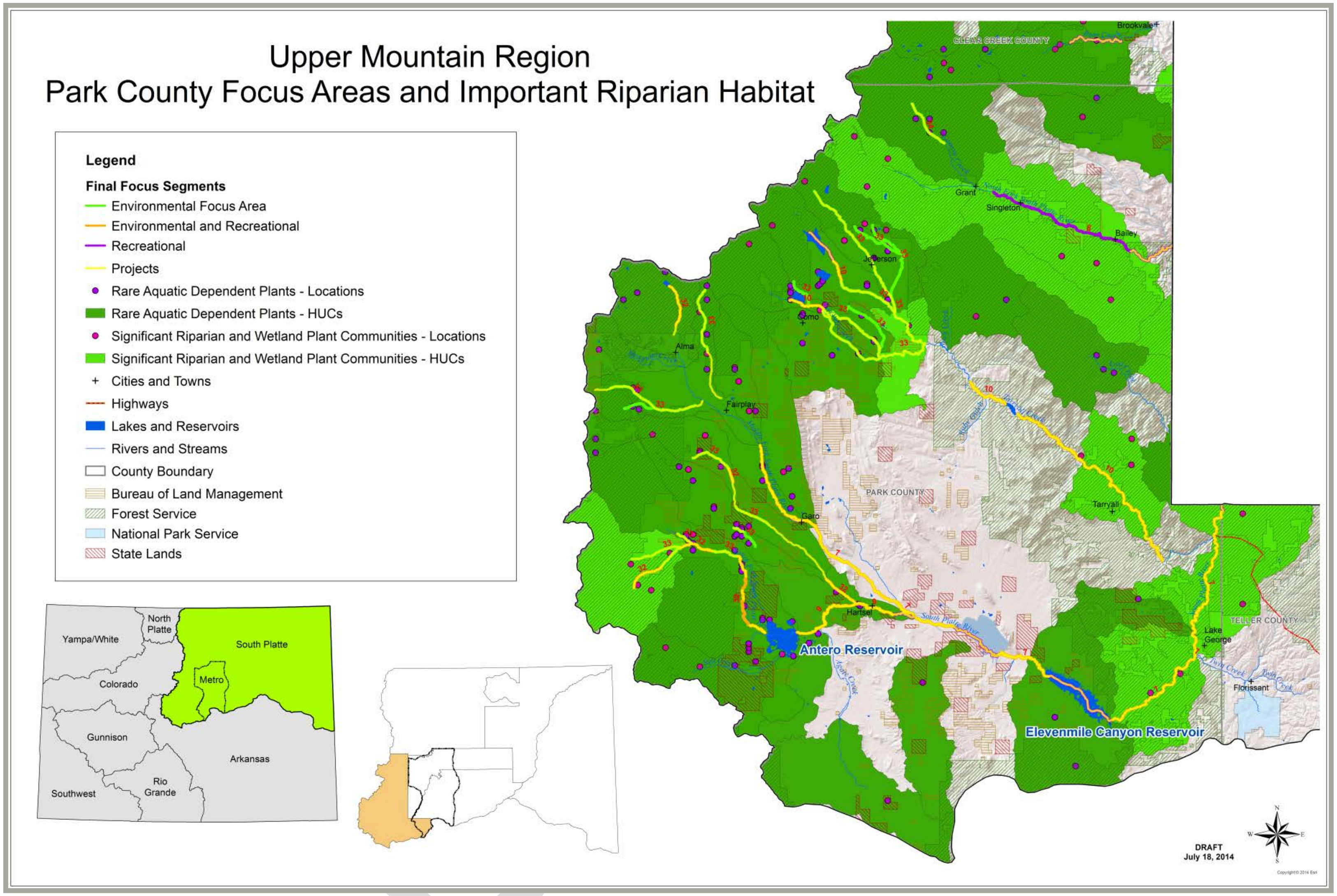

Figure 4-4. Park County Important Riparian Habitat

4.5.3.2 METRO CORRIDOR

There are several projects in the Metro Corridor that focus on the Metro Denver Greenways. These projects range from recreational and riparian improvements along the South Platte to flow protection with Chatfield Reallocation. Specific projects from the GIS data include Chatfield Reallocation Program, expansion/enhancement to Confluence Park, recreational and riparian improvements along the South Platte, River North Greenway Master Plan, River South Greenway Master Plan, and Westerly Creek Greenway Master Plan.

The projects listed above account for a total of approximately 15 miles in the Metro Corridor with restoration programs out of a total of approximately 23 miles in the South Denver Metro Corridor Focus Area. These types of projects provide protections for multiple attributes including riparian plant communities, recreation, and fishing. These projects also directly address the recreational goals of the plan as well as water quality concerns along the Metro Corridor.

Some specific examples of these types of projects include:

- The Big Dry Creek Greenway Project which included creek corridor clean up and bank stabilization, habitat rehabilitation, access to parks as well as wetland and riparian forest enhancements. The project does not specifically state which attributes would be the focal point of the project, however, attributes such as rare aquatic dependent plants, fishing and recreational corridors would likely benefit.

- Stream habitat work at the Carson Nature Center, which helps to improve riparian conditions. This project enhances plant, fish and wildlife attributes, as well as greenway usage along the stream corridor.

Figure 4-5 shows the environmental and recreational focus areas and locations of the rare aquatic-dependent plant, fishing and recreational corridors in the Metro Corridor.

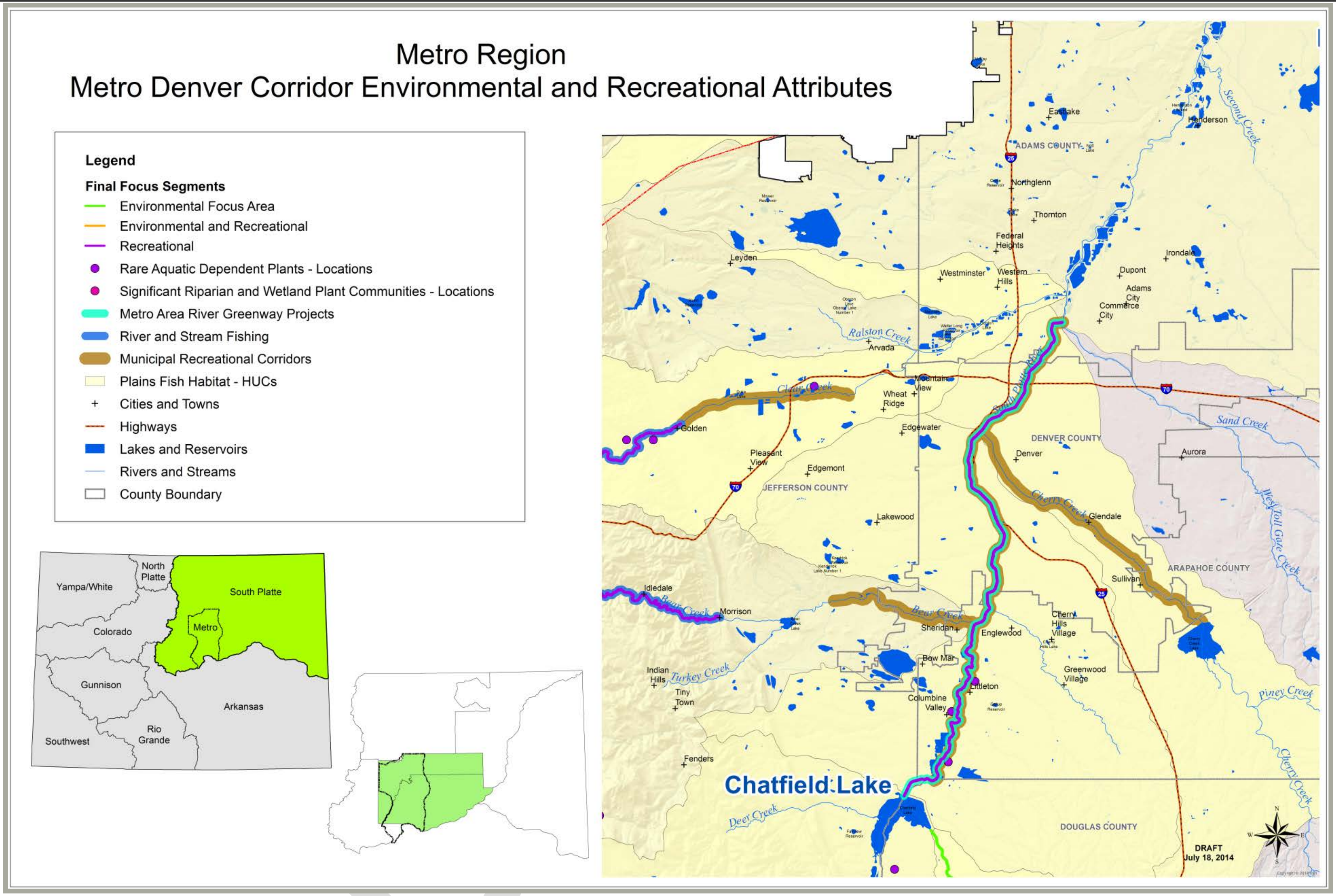

Figure 4-5. South Platte Metro Corridor Environmental and Recreational Enhancements

4.5.3.3 BOULDER/FORT COLLINS (NORTHERN AREA)

An example project that includes protection to both environmental and recreational attributes is the diversion structure modification project in the Cache La Poudre River from near the mouth of Poudre Canyon to the eastern edge of Fort Collins. Several individual projects are planned or ongoing to modify existing diversion structures in this section of river for fish passage. Some projects are removing structures that are no longer needed for diversion. Each structure modified provides additional miles of continuous aquatic habitat or recreational opportunities. The modification of the structures provides the opportunity for native non-game species, to have continuous habitat connectivity. While these individual projects may open several miles of the river, other structures are still present and could be modified in the future. Many of these species are on the state threatened and endangered list. The continuous habitat provides additional protection for these attributes. In addition, the removal of structures and some modifications provide additional flat water boating opportunities in the urban corridor of the river. These projects directly address both environmental and recreational goals.

Some examples of these projects throughout the basin include the Green Ditch on Boulder Creek and the Josh Ames Ditch on the Cache la Poudre River.

Figure 4-6 shows the environmental and recreational focus areas and locations of the rare fish habitat, and recreational boating areas in the Northern portions of the South Platte Basin. The data to evaluate the function of each structure in terms of fish or recreational passage is not in the current database and is beyond the scope of this BIP.

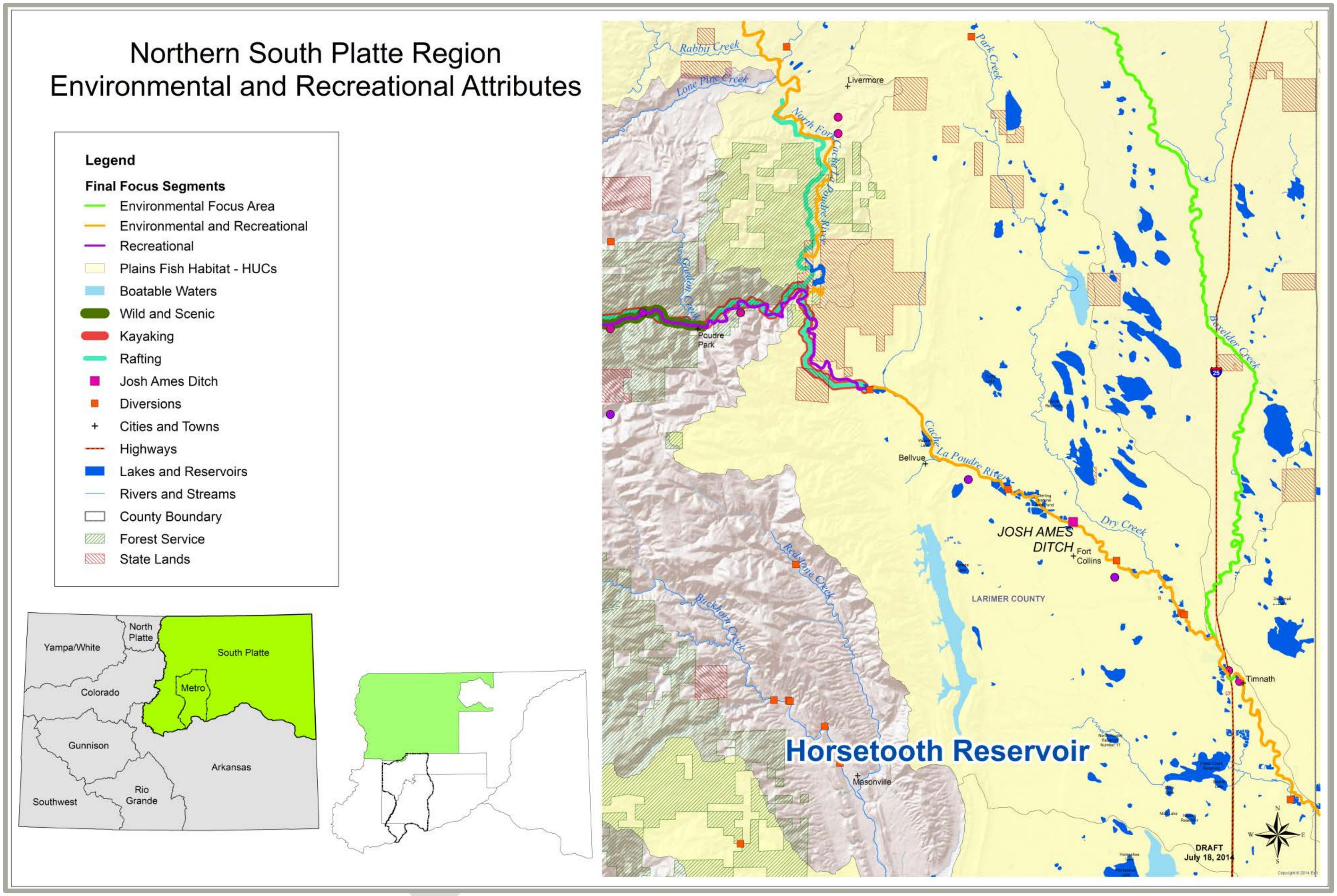

Figure 4-6. South Platte Northern Environmental and Recreational Enhancements

4.5.3.4 PLAINS (LOWER SOUTH PLATTE)

There are various example projects in the lower South Platte, including recharge projects, reservoirs and a species reintroduction project. The Colorado Parks and Wildlife (CPW) Tamarack recharge project retimes water flows that occur during high flow periods to times when flows are needed to meet Colorado's requirements under the Three States Agreement for the Platte River Recovery and Implementation Program (PRRIP). The (PRRIP) allows for water users within Colorado to continue to develop new supplies while still meeting the needs of downstream federally listed endangered species. The Ducks Unlimited recharge projects throughout the area cooperatively provide replacement water to wells in augmentation plans while also providing wildlife habitat and recharge flows that can benefit environmental and recreational needs. These and various other recharge projects in the region have the potential to increase wetland habitat and streamflows in the area. The Ducks Unlimited projects are currently indicated in the available data to affect the stream reaches in approximately 161 miles of the 212 miles present in the focus area in this region.[16] Julesburg Reservoir and North Sterling Reservoir are examples of water supply reservoirs for agricultural users on the lower South Platte River that also provide flatwater boating and waterfowl hunting and viewing.

The plains fish reintroduction project in the lower South Platte reintroduces several species, including common shiner, brassy minnow, plains minnow and suckermouth minnow to the lower South Platte where they are not currently present. These species are all on the state threatened and endangered species list. The common shiner is currently present in 19 miles out of the total 212 miles in the lower South Platte focus area. Plains minnow is currently present in 61 miles out of 212 miles. This project is intended to increase the amount of area with these species. The plains fish reintroduction is listed in 172 miles of the focus areas.

The reintroduction project alone may not fully protect the species. Additional protections could be provided by addressing the habitat fragmentation caused by diversion structures and dry-up points (Figure 4-7). These types of physical features can limit the amount of habitat available to plains fish species. These fish species require contiguous, year round habitat to complete their life cycle. Features that prevent fish movement disrupt their life cycle and can result in lower population sizes. Possible projects that could address the habitat fragmentation include cooperatively coordinated fish passageways and other structural solutions including storage and recharge to limit the number of days of dry-up on the river.

The recharge projects, including the Ducks Unlimited Projects, directly address the goal for enhancing water bird and waterfowl viewing and hunting. The various reservoirs throughout the area directly address flatwater boating goals and indirectly address wildlife habitat and waterfowl viewing and hunting goals. The plains fish reintroduction project directly addresses the environmental goal for state threatened and endangered species.

Figure 4-7 shows the focus areas and locations of the DU projects, recharge sites, reservoirs, rare fish habitat, dry-up points and diversion structures in the Lower South Platte Basin. The data to specifically evaluate the hydrology and tradeoffs for environmental flows, recreational uses and wildlife habitat is not currently available within the existing databases. The evaluation of the hydrology is not currently in the

[16] The Ducks Unlimited Project data is indicated as being present in the entire HUC. This highlights the stream reach associated with that HUC. The actual project may affect fewer stream miles based on location of the project within the HUC and other hydrological operations in the area. The project may also affect more stream miles due to the increased streamflows downstream of the recharge project.

scope of this BIP. Additional work could be undertaken in the future in priority focus areas to determine the hydrology and potential possible impacts and benefits, if such data is available. Additional analyses may assist in future decisions regarding tradeoffs in managing this area which has historically been highly managed and modified from natural flows. Additional analysis may allow for consideration of tradeoffs including costs, engineering, feasibility, and water rights administration of such projects. The methodology described in Appendix D can be used to assess where projects may benefit attributes in the future.

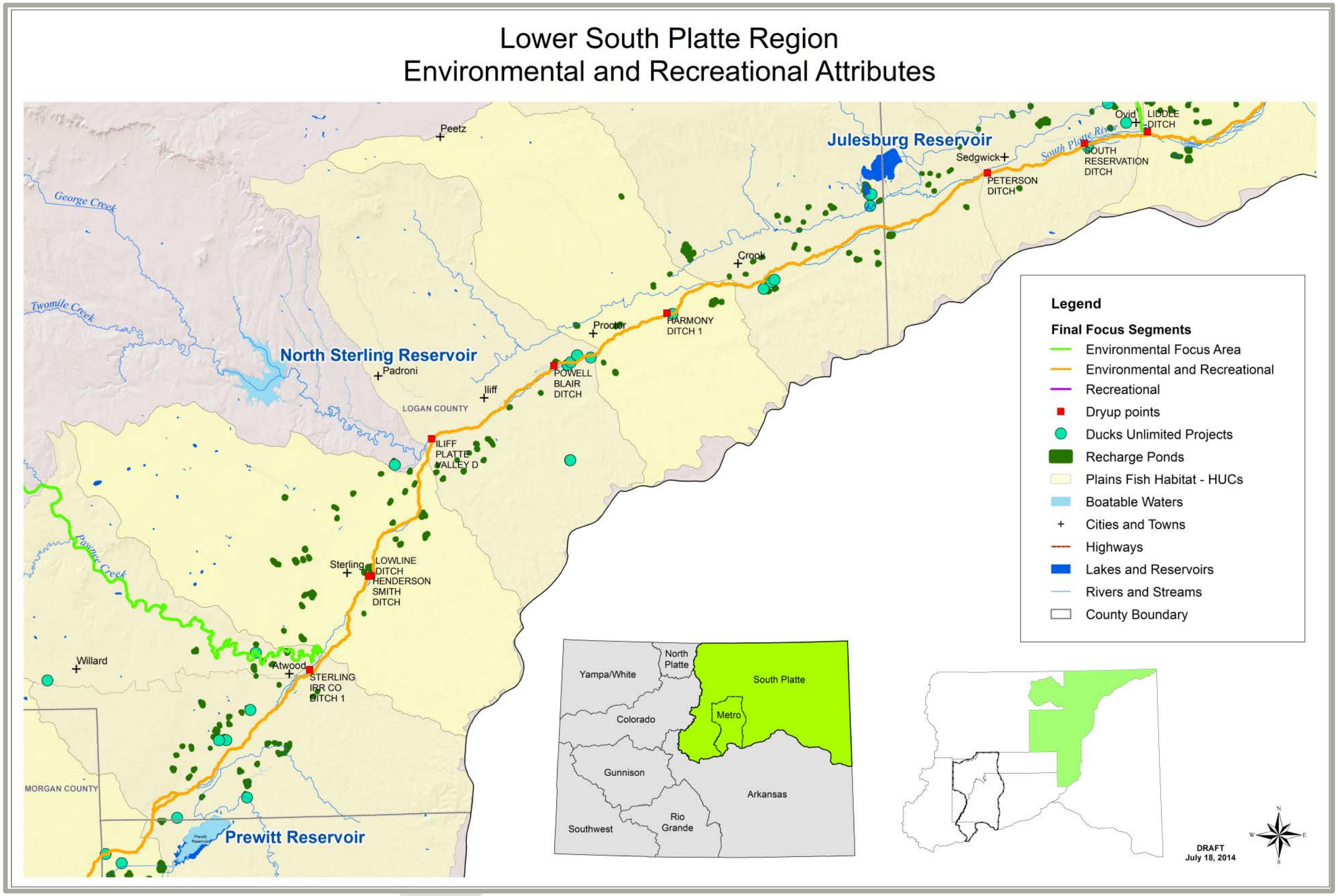

Figure 4-7. Lower South Platte Plains Fish Habitat

4.5.4 Environmental and Recreational Projects List

The existing projects in the South Platte Basin are included in Appendix D. Some refinements to the projects list were included, although more refinements to the list and specificity of the projects are needed.

4.5.5 Additional Analyses Needed

The examples given above and the IPPS discussed above indicate some projects that may provide protections to environmental and recreational attributes. In addition to the presence or absence of protections in focus areas, various other items can impact the shortage or gap for environmental and recreational needs. Changes in river conditions due to climate change or increased uses in the basin could result in reduced streamflows and further impair wildlife habitat. The trend of irrigated agricultural lands being dried up can impact the amount and location of environmental and recreational needs in the Basin. These trends and conditions can be further analyzed with the framework discussed in this section. Additional analyses to determine these impacts may be performed in the next phase of the BIP.

4.6 New Multipurpose, Cooperative, and Regional Projects and Methods

4.6.1 Overview of Multipurpose Projects in the Basin

Cooperative, multipurpose projects provide benefits to more than one type of water user in the basin and can benefit diverse water needs including one or more of the following: municipal, industrial, agricultural, recreational and environmental.

The Chatfield Reservoir Reallocation project provides an example of a multipurpose project that is currently under federal review in the South Platte Basin. Chatfield Reservoir, located south- west of the Denver Metropolitan area on the South Platte River, was built by the United States Army Corps of Engineers (Corps) in 1965 to provide the Denver Metro area protection from 100-year flood events. Denver Water is currently the only entity with rights to store water in Chatfield Reservoir, per their 1979 agreement with the Corps. In 1994 fifteen water providers and other interested parties began investigating the possibility to store additional water in the reservoir. In 1989, the Corps found that additional water could be stored in Chatfield without compromising the original flood control purpose or requiring modification to the dam structure. If approved, the Chatfield Reallocation would allow for an additional 20,600 acre-feet of water to be stored for municipal, agricultural and environmental needs.

Chatfield project proponents and collaborators include municipalities, agricultural producers, environmental groups, and recreational users. Member agencies of SMWSA would use their allocation of Chatfield storage to increase existing surface water supplies and decrease reliance on the nonrenewable Denver Basin aquifer. Agricultural users, such as Central Colorado Water Conservancy District, would use Chatfield to store water high in the basin to be strategically released for use in the agricultural community of Weld County. Environmental groups in Colorado are also strong proponents and cooperators in the Chatfield Reallocation Project. The Colorado Environmental Coalition, Greenway Foundation, Sierra Club and Trout Unlimited have documented their support for the project due to anticipated recreational and environmental benefits in downstream reaches of the South Platte River due to strategic releases of stored water.

Although the Chatfield Reallocation Project has received widespread support from the basin, it has been in the development and permitting process for over 19 years. The project must meet both Federal and state permitting requirements to be implemented. The Chatfield Reallocation Project has received approval from the State of Colorado for its Fish and Wildlife Mitigation Plan and is now in the final stages of the NEPA permitting process. The lengthy process for the reallocation of Chatfield Reservoir is due to changes proposed at a federal facility, mitigation necessary for endangered species and wetlands as well as the recreational mitigation that is necessary for higher anticipated water levels. The Final Environmental Impact Statement and the approved Fish and Wildlife Mitigation Plan include requirements for the project to construct recreational facilities, relocate roads and other facilities, and mitigate for environmental factors such as endangered species habitat and wetlands that will be impacted by rising water levels. On June 1, 2014 the U.S. Army Corps of Engineers issued a record of decision (ROD) authorizing this project.

Multipurpose projects have the potential to benefit many water supply needs including municipal, agricultural, industrial, environmental and recreational. Projects like the Chatfield Reservoir Reallocation can serve as an example of the challenges that should be considered prior to pursuing a multipurpose project. Considerations for multipurpose projects should include:

- Available water supply
- Federal, state and local permitting requirements and anticipated schedule for approval
- Financing challenges
- Local and political support or opposition
- Upcoming legislation that can potentially add additional requirements or increase the permitting schedule

4.6.2 Environmental and Recreational Impacts and Benefits from Multi-Purpose Projects

Multipurpose projects can address consumptive and environmental and/or recreational needs within the South Platte Basin. Cooperative multi-purpose projects can help to maintain and enhance environmental and recreational attributes. Some examples of multipurpose projects that can address various types of environmental or recreational needs while maintaining the benefit of the consumptive use include:

- **Diversion repair work for damage during September 2013 floods:** Incorporation of fish passage capability into the rebuilt structures provide connectivity of habitats that are important to plains fish species with fragmented habitats. These species life cycle include downstream drift of larval life stages and the upstream movement of older life stages.

- **Coordinated reservoir releases for multiple uses:** Reservoir operations with the ability to coordinate releases for downstream users with environmental and recreational needs can provide multiple benefits. An example of this type of release is the Joint operation release from the upper Cache La Poudre River that benefits winter fish habitat and provides water supply at the mouth of Poudre Canyon.

- **Recharge Projects benefiting multiple uses:** Other types of projects include irrigated lands or recharge projects that have wetland and riparian habitats associated with the irrigated lands or recharge areas. These areas provide benefits to riparian vegetation and wetland species (plant and animal). Ducks Unlimited has partnered with agricultural users to allow the recharge from recharge ponds to be used in augmentation plans, while creating the recharge ponds in such a way as to benefit wildlife habitat.

These are just a few examples of multipurpose projects. Conservation easements are another type of project that can be operated cooperatively. A framework for assessing the potential impacts of these projects on environmental and recreational attributes is described in Appendix E.

4.7 Net Gap Analysis

Water providers and other entities in the South Platte and Metro Basins are pursuing projects and methods in order to meet the projected gross gap as defined in Section 2. The net gap is defined by the estimated remaining gap after projects and methods have been implemented in the basin.

4.7.1 M&I and SSI

To meet the gross gap between projected M&I and SSI water demands and existing supplies, water providers throughout the South Platte and Metro Basin are pursuing water supply projects and planning processes as discussed in Section 4.3. If successfully implemented, these IPPs have the ability to meet some, but not all, of the South Platte and Metro Basin's 2050 M&I and SSI water needs.

The calculated net gap does not necessarily represent a future water supply shortage, but the net gap does demonstrate where additional work is needed to identify projects and methods to meet those future needs.

The full net gap analysis includes nine total gap scenarios based on low, medium, and high M&I demands and three IPP yield scenarios: 100 percent success rate, a medium success rate (60% success rate), and a low success rate (50% and 40% for the Metro and South Platte Basins, respectively). The medium and low IPP success rates are based on the IBCC's Alternative Portfolio and Status Quo success rates summarized in SWSI 2010. The percentage success rates for IPP yield for the net low, medium, and high scenarios are presented in Table 4-15.

Table 4-15. IPP Success Rates for Net Low, Medium, High Gap Scenarios

Basin	High Success	Medium Success	Low Success
Metro Basin	100%	60%	50%
South Platte Basin	100%	60%	40%

Presented in this report is the medium net gap scenario, which uses the medium demand scenario and an IPP yield success rate of 60 percent (highlighted in blue in Table 4-15), to account for the future uncertainty in long-range population, demand, and water supply forecasting. M&I and SSI net gap analyses, performed on a countywide basis, were aggregated to a regional subbasin level for presentation in this report and for consistency with SWSI 2010. These regional subbasins are defined in Figure 4-8.

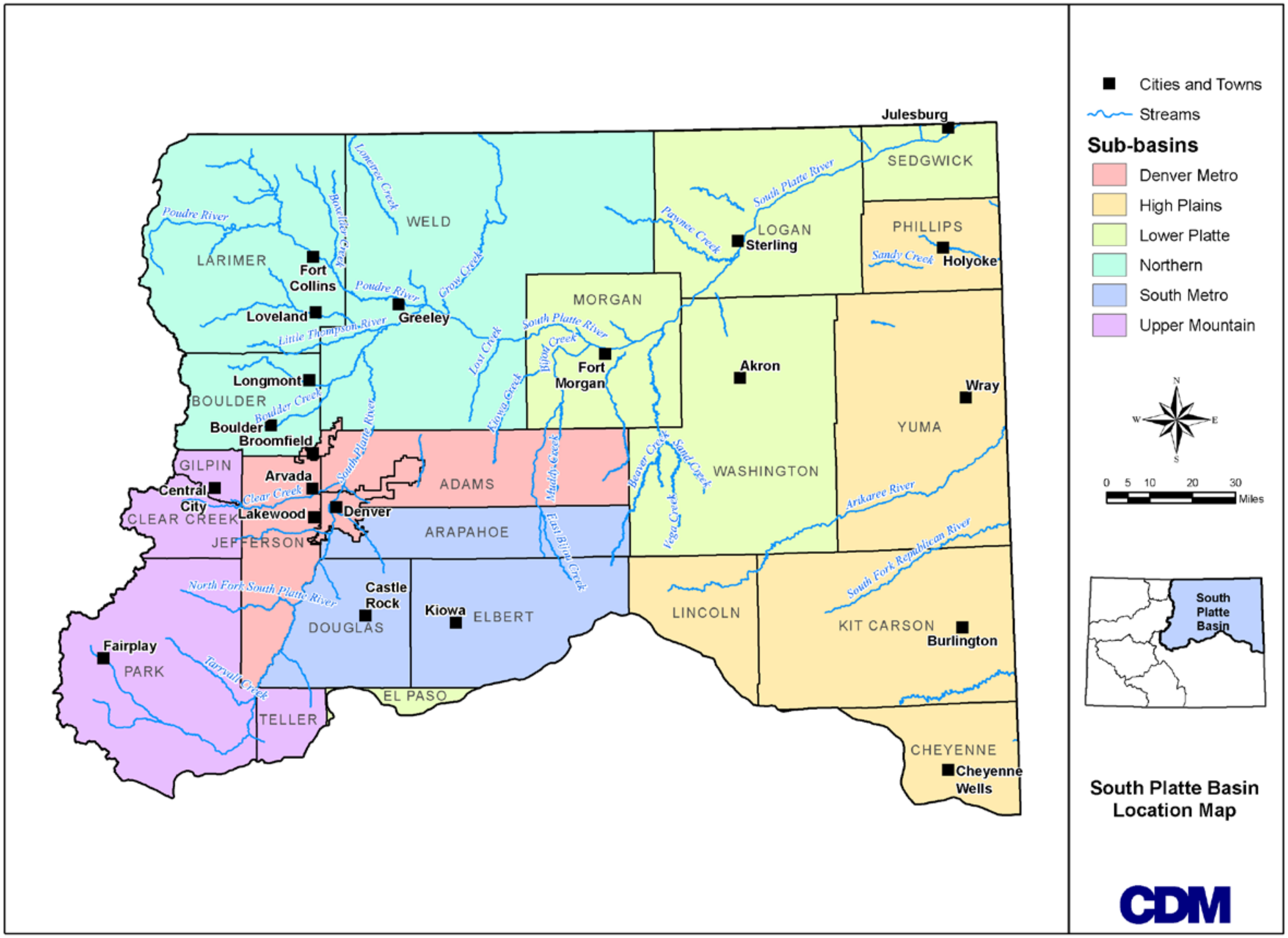

Figure 4-8. Location of Subbasins in the South Platte and Metro Basins

4.7.1.1 M&I NET GAP CALCULATION METHODOLOGY

The M&I gap analysis began by calculating the 2050 total new M&I water needs, which are described in Section 2. Potential impacts of conservation goals and strategies are provided in Section 4.3.1.5.

Reference Documents

The following discussion is extracted from:

SWSI 2010 Metro (& South Platte) Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments - Section 4

Next, the anticipated yield from the water providers' 2050 IPPs were incorporated, assuming a 60 percent success rate. For counties with more than one water provider, all relevant information was compiled to create the most complete picture of projected water supplies in the county. This IPP yield was then subtracted from the 2050 net new water needs, defined as the demand increases beyond existing supplies, at the county level.

Passive and active conservation measures are not included in the categorized IPPs. Passive conservation is already factored into the 2050 M&I demand forecasts presented in Section 2. For the purpose of this analysis and by request of the Basin Roundtables, active conservation was not included as an IPP due to the difficulty of quantifying the yield of these projects. Active conservation should, instead, be considered as a strategy for meeting M&I gap.

The categorized IPP data presented in this section is based primarily on information provided by the Basin M&I Gap Analysis Memorandum conducted by CDM in June 2011, along with new or updated information provided to HDR by IPP sponsors. While some IPPs include features that could be applied across more than one category, HDR relied upon the water providers' designations to determine the most appropriate category for each IPP.

Many water providers design their projects to meet water demands based on planning numbers, which are often higher than per capita water usage rates. This allows these providers both flexibility and a safeguard for reliability. Using planning numbers helps providers to:

1. Ensure water supply if another component of their system fails
2. Plan for drought or climate change
3. Weather an expected increase in commercial water use
4. Absorb losses if one or more planned projects is not successfully implemented

Because planning numbers can result in projections that are higher than actual future demand, where the total potential volume of IPPs exceeded either the 2050 total water needs or the 2050 total water needs minus any provider-specified gaps, each IPP category (by county or subbasin) was proportionately reduced on a pro-rata basis to that amount needed to meet the 2050 net new water needs. For the purposes of this report, the reduction serves to show only the quantity of successful IPP implementation necessary to meet 2050 water needs, not exceed them.

Note, however, that though this methodology and data presentation excludes IPP's in excess of the 2050 needs, it does not in any way preclude water providers from developing IPPs in excess of their 2050 needs. Rather, it is beyond the scope of this net gap analysis to present data for individual water providers whose demand projections, planning horizon, and system reliability may differ from the regional analysis presented here. Any excess IPP yield quantified for a particular county is assumed to not be available to meet water supply gaps in other counties, unless specified otherwise by the provider. Likewise, there is no intention of implying intra-county sharing among water providers, unless specifically noted. By proportionally scaling back each entity's 2050 IPP yields when they exceed the forecasted 2050 net new water needs for that county—and explicitly accounting for provider-specified gaps—it was the intention in SWSI 2010 to avoid implying that any one provider's excess yield would be used to meet the shortfall (i.e., gap) of another water provider.

During HDR's efforts to update IPP yields and gap calculations, SWSI IPP methodology was followed. Not all Metro and South Platte water providers responded to HDR's IPP Data Surveys. However, many project yields and projections were able to be updated, and water providers identified new projects to meet their future needs.

For the purpose of this study, the M&I and SSI water supply gap is defined as follows:

$$M\&I\ and\ SSI\ Medium\ Water\ Supply\ Gap = 2050\ Medium\ Net\ New\ Water\ Needs - 2050\ IPPs\ (at\ 60\%\ success\ rate)$$

Where:

$$2050\ Medium\ Net\ New\ Water\ Needs = (2050\ medium\ M\&I\ baseline\ demands - high\ passive\ conservation - current\ M\&I\ use) + (2050\ medium\ SSI\ demands - current\ SSI\ use)$$

$$2050\ IPPs = Water\ Provider\ Anticipated\ Yield\ (at\ 60\%\ success\ rate\ )$$
$$from\!: Agricultural\ Transfers + Reuse + Growth\ into\ Existing\ Supplies + Regional\ Inbasin\ Projects + New\ Transbasin\ Projects + Firming\ Inbasin\ Projects + Firming\ Transbasin\ Projects$$

4.7.1.2 IPP YIELD ALLOCATION AND EXPLANATION

For the purpose of conducting the IPP and net gap analysis updates, the counties of the South Platte Basin were aggregated to regional subbasins, as follows (see Figure 4-8):

- Denver Metro (Adams, Broomfield, Denver, Jefferson)
- South Metro (Douglas, Arapahoe, Elbert)
- Northern (Boulder, Larimer, Weld)
- Upper Mountain (Clear Creek, Gilpin, Park, Teller)
- Lower Platte (Logan, Morgan, Sedgwick, Washington)

Reference Documents

The following discussion is extracted from:

SWSI 2010 Metro (& South Platte) Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments - Section 4

- High Plains (Cheyenne, Kit Carson, Lincoln, Phillips, Yuma)

The net gap was then disaggregated further to display gap at a county level. Some providers, such as Denver Water and Aurora Water, span over multiple counties. The Denver Water Combined Service Area (CSA) extends into nearly every surrounding county. Denver Water IPPs and the provider specified gap were proportionally split among counties based on the percentage of county population located within Denver Water's CSA (Denver County – 100 percent, Arapahoe County – 35 percent, Jefferson County – 54 percent, Douglas County – 5 percent, Adams County – 10 percent). The relative proportion of Denver Water IPPs and provider-specified net gap applied to each county varied by growth scenario (low/medium/high). Aurora Water's IPPs were split between Adams County (40 percent), Arapahoe County (58 percent), and Douglas County (2 percent). These percentages are based on the portion of Aurora's population located in each county.

In the High Plains region, continued reliance on nontributary groundwater supplies is expected to occur to meet future M&I needs through 2050. The northern High Plains Ogallala aquifer is anticipated to provide for the limited M&I growth anticipated in this region; thus, IPPs were set equal to 100 percent of 2050 net new M&I and SSI water needs.

The Lower South Platte area will rely on existing rights and agricultural transfers for well augmentation. Based on SWSI assumptions regarding these supply sources, IPPs for the Lower South Platte region were set equal to 50 percent of 2050 net new M&I and SSI water needs.

The Upper Mountain areas primarily rely on groundwater for M&I demands. These areas will have the challenge of the limited physical availability of groundwater. Much of the groundwater is in fractured bedrock and well yields can be highly variable and decline as additional growth occurs. Many of these areas already experience reduced well production. Additionally, the Upper Mountain Counties have large numbers of pre-1972 platted lots, which are not required to provide augmentation. Many of these lots are platted with relatively high densities. These approved densities may impact well yields, and trucked water or onsite storage tanks may be required to meet peak demands for some in-home domestic uses if additional development occurs.

Jefferson County is in the process of regulating densities in certain mountain areas in order to prevent over-development of the limited groundwater resources. Yield assumptions from SWSI were followed for this report, and IPPs for the Upper Mountain Counties region were set equal to 90 percent of 2050 net new M&I and SSI water needs.

4.7.1.3 REGIONAL IPP YIELDS

During HDR's update process, the IPP yield in Metro Basin increased by a total of 6,000 AFY for the medium success rate from SWSI 2010 calculations. In the South Platte Basin, the IPP yield decreased by approximately 2000 AFY for the medium success rate from SWSI 2010 calculations. In the Metro basin, major additions were Arapahoe County Water and Wastewater Authority's Flow Project, additional Denver Water reuse through the Downstream Reservoir Exchanges project, Castle Rock reuse projects and South Metro providers' involvement in WISE. In the South Platte, the IPP yield decreased due to a decrease in estimated yield from Greeley's Seamon Reservoir Enlargement project.

A summary of anticipated yields from each category of regional IPPs at a 60 percent success rate is given in Table 4-16. The Metro will meet some of the M&I gap through existing supplies, reuse, and new transbasin projects. The South Platte will meet a part of the M&I gap mainly through existing supplies and regional in basin projects.

Table 4-16. Subbasin IPPs at 60 Percent Success Rate

Region	Agricultural Transfer	Reuse (AFY)	Growth into Existing Supplies (AFY)	Regional In-Basin Project (AFY)	Firming In-Basin Water Rights (AFY)	Firming Transbasin Rights (AFY)	New Transbasin Rights (AFY)	Total IPPs at 60% Yield
Denver Metro	3,000	12,600	20,000	10,000	900	4700	10,800	62,000
South Metro	3,000	20,700	8,100	13,800	0	500	6,000	55,200
Northern	10,200	6,200	16,600	28,100	8,200	12,000	0	81,300
Upper Mountain	0	0	2,200	25	2,200	0	0	4,400
Lower Platte	0	0	4,500	2,900	4,500	0	0	11,900
High Plains	0	0	2,100	0	0	0	0	2,100

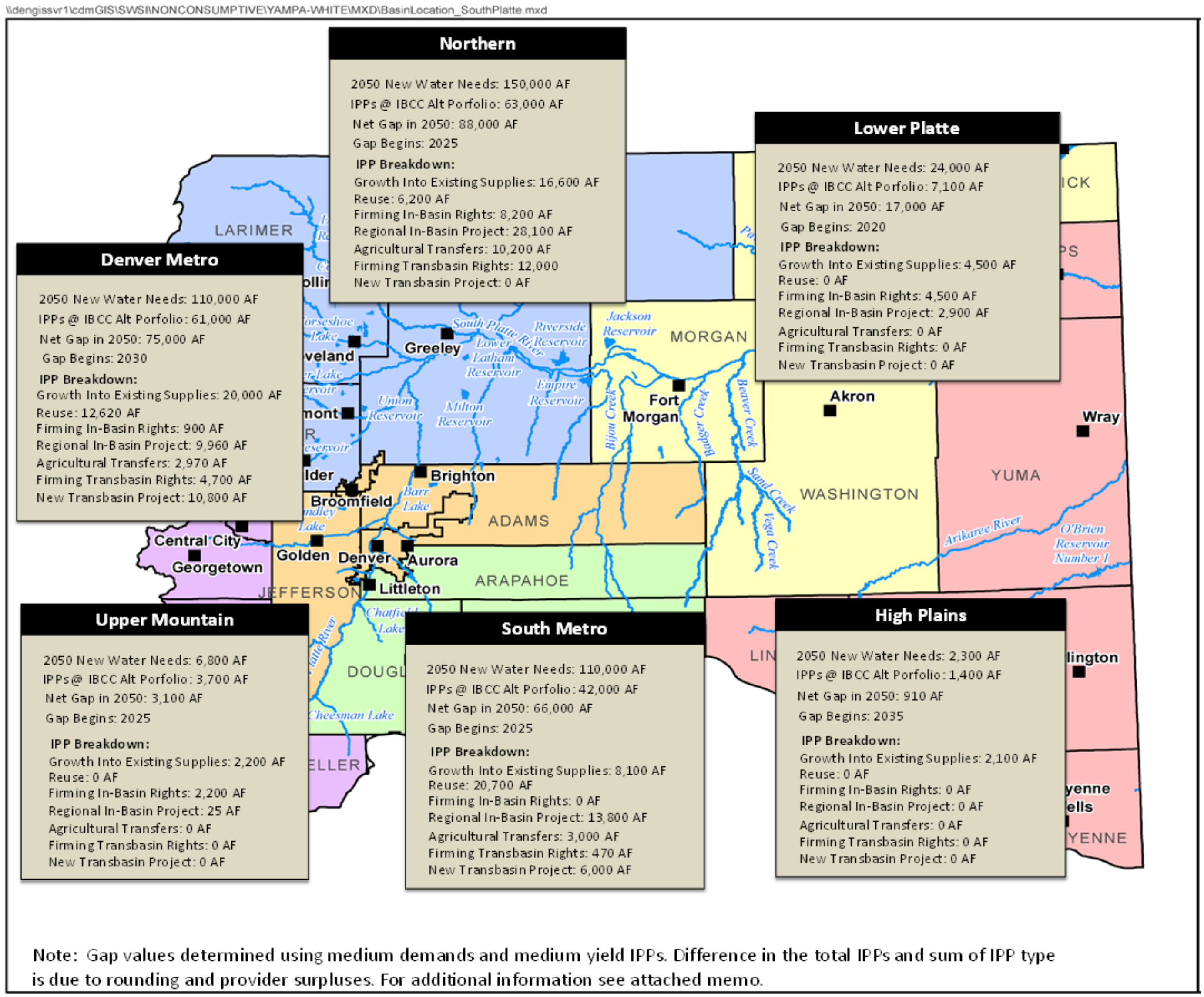

Figure 4-9. South Platte and Metro Basin IPPs 60 percent Success Rate

Source: CDM, updated by HDR

4.7.1.4 REGIONAL M&I AND SSI GAP ANALYSIS

Reference Documents

The following discussion is extracted from:
SWSI 2010 Metro (& South Platte) Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments - Section 4

This analysis includes 2050 medium net gap values for the Metro Basin, South Platte Basin, and the combined Metro and South Platte net gap.

The results of the net gap analysis presented in this report follow the methodology used in previous CDM studies and incorporate the updated IPP information gathered by HDR. IPP yields are based on the estimated yield of IPPs. Furthermore, the demand values that are integral to the gap calculations are based on water providers' treated water deliveries and do not account for losses during raw water collection, treatment, and distribution, which are highly variable depending on, among other things, water source, types of treatment processes, and age and condition of distribution system.

Additionally, there are many future uncertainties such as the potential for climate change, drought, infrastructure failure, and other factors. Therefore, raw water needs are very likely to be greater than the net gap values presented in this report.

Table 4-17 summarizes the medium scenario total gap, IPP yield and net gap for each county and region in the South Platte and Metro basins. In this scenario, the largest gaps are located in the following counties:

- Weld (47,900 AFY)
- Larimer (31,500 AFY)
- Arapahoe (32,700 AFY)
- Denver (33,000 AFY)

Figure 4-10 through Figure 4-12 summarize the results of the gap analysis in the Metro and South Platte Basins. Figure 4-13 illustrates IPP by region in the South Platte and Metro Basin.

Table 4-17. Summary of Medium Scenario Gap by County

Region	County	Total Gap	IPPs at Medium (60% Yield) Success Rate (AFY)	2050 Medium Net Gap After IPPs are Implemented (AFY)
High Plains	**Cheyenne**	0	0	0
	Kit Carson	1,000	600	400
	Lincoln	200	100	100
	Phillips	300	200	100
	Yuma	800	500	300
REGIONAL TOTAL		**2,300**	***1,400***	***900[17]***
Lower Platte	**Logan**	5,300	1,600	3,700
	Morgan	18,100	5,400	12,700
	Sedgwick	300	100	200
	Washington	100	0	100
REGIONAL TOTAL		23,700	***7,100***	***16,600[17]***
Metro	**Adams**	46,700	25,500[18]	21,200
	Broomfield	7,000	4,200	2,800
	Denver	50,800	17,800[18]	33,000
	Jefferson	31,800	13,300[18]	18,500
REGIONAL TOTAL		***136,100***	***60,700***	***75,400[17]***
Northern	**Boulder**	21,500	12,900	8,600
	Larimer	53,200	21,700	31,500
	Weld	76,800	28,900	47,900
REGIONAL TOTAL		**151,400**	***63,400***	***88,000[17]***
South Metro	**Arapahoe**	56,800	24,100[18]	32,700
	Douglas	42,500	17,900[18]	24,600
	Elbert	8,600	0	8,600
REGIONAL TOTAL		**107,900**	***42,000***	***65,900[17]***
Upper Mountain	**Clear Creek**	2,000	1,100	900
	Gilpin	400	200	200
	Park	2,800	1,500	1,300
	Teller	1,500	800	700
REGIONAL TOTAL		***6,800***	***3,700***	***3,100[17]***
BASIN TOTAL		***428,200***	***178,300***	***249,900***

- Share of NISP (11%)

- Share of Aurora Water IPPs (40%)
- Share of Denver Water IPPs (6%)
- South Platte Beebe Well Draw Project
- Agricultural Transfers
- Thornton Northern Project
- New Storage Projects
- Reuse
- Westminster Agreement
- Grow Into Existing Supplies
- Westminster Gravel Storage
- Share of Chatfield Reallocation Project (9%)

- Share of Windy Gap Firming Project (21%)
- Grow Into Existing Supplies

- Share of Denver Water IPPs (45%)

- Share of Denver Water IPPs (20%)
- Clear Creek Agricultural Transfer
- Moffat Collection System Project
- Highway 93 Lakes
- Grow Into Existing Supplies
- Share of Chatfield Reallocation Project (0.3%)

- Agricultural Transfer
- Reuse
- Union Reservoir Enlargement
- Grow Into Existing Supplies
- Share of NISP (30%)
- Share of Windy Gap Firming Project (39%)

- Agricultural Transfer
- Halligan Reservoir Enlargement
- Grow Into Existing Supplies
- Share of NISP (7%)
- Share of Windy Gap Firming Project (20%)

- Agricultural Transfer
- Milton Seaman
- Reuse
- Share of Chatfield Reallocation Project (28%)
- Share of NISP (52%)
- Share of Windy Gap Firming Project (20%)

- Share of Aurora Water IPPs (58%)
- Share of Denver Water IPPs (26%)
- ECCV Northern Expansion
- WISE
- ACWWA Flow Project
- ACWWA Reuse Flow Project
- Share of Chatfield Reallocation Project (13%)

- Share of Aurora Water IPPs (2%)
- Share of Denver Water IPPs (3%)
- WISE
- ECCV Northern Expansion
- ACWWA Flow Project
- ACWWA Reuse Flow Project
- Share of Chatfield Reallocation Project (13%)

- Share of Chatfield Reallocation Project (0.7%)

[17] Where the total potential volume of IPPs exceeded either the 2050 total water needs or the 2050 total water needs minus any provider-specified gaps, each IPP category (by county or subbasin) was proportionately reduced on a pro-rata basis to that amount needed to meet the 2050 net new water needs. The total IPP yield shown in Table 4-16 is independent of 2050 estimated demands.
[18] Aurora Water IPPs include: Eagle River Joint-Use Project (Eagle River MOU), Prairie Waters Project Expansion & Storage, Box Creek Reservoir, Grow Into Existing Supplies. Denver Water IPPs include: Reuse, Chatfield Pump Station, Upper Colorado Cooperative Project, Downstream Reservoir Exchanges, South Platte Protection Plan, Moffat Collection System, Grow into Existing Supplies.

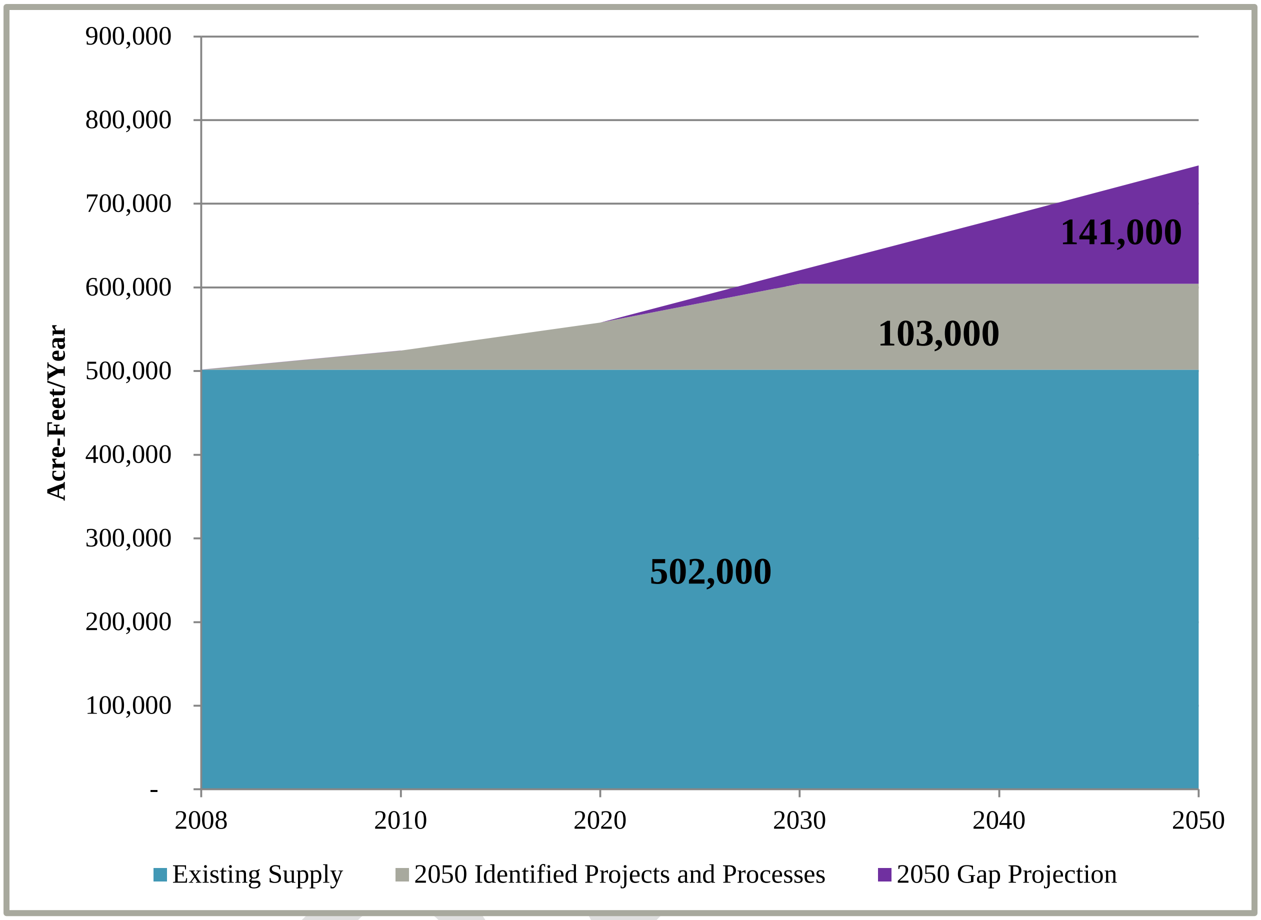

Figure 4-10. Metro Basin M&I and SSI Gap Summary Medium Scenario (IPPs at 60% Success Rate)

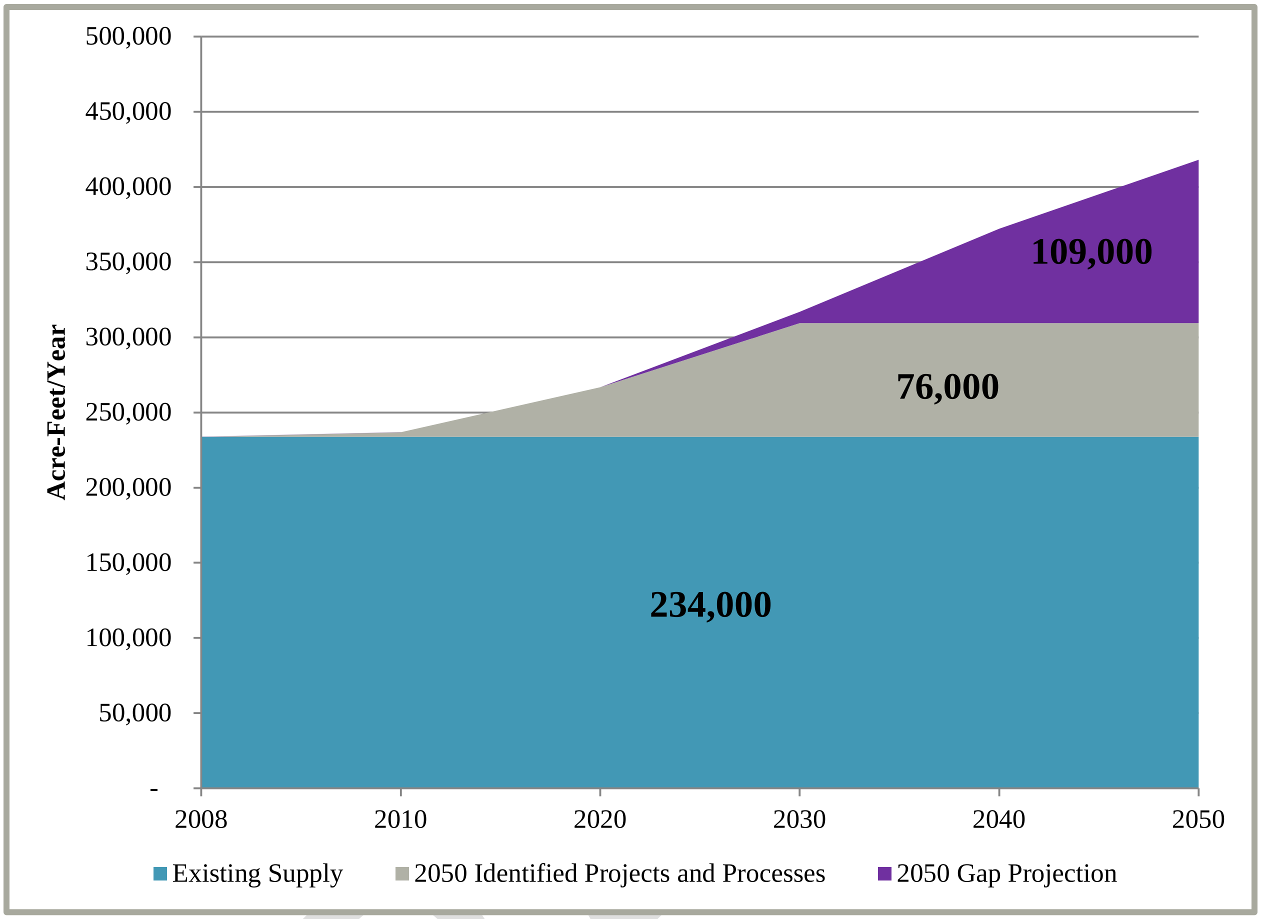

Figure 4-11. South Platte Basin M&I and SSI Gap Summary Medium Scenario (IPPs at 60% Success Rate)

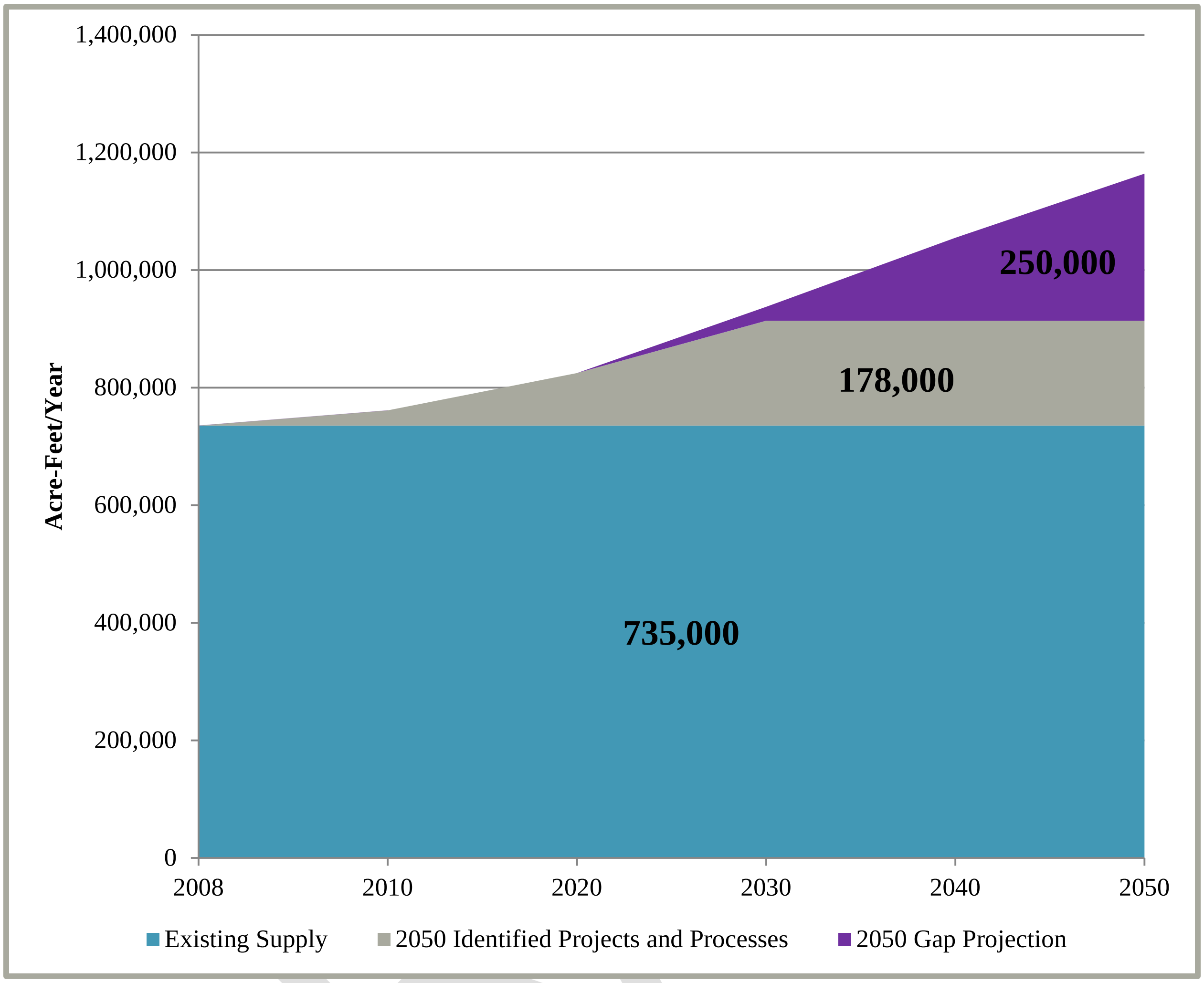

Figure 4-12. South Platte Basin and Metro Basin M&I and SSI Gap Summary Medium Scenario (IPPs at 60% Success Rate)

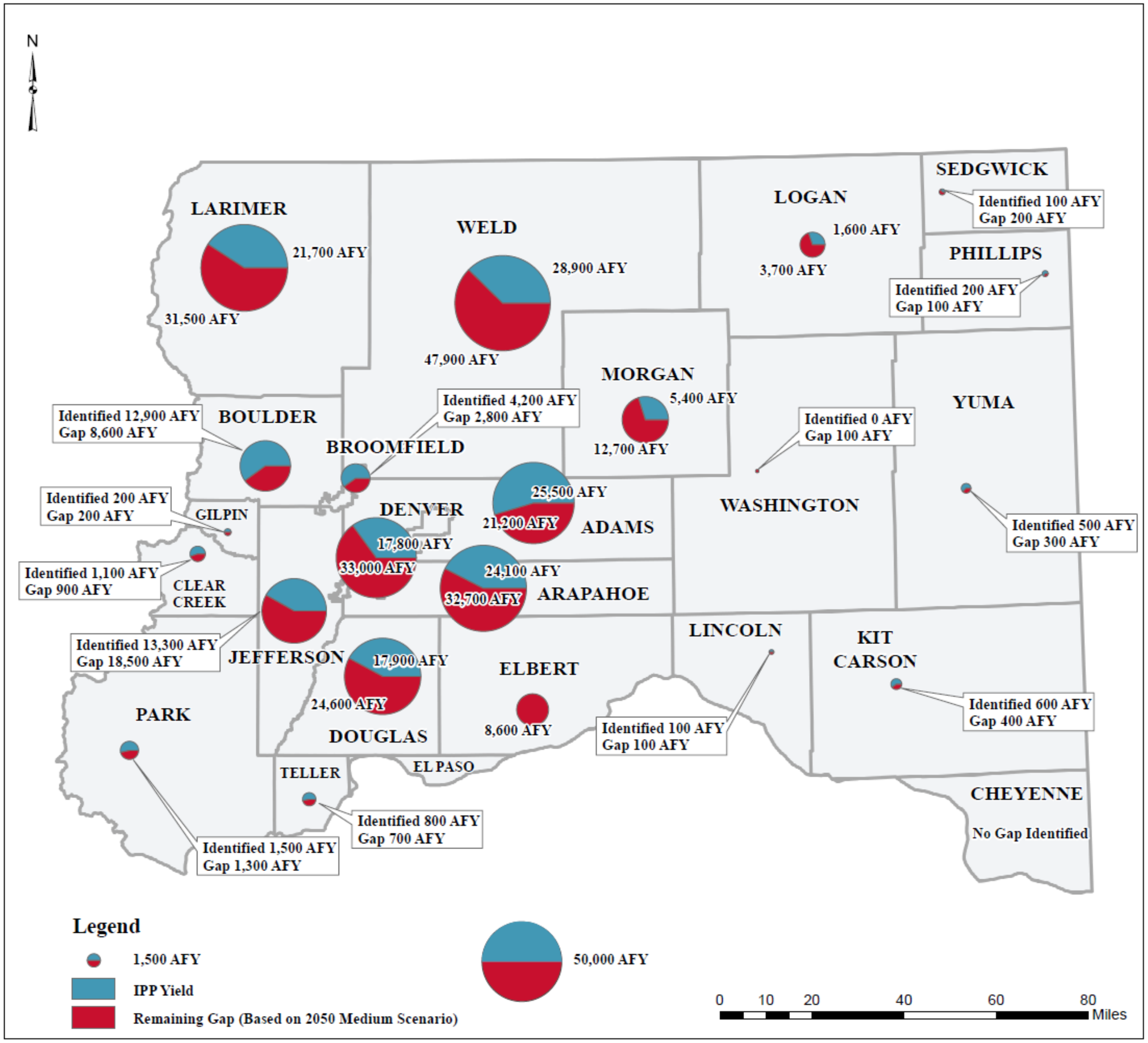

Figure 4-13. South Platte Basin Gap Disaggregation by County

4.7.2 Agricultural

As presented in Section 2.4.2.2, the South Platte and Republican River Basins are expected to have an agricultural gap of approximately 434,000 AFY by 2050 (160,000 AFY in the South Platte and 274,000 AFY in the Republican). There were no agricultural-specific IPPs included in SWSI 2010 nor were there any additional identified within these basins. As such, the estimated 2050 gap equals the 2050 net gap.

4.7.3 Environmental and Recreational Protections and Enhancements

The protection and enhancement of environmental and recreational attributes is important to protecting the state's economy and quality of life. To determine the "gap" for environmental and recreational needs, analysis of the protections available as well as the sufficiency of those protections is needed. These additional analyses can be performed in the next phase of the BIP using the framework and methodology presented above and in Appendix D with additional data being provided, as discussed in that Appendix.

4.7.3.1 ASSESSMENT OF GAP

The CWCB along with CDM and the Nature Conservancy worked on a gap analysis framework to help BRTs evaluate existing levels of protection for environmental and recreational attributes provided through planned or ongoing projects and methods. This gap analysis categorizes existing project and methods to identify where opportunities may exist to provide protection or enhancement of environmental and recreational attributes.

The analysis is designed as a series of questions to guide the user in assessing and categorizing the existing Projects and Methods. Additional information regarding this analysis is included in Appendix D.

The assessment does not address the sufficiency of projects or methods to provide protection to the environmental or recreational attributes. The assessment only relies upon whether attributes are indirectly or directly protected by the project and what type of project it is, rather than whether the project is addressing the needs of the specific attributes in the Focus Areas. The assessment does not address the sufficiency of protection of any specific attributes. In addition, the focus areas with no protection are not necessarily needing protection, as senior downstream calling water rights may call for water through these reaches.

As discussed above, the methodology detailed in Appendix D could allow future analysis regarding the sufficiency of protections in specific locations, once additional information is available regarding hydrology and other basin-wide hydrological and operational models.

4.7.3.2 ADDITIONAL ANALYSES NEEDED

In addition to the presence or absence of protections in focus areas, various other items can impact the shortage or gap for environmental and recreational needs. Changes in river conditions due to climate change or increased uses in the basin could result in reduced streamflows and further impair wildlife habitat. The trend of irrigated agricultural lands being dried up can impact the amount and location of environmental and recreational needs in the Basin. These trends and conditions can be further analyzed with the framework discussed in this section if the BRTs decide to pursue additional work in these areas after the draft BIP.

Additional studies would be useful to more fully determine the baseline for various attributes, including recreational attributes and environmental attributes. Baseline recreational user day studies would be beneficial when determining the needed protections and help to determine projects to meet those needs. In addition, studies to assist in determining the full extent of various species would be helpful in quantifying what can be done to protect those species. Studies to determine the flow rates needed to sustain species would also be beneficial.

Additional work regarding the NCNA database and the GIS data sources is needed to ensure all of the data is correctly entered and to clean up errors that continue to be prevalent in the data sources. Analyses are needed regarding the scenarios and new work that may be done with respect to the consumptive demands for water in the basin. Streamflow data and analyses are needed as well as the reduction in streamflows possible due to IPPs and other conditional water rights. The IPPs need to be spatially represented in order to fully assess the impacts within the methodology developed.

4.8 Interbasin Projects and Methods

The South Platte and Metro Roundtables are fully supportive of the IBCC in its efforts to develop an interbasin agreement on additional Colorado River supply development. This section summarizes the current process and communicates the views held by the South Platte and Metro BRTs related to previously-considered Colorado River supply concepts including both large and smaller projects.

4.8.1 The IBCC Process

IBCC representatives are currently assembling an “IBCC Conceptual Agreement” related to development of additional Colorado River supplies for the benefit of both the West and East Slopes. The State of Colorado (CWCB and the Office of the Attorney General) is also engaged with the other six Colorado River Basin states, the Upper Colorado River Commission, federal agencies, and others to address Colorado River system operations in relation to the Colorado River Compact, the Upper Colorado River Compact and other documents and agreements collectively referred to as “the Law of the River.”

Among the issues under discussion are the current low levels of storage in Lakes Powell and Mead. This situation impacts the operations of these facilities and has the potential to worsen over the next few years. The operation of these reservoirs has ramifications for water management throughout the entire basin. Although there are no major concerns currently identified over the ability of Colorado, Wyoming and Utah to meet obligations under the Law of the River in the foreseeable future (for example, not causing the flow below Lake Powell to be less than 75 million AF in any consecutive 10-year period), there are serious and expensive implications if the these reservoirs drop to levels that hinder or prevent hydroelectric power production, municipal water withdrawal, or other operations. Progress on programs to manage these situations are relevant to South Platte Basin water interests because they impact the way the IBCC will develop and manage intra-state conceptual agreements regarding the Colorado River.

Three IBCC task groups have been set up to explore elements of a conceptual agreement including the topics and summary points listed in Table 4-18.

Table 4-18. Current IBCC Discussion Topics and Summary Points

Topics		Summary Points
How drought reserves and drought restrictions can (or cannot) be used to support a new TMD project that only diverts water when it is available. A discussion of more detailed strategies for enhanced municipal conservation. • An additional discussion of the intersection of reuse and conservation A discussion of the framework for what constitutes “agreed-to projects” for future West Slope needs. Further description of the mutual benefits and advantages for Colorado’s shared future, regarding risk management. A discussion of near-term funding strategies to enhance environmental resiliency. How to keep a new transmountain diversion on an equitable basis with agricultural transfers as an option for new water supplies.		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 is needed for existing uses, “agreed-to” projects*, and some reasonable increment of future West Slope development. 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

TMD = transmountain diversion

Other items being addressed by the CWCB and IBCC include:

Risk Management: Though not specifically designated as such, many elements proposed in the seven Summary Points above will also serve as risk management tools. As the dialogue progresses, the IBCC and CWCB plan to further clarify which elements most impact the concept of risk management. This conversation will help reduce the risk that Colorado agriculture will have to bear the full brunt of meeting a future water supply shortfall.

Transmountain Diversion (TMD) Triggers Memo: The memo will address situations that have the potential to trigger the need for a new TMD within the state of Colorado. This is separate from any discussion of triggers at the interstate level.

Contingency Planning Updates: The IBCC has identified this process as “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

4.8.2 South Platte Basin Perspectives on New Colorado River Supply Options

The South Platte and Metro BRTs are supportive of the on-going IBCC discussions and believe that a wide range of water supply solutions should be carefully considered including continued and expanded water conservation and reuse programs statewide. ***All "four legs of the stool plus storage" need to be simultaneously considered as the development of Colorado's Water Plan continues.*** The South Platte and Metro Roundtables also believe that the State should take a proactive role in helping to assure that, within the constraints of federal, state and local laws and regulations, potential future Colorado River supply options are not prevented through permanent federal, state or local land management designations, new water rights (such as recreational in-channel diversions and/or federal reserved rights) or other measures prior to Colorado's Water Plan being finalized.

4.8.2.1 IBCC-REQUESTED INPUT FROM THE SP-BIP

The IBCC concluded that further discussion of new Colorado River supply development would be more appropriately held after the BRTs had completed draft Basin Implementation Plans to provide a more comprehensive overview of basin issues and goals. In particular, the IBCC identified three specific topics for the basins to address:

1. Future Use Allocation (previously referred to as "equitable apportionment")
2. How A TMD Could/Should Be Structured
3. Steps to Preserve the Option for a New TMD

Table 4-19. South Platte BIP Draft Input to the IBCC

Topic	SP-BIP Draft Input to the IBCC
Future Use Allocation	Given the context of the current discussions among West Slope roundtables, the status of the IBCC discussions and the need to obtain input from diverse South Platte River Basin water interests, it is premature for the SP-BIP to state a position on a Future Use Allocation. As the IBCC process continues and input is also received on the July 31, 2014 Draft SP-BIP, the perspectives of the South Platte and Metro Roundtables may continue to evolve throughout the process of developing the Final SP-BIP for submittal to the CWCB on April 1, 2015.
How A TMD Could/Should Be Structured	A large transmountain diversion project would beyond the ability of an individual provider to plan, permit, fund and implement. Additionally, for smaller providers to benefit from the potential economies-of-scale of a multipurpose TMD with comprehensive environmental and recreational components, the State or a specially-created umbrella organization may be needed to lead the formulation (identification, evaluation of alternatives and selection of a complete project plan) and implementation. There are examples of innovative approaches to water and other infrastructure development to draw from across the country. In addition, a concept as presented by the South Metro Water Supply Authority (see Appendix F) provides one approach on how a project might be configured and implemented.
Steps to Preserve the Option for a New TMD	This is among the most important and most challenging issues for the IBCC program to deal with now and in the next few years. Potential projects and future water management options, regardless of their merit, have been either purposefully or inadvertently set aside through federal and state legislative or executive actions without full consideration of long-term implications and alternatives.

4.8.2.2 ALTERNATIVE CONCEPTS FOR ADDITIONAL COLORADO RIVER SUPPLY DEVELOPMENT

As past discussions of Colorado River options took place in association with IBCC and BRT activities and various forums associated with SWSI and other programs, two concepts emerged: 1) a single, larger project such as various configurations of Flaming Gorge, Green River and Yampa River projects, and; 2) the possibility of potentially smaller or incremental projects. As these discussions evolved, several other processes and events took place that may either constrain or inform future possibilities and discussions including:

- The Colorado River Cooperative Agreement (CRCA) sets the stage for resolution of many water management issues and also defines limitations for implementation of new projects in the upper Colorado River basin by participating entities.
- Previously executed agreements like the Eagle River Memorandum of Understanding (ERMOU) put side-boards on what might still be considered for potential projects. The ERMOU defines the potential arrangements for additional water supplies for both the West and East Slopes from this Colorado River tributary basin.
- The Colorado River Water Availability Study (CRWAS) and other programs being executed by the CWCB and by the BRTs under Water Supply Reserve Account (WSRA) programs

provide important data and information useful in the consideration of new Colorado River supply projects.

4.8.2.2.1 OVERVIEWS OF KEY INTERBASIN AGREEMENTS

There are relatively recent agreements that are especially pertinent to the consideration of inter-basin water supply possibilities in this BIP. Presented below are summaries of the: 1) Colorado River Cooperative Agreement and the 2) Eagle River Agreement.

***Colorado River Cooperative Agreement* (CRCA)**[19]

CRCA Mutual Commitments

- The parties agree to a "peace pact" on water court diligence applications.
- The parties commit to promote best management practices for water conservation.
- The parties commit to cooperate to develop and implement a strategy to diminish the impact of a Colorado River Compact Call on Colorado.

This multi-party agreement begins a long-term partnership between Denver Water and the West Slope and sets a framework for numerous actions by the parties to benefit water supply, water quality, recreation, and the environment. Benefits to Colorado include:

- Moves forward an important project for the enlargement of the existing Gross Reservoir (the Moffat Project), which will provide additional water and enhance system reliability for the customers of Denver Water.
- Reinforces the priority and increases the amount of conservation and reuse within Denver Water's service area.
- Provides water for current and future West Slope environmental and consumptive use needs.
- Provides protections for river flows and water quality along the entire reach of the mainstem of the Colorado River.
- Provides that future water projects on the Colorado River will be accomplished through cooperation, not confrontation.
- Demonstrates how future water agreements can be reached through negotiations where all parties can be better off with an agreement than without one.

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 as shown in Table 4-20.

[19] A full description of CRCA provisions can be found at http://www.denverwater.org/docs/assets/9CB8A619-BF08-4153-64E81D61ADC4FCB9/ColoradoRiverCooperativeAgreementSummary.pdf http://www.denverwater.org/docs/assets/31BFA3E6-BC18-15E1-C74D1F13ACA992B5/ColoradoRiverCooperativeAgreement

Table 4-20. Signatories and Benefactors of the CRCA

Signatories to the CRCA	
• Denver Water	• Middle Park Water Conservancy District
• Colorado River Water Conservation District	• Board of County Commissioners of Grand County
• Board of County Commissioners of Eagle County	• Clinton Reservoir Company
• Board of County Commissioners of Summit County	• Eagle River Water and Sanitation District
• Eagle Park Reservoir Company	• Grand Valley Water Users Association
• Upper Eagle Regional Water Authority	• Ute Water Conservancy District
• Orchard Mesa Irrigation District	• Mesa County Irrigation District
• Palisade Irrigation District	• City of Glenwood Springs
• Grand Valley Irrigation Company	• City of Rifle
Entities Receiving Water or Money – Signatories to Implementation Agreements	
• Grand County	• Grand County Mutual Ditch and Reservoir Company
• Granby Sanitation District	• Tabernash Meadows Water and Sanitation District
• Grand County Water and Sanitation District No. 1	• Town of Granby
• Town of Fraser	• Winter Park Recreational Association
• Winter Park Ranch Water and Sanitation District	• Arapahoe Basin Ski Area
• Winter Park Water and Sanitation District	• Copper Mountain Resort
• Summit County	• Frisco Sanitation District
• Copper Mountain Metro District	• Town of Breckenridge
• Dillon Valley Metro District	• Town of Frisco
• Snake River Water District	• Vail Summit Resorts (Breckenridge)
• Town of Dillon	• Buffalo Mountain Metropolitan District
• Town of Silverthorne	• Hamilton Creek Metropolitan District
• Vail Summit Resorts (Keystone)	• Mesa Cortina Water and Sanitation District
• East Dillon Water District	

Provisions in the agreement are effective: (1) upon execution, (2) when the federal district court approves the parties' stipulations in the Blue River (water) Decree, (3) when the Denver Water Board accepts all the permits necessary for the construction of the Moffat Project, and (4) when the Moffat Project becomes operational. An important provision in the CRCA in relation to the participation of Denver Water in new Colorado River supply projects are the agreement's "Abstention Provisions" as shown below. These provisions extend to: 1) potential recipients of water under future contracts with Denver Water; 2) lessees or purchasers of Denver Water's reusable flow for use outside the Denver Water's service area; 3) recipients of WISE water and 4) any participants with Denver Water in a "Joint Use Project" that would increase diversions from the West Slope to the East Slope. The abstention provisions do not apply to other Front Range water providers.

CRCA Abstention Provisions

a. Abstain permanently from pursuing or participating in any project that would result in any new depletion from the Colorado River and its tributaries above the confluence with the Gunnison River, including without limitation the Eagle River (with the exception of the Eagle River MOU for Aurora and the Upper Colorado Cooperative Project). Pursuing or participating in a project means seeking formal approval of any aspect of a project in a regulatory or judicial forum, but does not include conducting various planning activities such as feasibility studies.

b. Abstain from pursuing or participating in any project that would result in diversions from the Colorado River Basin within Water Divisions Nos. 4 and 6, or downstream from the confluence of the Gunnison and Colorado Rivers in Water Division No. 5 for a period of 25 years. Pursuing or participating in a project means seeking formal approval of any aspect of a project in a regulatory or judicial forum, but does not include conducting various planning activities such as feasibility studies. This abstention period would be reduced to 15 years if, within the first 10 years following execution of this agreement, the NEPA permitting process for the Upper Colorado Cooperative Project has not been initiated. If construction of a cooperative project commences within 20 years from the date of this agreement, then the abstention period under this paragraph would be extended for an additional 10 years (a total of 35 years).

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

ERMOU Project sponsors and beneficiaries include:

- The Cities of Aurora and Colorado Springs;
- The Eagle Park Reservoir Company (consisting of the Colorado River Water Conservation District, Eagle River Water & Sanitation District, Upper Eagle Regional Water Authority and Vail Associates, Inc.); and
- The Climax Molybdenum Company.

The intended M&I uses of the ERMOU Project include:

- 10,000 AFY average annual yield for Aurora
- 10,000 AFY average annual yield for Colorado Springs
- 10,000 AFY firm dry year yield for the Eagle Park Reservoir Company
- 3,000 AF of reservoir storage space for Climax Molybdenum Company

The intended non-consumptive (environmental and recreational) uses of the ERMOU Project will use a portion of the 10,000 AFY firm yield for the Eagle Park Reservoir Company independently, or conjunctively with M&I uses, for environmental and recreational flow enhancement within the Eagle River basin.

Progress on the ERMOU Project has been continuous since 1998, with development and use of the Eagle Park Reservoir as a phase component of the Project, investigation of specific project configurations described in the ERMOU, investigation of alternative project configurations, and acquisition and adjudication of water rights to be used for the ERMOU Project. Currently, the Project Sponsors are continuing investigations to evaluate the “Whitney Creek” alternative, consisting of a surface diversion from the Eagle River in the area of Camp Hale with a dual purpose storage reservoir / pumping forebay on Homestake Creek to store West Slope yield, and regulate and feed East Slope yield up to Homestake Reservoir. The Project Sponsors hope to conduct field reservoir siting studies for this possible Project component during the summer of 2014. They will continue to examine additional project variations and components that will be needed to develop the full yield contemplated for the ERMOU Project.

4.8.2.2.2 LARGE-SCALE CONCEPTS

Over the years, many alternatives for new large-scale trans-mountain diversions have been identified, ranging from the Union Park Project in the Gunnison River Basin over 25 years ago, to the to the Yampa and Flaming Gorge projects in recent years. When considering alternatives like these, which go beyond current IPPs, a primary challenge is integrating Colorado’s interstate Colorado River Compact management strategies and pro-actively addressing environmental and recreational components to develop well-balanced opportunities that benefit Colorado’s wide-ranging water management interests.

As part of the technical work to assist the CWCB, IBCC, and Basin Roundtables in their discussions, CWCB developed reconnaissance-level cost estimates for several large-scale concepts utilizing the development of additional Colorado River System supplies. Figure 4-15 below shows the geographic extent for four Colorado River transbasin concepts—Blue Mesa Pumpback, Flaming Gorge Pumpback, Green Mountain Pumpback, and Yampa Pumpback.

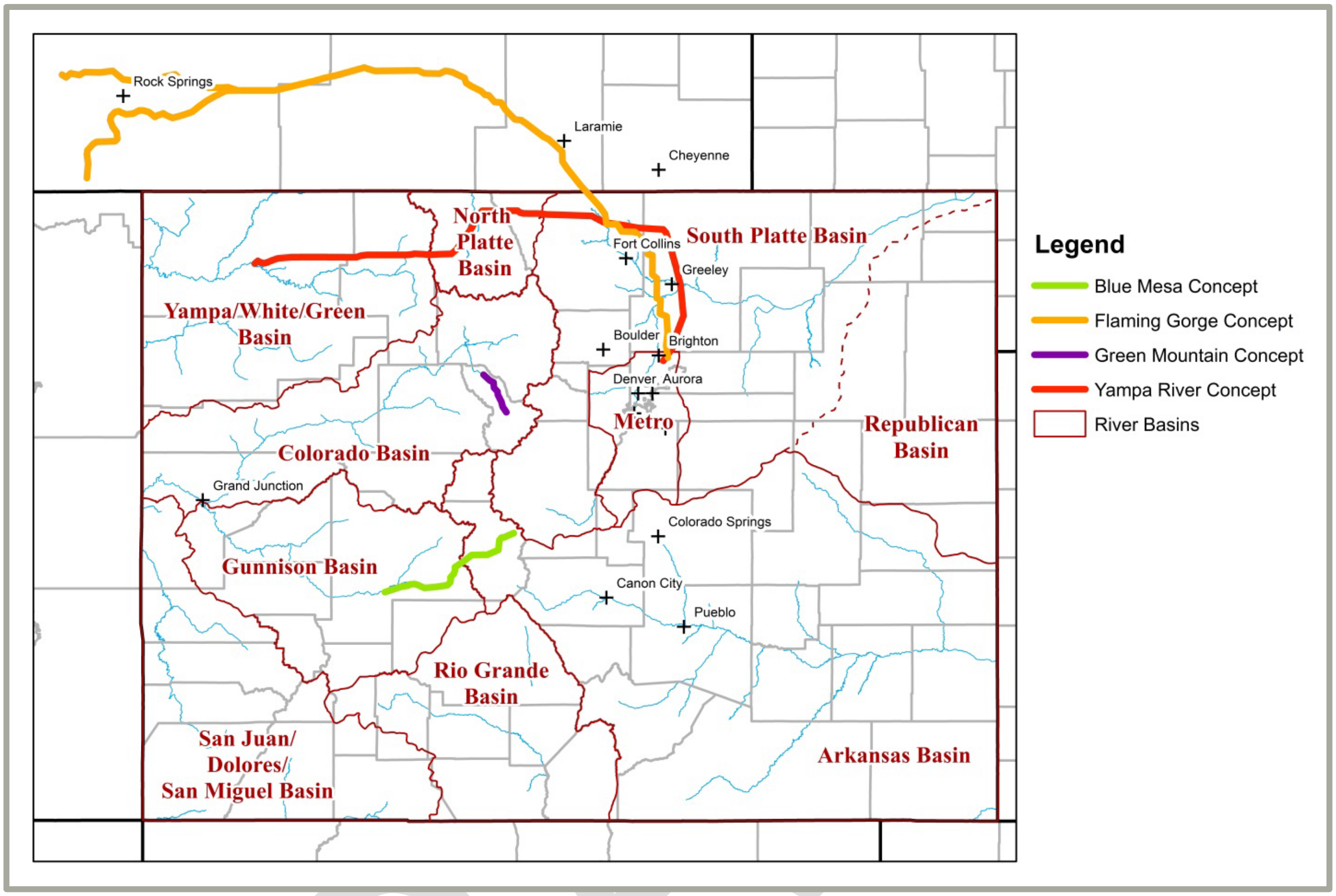

Figure 4-14. Overview of Agricultural Transfer and New Supply Development Concepts

The basic attributes of the four Colorado River Basin concepts as are presented in Table 4-21 below. For each concept the table describes the water source, conveyance and storage, as well as water quality and treatment considerations. In the Flaming Gorge and Blue Mesa concepts, water supply would be acquired through the U.S. Bureau of Reclamation (BOR) marketable pool for each reservoir, per SWSI Appendix N. For the other Colorado River supply development concepts, the water supply would be a new acquisition. While new Colorado River Basin supply development concepts would not require advanced water treatment, development concepts utilizing water from the Lower South Platte and Arkansas Rivers would require potentially costly treatments according to SWSI Appendix N.

Table 4-21. Colorado River Supply Development Concept Attributes (after SWSI Appendix N)

Concept	Water Source/ Water Rights	Conveyance and Storage	Water Quality and Treatment Costs
Green Mountain	• Blue River water in the Colorado River basin as well as new South Platte water rights	• 22 mile pipeline with static pumping requirement of 1,100 feet • Firming storage required	• Conventional treatment technology
Yampa	• New water rights appropriation	• 250 mile pipeline with static pumping requirement of 5,000 feet • Firming storage required	• Conventional treatment technology
Flaming Gorge	• Contract with BOR for water from the Flaming Gorge marketable pool	• 357 to 442 mile pipeline with static pumping requirements of 1,400 to 3,100 feet • Firming storage required	• Conventional treatment technology
Blue Mesa Reservoir	• Contract with BOR for water from the Aspinall marketable pool	• 81 mile pipeline with static pumping requirement of 3,400 feet • Firming storage required	• Conventional treatment technology

SWSI suggests several ways that each concept could incorporate project elements to help offset the regional impacts of the projects, maximize and distribute statewide benefits, and ensure continued viability of the West Slope's economy. The elements identified by SWSI for each concept are listed below:

Yampa/White

- Infrastructure for irrigation of additional acres in Moffat County.
- Water for future municipal development particularly in Steamboat Springs and Craig.
- Upper Basin interests have previously secured 60,000 AF subordinations to protect future uses.
- They have indicated they would want a similar subordination or component of the project.

Colorado

- Exchanges with current transbasin diverters for additional flows in Colorado headwaters (Grand County Streamflow Management Plan; Blue River Flow enhancement).
- Maintenance of Dillon Reservoir levels.
- Use of Wolcott Reservoir for future West Slope water demands, additional yield to the Grand Valley, some or all of the 10,825 AF obligation to the 15-mile reach.
- Potential abandonment of Eagle River Rights.

Gunnison

- Agricultural firming projects in the Upper Basin (Tomichi Creek, etc.) to help with current agricultural shortages.
- Water quality improvements in the Uncompahgre River and Lower Gunnison (selenium).

Southwest

- Financial assistance with several of their IPPs.

<u>SMWSA Concept for Discussion</u>
(see Appendix F)

The South Metro Water Supply Authority has put forward a collaborative multi-purpose project concept based on a potential Flaming Gorge Pipeline project and conjunctive use with the Denver Basin Aquifer. SMWSA assembled this concept for others to react to and that it might be evaluated and built upon through the Basin Roundtables process and be considered in IBCC discussions. Although this "straw-man" is conceptualized around a Flaming Gorge Pipeline project, many of the concepts could extend to other new water supply projects. The concept was also put forward with the consideration that the CRCA “Abstention Provisions” as presented above extend to ten South Metro water supply entities through their participation in the WISE Project with Denver Water. These provisions, as enumerated above, place limitations on Colorado, Yampa and Gunnison River Basin projects and/or the timeframes under which the projects could be implemented. There is, however, the possibility of a Colorado cooperative project that might be able to use Denver Water’s existing facilities providing that there is compliance with the CRCA terms.

4.8.2.2.3 SMALLER-SCALE AND INCREMENTAL CONCEPTS

Several potential small scale and incremental projects involving large on- and off-stream water storage and transbasin diversion projects have been proposed for a variety of benefits. Many of these have been set-aside or sidelined for reasons including lack of funding, environmental impact, water rights, water availability, and others.

The CWCB staff has evaluated “small-to-medium” water supply development projects covering less than 100,000 AFY, to examine the tradeoffs between developing combinations of many smaller projects versus one or two larger projects. Table 4-22 presents the initial list of projects identified by the CWCB which involve potential transbasin water delivery from the Colorado River Basin to the South Platte River Basin.

Table 4-22. Potential Transbasin Water Projects

West Slope Supplies	
Colorado Basin	**<u>Enhanced Green Mountain Pumpback</u>** • Grand Valley System Improvements • Increased yield for existing systems • Shoshone
	<u>Wolcott Pumpback "Little Straw"</u> – Wolcott Reservoir to Vail Pass 90 – 100K AF yield (Eagle Piney)
	<u>Webster Hill Reservoir</u> – Regulating reservoir 30K AF
Yampa Basin	**<u>Middle Yampa Pumpback</u>** – Elk River to tributary storage in the South Platte
	<u>Mini Yampa</u> - Four counties project. Diversion from Morrison and Service Creek into Northern's system
Gunnison Basin	**<u>Taylor Reservoir</u>** – Tunnel to Arkansas Basin with pumpback to enhance Taylor River slows

Colorado River Basin System Improvements – Green Mountain and Grand Valley

The U.S. Bureau of Reclamation (Reclamation) has completed system improvements on the Government Highline Canal (GHC) in and around Grand Junction including the installation of automated check structures that save about 15,000 AFY to enhance flows in the Colorado River in the critical 15 mile reach for Endangered Species Act (ESA) fish species. CWCB research suggested that it may be possible to accomplish additional system improvements on other canals in the Grand Valley such as the Grand Valley Irrigation Canal (GVIC). If this system improvement was undertaken, the increased conveyance efficiency would have no impact on downstream water rights from diminished return flows. A pumpback system from below the confluence of the Colorado River and Gunnison River to above the GHC (approximately 16 river miles) may also warrant further analysis. A pumpback project on this stretch could provide water for the senior calling rights, therefore reducing the amount of Green Mountain Reservoir water that would need to be released for West Slope beneficiaries. This would allow greater storage in the Green Mountain Reservoir for a Green Mountain Pumpback. It also may reduce the amount of water needed in the proposed Wolcott Reservoir for West Slope beneficiaries of Green Mountain Reservoir. Additional benefits could include in the ability to provide water in the late summer and fall for the endangered fish species in the 15-mile reach of the Colorado, thus reducing from the need for water from Green Mountain or Ruedi Reservoirs.

Colorado River Basin - Wolcott Pumpack

Denver Water filed for conditional water rights in the Eagle River Basin for storage and a pumpback/collection system over Vail Pass to Dillon Reservoir. Some of the associated structures would be in the Eagle-Piney Wilderness Area and have not been pursued. The proposed Wolcott Reservoir, however, is an off-channel reservoir that could be utilized to replace some of the yield of Green Mountain Reservoir that would be used for the Green Mountain Pumpback. It may be possible to increase Wolcott Reservoir's storage capacity to allow some pumpback over Vail Pass. Wolcott Reservoir would be filled by pumping from the Eagle Reservoir, which would result in significant operational costs.

Colorado River Basin - Webster Hill Reservoir

This concept would include a regulating reservoir on the mainstem of the Colorado River with a volume of 30,000 to 40,000 AF. This reservoir could potentially increase the yield of Green Mountain Reservoir or another substitute reservoir by providing improved water deliveries to adapt to daily fluctuations in river flows and the timing of water deliveries to meet downstream needs. The reservoir's location in a critical habitat reach of the Colorado River is a major obstacle to further consideration.

Yampa River Basin - Middle Yampa Pumpback

This concept has not been clearly described in previous study efforts by the CWCB but appears to combine a tunnel under the Continental Divide and Mt. Zirkel Wilderness Area and a pipeline across North Park and over the Medicine Bow Range to the headwaters of the Poudre River Basin. The CWCB indicates that this could be an expensive project considering its potential size (i.e., less than 100,000 AF).

A possible alternative could be to deliver water to the North Platte system via the tunnel and exchange this water for an enhanced collection system on the Medicine Bow Range. This collection system would deliver water to the Poudre River Basin. The yield may be limited, however, due to runoff from the Medicine Bow Range into the Michigan River and its tributaries.

Yampa River Basin - Mini Yampa Pumpback

This project would require a change of purposes to the Four Counties Conditional water rights from the Service and Morrison Creek basins to deliver water to the Front Range into the C-BT. The water would be diverted by a collection system in the headwaters of the Yampa Basin and delivered by a pipeline to Granby Reservoir for delivery to the Front Range. A potential complication could be that the water right obtained would probably be junior to the recreational in-channel diversion (RICD) water right for Steamboat Springs, thus limiting its yield substantially.

Gunnison River Basin - Taylor Reservoir Pumpback

This project would require a pumpback from Blue Mesa, as well as a contract for purchase of project water in order for it to have sufficient yield to be feasible. This is due to yield limitations as at Taylor Park Reservoir because of the senior Aspinall Unit calls. The water court has previously stated that the yield from this concept would be around 50,000 to 60,000 AF. Probable uses for the pumpback include providing enhanced flows in the Taylor River. The tunnel and pumpback facilities costs could be significant for a project with a yield less than 100,000 AF. Moreover, a recently draft programmatic biological opinion indicates only 25,000 AF is available for development above and below Blue Mesa, suggesting that legal water availability issues are likely with both this project as well as the Blue Mesa Pumpback previously described.

4.8.3 Potential Future Actions[20]

The vision of the South Platte and Metro Roundtables for future Colorado River supply development is based on the implementation of a balanced, integrated plan for the overall benefit of Colorado. The Roundtables do not support the agricultural default plan and instead, propose a balanced plan of conservation, reuse, implementation of IPPs, development of storage, Colorado River supply

[20] References for this section include: 1) Metro Basin Roundtable Water Supply Paper, May 25, 2012; 2) Front Range Water Council letter to Mr. John Stulp et al, April 3, 2014 and

development and agricultural transfers developed and operated in an integrated manner that maximizes benefits and minimizes impacts. A key measure in this plan is building integrated projects with components operated in a manner that will minimize impacts to agriculture and the environment and make enhancements where possible. Though it will minimize impacts, this type of integrated project strategy would be very expensive. Water provider customers cannot afford to pay for this approach alone. Broader political and financial support will be essential for the state to address Colorado River management issues and minimize the water-related impacts of growth.

The South Platte and Metro Roundtables have expressed in many documents and venues that all the available options for water supply development must be pursued simultaneously, not sequentially. This approach can provide the greatest assuredness that Colorado River water supply development may be available for use, thereby reducing the need for East Slope providers to implement large-scale traditional agricultural to urban water transfers. This approach is consistent with long-standing goals of the Roundtables and the IBCC.

In addition, it is premature to quantify any specific increments of water as being “available” to the East Slope for new Colorado River supply development. It is possible that the risk management strategies being considered by the IBCC can reduce or eliminate the need to arbitrarily cap future water supply development. Moreover, questions still need to be explored concerning how to allocate a “carve-out” to either the East of West Slope, who bears the risks associated with climate variability and future permitting, and how a “Colorado” resolution fits in with a “big river” multi-state agreement.

Any agreement which allows East Slope entities to move “non-headwaters” supplies to the East Slope through exchange is cause for considerable concern if the concept involves reductions of diversions by long-established projects that have been providing efficient, cost effective, and reliable water supplies to the East Slope for, in some cases, about 80 years. Under such a concept, a water derived from these efficient, low cost diversions could be replaced with high cost supplies requiring new infrastructure with substantially increased energy consumption and operating costs. This would not be a desirable outcome. The “non-headwaters” concept for the new supply may be appropriate but not as a substitute for existing water supply projects.

The Roundtables believe that Colorado River supply options should be preserved for future generations on both the west and east slopes. There are many challenges to development of Colorado River supply. These include water rights for recreational in-channel diversions and wild and scenic river designations, or their alternative protection plans. On the Colorado River, this could prevent full use of the state’s compact entitlement.

In summary:

- 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.

- Options to develop Colorado River supply are systematically being closed, and a concerted effort is needed to preserve future options to develop Colorado River supply while complying with existing environmental laws and searching for environmental and recreational enhancement opportunities. A balance needs to be struck between providing protections for in stream uses and retaining options to develop supplies in the future if and when they are needed.

- Previous planning exercises highlight the reality that even by pushing water efficiency to practical limits, the difficulties in developing and preserving Colorado River supply options necessitate some Agricultural Transfers as the default option if decision makers do not exercise the political will to preserve and promote opportunities to develop Colorado River supply for use along the urban Front Range. The South Platte and Metro Roundtables oppose this default approach and seek a more balanced approach.

- 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.

Our vision is to develop solutions to use Colorado River supply and Agricultural Transfer in a coordinated manner to reduce recreational, environmental and social impacts and to equitably spread project benefits and impacts between the east and west slopes. We are proposing the building of projects that develop both sources of supply – from Colorado River supply and Agricultural Transfers – instead of building a project that has a single source, from either Colorado River supply or Agricultural Transfer. Because the required facilities essentially double with dual source projects, the cost would roughly twice that of single source projects. These higher costs may be well beyond the ability of water providers to finance. To afford the benefits of dual source systems, additional funding sources would probably be needed. This should be a research area for the IBCC to consider.

To preserve these long-term options for future supplies, the following actions should be considered:

- Where needed, obtain water rights that protect the Colorado River supply options and use the IBCC process as a starting point to determine where water rights might be needed to protect options, when water rights should be filed, how they should be filed, who should file and hold the rights, and how the water rights would be maintained for the long-term.
- Consider legislation to establish a mechanism for obtaining and maintaining of water rights that protect the Colorado River supply options.
- Investigate the viability of obtaining Bureau of Reclamation water contracts in lieu of water rights.

- Require an allowance for these new projects in relevant Recreational In-channel Diversion projects, Wild and Scenic processes, and alternative protection plans in consideration of the fact that instream flows will remain unaffected until a decision is made to implement a project, and that the project would be designed to minimize impacts to and, where possible, enhance instream values.
- Ensure early state involvement in these new projects through supporting project proponents in local, state and federal processes, maintaining compliance with environmental laws, and seeking opportunities for environmental and recreational enhancements.
- Obtain land or right-of-ways for project facilities.
- Continue efforts to recover federally listed endangered species and to keep new species from becoming listed.

4.8.4 Environmental and Recreational Impacts and Benefits from Interbasin Projects

Interbasin projects could potentially impact environmental and recreational attributes both by benefiting those attributes and by creating possible concerns. This review of potential concerns is based on environmental and recreational attributes within the South Platte Basin. Environmental and recreational concerns in other basins should be addressed in those basins' implementation plans.

Interbasin projects have the potential to increase flows in reaches downstream of the projects. For example the outflow from a transmountain diversion pipeline can increase flows in the receiving stream. Additional flows in a stream reach can both benefit and negatively impact the receiving stream. In general, additional flows can help maintain or enhance streamflows and benefit environmental or recreational flows. However, the additional streamflow can also scour the receiving stream channel creating habitat and wildlife concerns, as well as increasing turbidity in the water below the outfall and enlarging the channel to accommodate the larger flows, limiting habitat at low flow periods when water is not being imported.

Flows associated with transbasin diversions can also impact or benefit environmental and recreational attributes based on the timing of the flows. Cooperative operational agreements coupled with in-basin storage can assist in the timing of the deliveries to the receiving stream and could potentially maintain or enhance recreational and environmental attributes.

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5

Implementation Strategies for the Projects and Methods

5 Implementation Strategies for Projects and Methods

Key Points:

- **Three illustrative Portfolios** help portray the range of options and resulting effects of supplying future water needs. They are also presented with additional M&I conservation and in relation to a climate change scenario.
  - Portfolio A: In-basin portfolio with only traditional buy-and-dry agricultural transfers
  - Portfolio B: In-basin portfolio assuming a 60 percent IPP success rate, ATMs and multipurpose/cooperative water supply projects including additional East Slope storage and conveyance infrastructure
  - Portfolio C: A balanced portfolio with the in-basin methods of Portfolio B combined with new Colorado River supplies
- **Ten Key Elements** of the Draft South Platte Basin Implementation Plan:
  1. Maximize the implementation of IPPs
  2. Maintain leadership in conservation and reuse and implement additional measures
  3. Maximize use and effectiveness of native South Platte River Basin supplies including new storage, systems integration and conjunctive use of surface and groundwater supplies to extend use of both the Denver Basin Aquifers and the foothills/ mountain crystalline rock aquifers as well as make better use of the South Platte River alluvial system
  4. Minimize traditional agricultural buy-and-dry and maximize use of ATMs to extent practical and reliable
  5. Protect and enhance environmental and recreation attributes through collaboration with other water use sectors
  6. Simultaneously advance the investigation, preservation, and development of new Colorado River supply options;
  7. Manage the risk of increased demands and reduced supplies due to climate change
  8. Facilitate effective South Platte communications and outreach programs that complement the State’s overall program
  9. Research new technologies and strategies (especially those that could enhance use of lower quality water sources)
  10. Advocate for improvements to federal and state permitting processes, without decreasing environmental protections

5.1 Introduction

In water supply planning, “implementation” is generally used in the context of taking a combination of elements that comprise a plan through the design, financing, construction and start-up phases of implementation. The plan being implemented typically is selected from among other competing plans based on technical, economic, environmental and other factors. For elements of the selected water supply plan that are not structural (such as revisions to water management procedures), “implementation” might consist of putting in place a variety of formal or informal inter-agency agreements and other legal documents and water right transfers (including applications for new water rights or changes in type or location of use of existing absolute water rights). In the context of the SP-BIP (within the current status of Colorado’s Water Plan), “implementation” must be considered in a much broader context since detailed alternative plans have not yet been developed. Therefore, “implementation” herein focuses on more broadly described concepts that can lead to development and selection of a detailed plan for long-term water supply reliability of the South Platte Basin.

In Section 1 of this SP-BIP G&MOs were identified to help guide the development of South Platte water supply solutions and also support the State in development of the CWP. The G&MOs support the four overarching themes unique to the SP-BIP that were also presented in Section 1. These overarching themes are repeated below:

South Platte Basin Approach and Overarching Themes:

- A Good Colorado Plan Needs a Good South Platte Plan
- Pragmatic and Balanced Solutions Consistent with Colorado Law and Property Rights
- The South Platte River Basin will continue its Leadership Role in Efficient Use and Management of Water
- A Balanced Program is needed to Plan and Preserve Colorado River Options

5.1.1 Successful Implementation Requires Diverse Collaboration

To successfully meet the growing municipal water needs of Colorado's Front Range while maintaining a vibrant agricultural economy and protecting and enhancing environmental and recreational water uses, coordination and cooperation among a diverse group of water users and decision-makers will often be needed.

The South Platte's Overarching Themes will guide the identification and implementation of solutions to provide water needed for consumptive (municipal, industrial and agricultural) and nonconsumptive (environmental and recreational) uses. The potential solutions considered in this SP-BIP range from traditional approaches involving development of very limited remaining South Platte water and agricultural-to-municipal water transfers ranging from buy-and-dry of farms to more innovative and potentially less impactful solutions to create a balanced plan that includes:

1. Water use efficiency improvements and water sharing strategies including conservation, reuse, ATMs and system integration
2. New storage and conveyance systems that might be developed and shared among more than one water supply agency to take advantage of synergies in their systems and supply water for multiple purposes (M&I, agriculture, environmental and/or recreational)
3. Additional focus on opportunities to conjunctively use surface and groundwater supplies to extend use of both the Denver Basin Aquifers and the foothills/ mountain crystalline rock aquifers as well as make better use of the South Platte River alluvial system extending downstream of Denver to the Nebraska state line
4. Investigation, preservation, and development of Colorado River options that could benefit multiple basins using transparent processes involving IBCC representatives and BRT Chairs
5. Comprehensive up-front consideration of watershed health and water quality management protections and enhancements by mapping key attributes and defining important focus areas instead of the more traditional approach of defining mitigation strategies after consumptive water supply options are defined

The implementation of such a balanced South Platte plan will benefit the whole state. Colorado's population is poised to grow significantly in the coming decades. Half of all population growth in Colorado will consist of people moving into Colorado to fill jobs, mostly into the urban areas along the Front Range. Colorado's Front Range is home to 80 percent of the state's population and provides 80 percent of the state's economy and tax base. Additionally, a large portion of the agricultural, recreational, and tourism sectors of the state's economy are based here. Projections developed independently of this BIP show that 80 percent of the state's population and job growth will be on the Front Range going forward.

Cities along the Front Range are national leaders in water conservation and reuse and will continue to improve the efficient use of their water. These cities are struggling, however, to obtain permits for incremental expansions to their water systems despite the environmental mitigation and enhancements offered by the projects. The cities, towns, and rural neighborhoods on the Front Range are projected to face a shortfall of between 150,000 and 500,000 acre-feet of water supply by 2050. This municipal supply gap constitutes about 75 percent of the total projected statewide supply gap. If the state's population grows faster than predicted, the gap could be even larger. Colorado lacks a cohesive plan to meet this growing Front Range municipal water needs. Beyond conservation, reuse, and modest expansion projects, the default is the dry-up of hundreds of thousands of acres of some of Colorado's most productive agricultural land; a result that is not preferred by the South Platte Basin. The state's economy is regionally interdependent which makes it critical to Colorado's prosperity that the supply gap be filled both in the Front Range and throughout the state.

5.2 Challenges in Implementing South Platte Solutions

Presented below are 10 primary challenges that must be addressed to effectively implement solutions to water supply shortages in the South Platte Basin.

5.2.1 The M&I Gap Drives Implementation Planning

There are currently agricultural water supply shortages throughout the South Platte and Republican River basins and there are needs for additional or modified streamflows to protect and enhance environmental conditions throughout the basins, but the single largest factor affecting the implementation of the water supply solutions is the potential for significantly greater M&I water demands. The gap of approximately 428,000 AFY (Section 4; medium demand level) in M&I water demands could be much greater under other assumptions regarding future conditions (including higher demand levels from population growth, industrial expansion and per capita water consumption rates). Increased hydrologic variability or Climate Change could potentially result in even greater demand and reduced water supply. The process of implementing solutions for growing M&I water supplies can greatly affect agricultural, environmental and recreational water use sectors as water is either formally or informally reallocated to the M&I water use sector.

5.2.1.1 CHALLENGES IN IMPLEMENTING MEASURES TO MEET M&I WATER NEEDS

Several factors combine in the South Platte and Metro Roundtable region, presenting challenges to meeting the projected supply gap. These challenges include:

- Water efficiency (conservation and reuse) will not meet the growing economic and population needs of the state
- Incremental additions to existing supply projects are detained in approval process with no definite end in sight
- Options to develop new Colorado River supply are systematically being closed; a concerted effort is needed soon to preserve future options to develop new supply while also protecting or enhancing important environmental and recreational stream benefits
- A balance needs to be found between providing protections for in-stream uses and retaining options to develop supplies in the future if and when they are needed
- Additional storage is a critical component in solving the supply gap. Development of new storage must be facilitated as it requires a long lead time for permitting, design, funding, and construction

5.2.1.2 ROLES OF WATER DEPARTMENTS, WATER UTILITIES AND LOCAL GOVERNMENTS IN PLANNING

Municipal water departments are tasked with meeting a large portion of the water supply needs in the South Platte basin. In addition to established tools like water audits, watering restrictions, prohibiting and monitoring for waste, rebates for efficient water fixtures and appliances, education, and water rate incentives, these water departments can work with their corresponding planning and other city 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.

However, in many cases, water utilities rather than city water departments actually provide the water supply. In fact, water utilities in the Metro area are tasked with meeting over half of the state's municipal and industrial supply gap. The current responsibilities held by water utilities are generally limited to providing for water needs within their service areas. Some utilities have expanded their limited role. However, these utilities are generally restricted to using the established tools discussed in the previous paragraph and they do not have land use planning authority.

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.

The State Engineer's Office and recent legislation has provided direction and methods to local governments via land use planning in determining whether or not adequate water is available for build-out of new development and re-development. Local governments will need to implement CRS 29-20-103, -302 et seq. through land use planning processes to ensure adequate water resources for future development/redevelopment to meet water demands associated with population growth in the South Platte Basin.

Opportunities for reducing water use in the land use planning process include:

- Updates to Comprehensive Plans,
- Changes to zoning requirements,

- Revising water/land use subdivision regulations
- Utilizing the direction provided by the State Water Engineer and recent legislation

One example of coordinated effort to look at methods for water saving is that of the Keystone Center, a broad based group with a mission of a "Bringing together today's leaders to create solutions to society's pressing challenges." The Center has a project underway, with partial funding from the CWCB, to help identify and analyze methods for reducing water use through integration of land and water planning in the Denver metro area.[1] An extensive working group will inform the study. The effort will build on previous CWCB findings.

New training is also being developed to assist in the challenges of planning smart growth. One such group is the Land Use Leadership Alliance Training Program (LULA). LULA 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.

As discussed in Section 6.5 investigating options for increased coordination between water utilities and land use planners is an area for additional analysis and refinement to the South Platte BIP.

5.2.1.3 SAFETY FACTORS FOR WATER SUPPLY RELIABILITY

In water supply planning, safety factors are typically used to account for the inability to precisely predict future demand and supply. For example, water providers utilize a safety factor for water conservation to provide a buffer or reserve that can be called upon if and when more severe and/or frequent drought restrictions become necessary. A large safety factor for conservation reduces the potential water available to meet new demand, forcing water providers to develop other sources of supply.

5.2.2 Statewide Importance of Agriculture Production in the South Platte and Republican Basins

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 overall economy and includes processing of food and livestock from the entire state. It also adds to the overall economic stability of the state by enhancing the diversity in the state's output. Although the term "agriculture" is used very broadly in this SP-BIP, it is recognized that it consists of many different types of operations including the growth of a broad range of crop types; livestock and dairy operations and many others. Agricultural operations contribute greatly to the basins' aesthetic and environmental settings and contribute late irrigation season and winter return flows that contribute to healthier stream and riparian ecosystems. Other important factors to consider regarding the long-term management of the basins' agricultural production is the growing consumer awareness of the value of buying more locally produced commodities and, while, there is broad support for maintaining strong agricultural production, it is also recognized that, in Colorado, individual water rights owners have the authority under Colorado water law to sell their rights to others for non-agricultural purposes.

[1] https://www.keystone.org/about-us-the-keystone-center.html

5.2.3 Environmental and Recreational Protection and Enhancements Must be Proactively Considered

As implementation programs proceed, opportunities for the protection and enhancement of environmental and recreational attributes should continue to be proactively considered. These programs are important to help assure that, as new projects and methods are being formulated, these types of opportunities are incorporated from the outset of the planning efforts. Through development of diverse partnerships, impacts can be lessened, funding can be sought, and "win-win" strategies can be implemented. Continuing to identify and develop projects that help enhance and protect environmental attributes can help to assuage potential additional constraints due to species being federally listed in the future. Cooperative operations can assist in more flexible operation of water rights in areas where recreational and environmental attributes have specific needs that can be addressed by timing of releases or movement of those water rights through the stream system.

The lack of useful data and information is one of the challenges in assessing the impacts and benefits of environmental and recreational projects. Some information that is important to acquire includes a better understanding of funding pipeline and opportunities for local organizations to cooperate. To fully address the environmental and recreational needs, the impact or benefit of projects requires good data, therefore baseline streamflows and other quantifiable indicators should be measured and monitored.

5.2.4 Effects of Extreme Hydrologic Variability and Climate Change

The effects of climate change on water resource availability are very difficult to assess and the exact ways it will affect Colorado are unknown. For planning purposes, the Metro Roundtable included in its portfolio exercise for SWSI the consideration of a temperature increase of 5 degrees F which is in the mid-range of projections for 2050.

Based on results of the Joint Front Range Climate Change Vulnerability Study and additional analysis, the Metro Roundtable estimated that demand would increase roughly ten percent due to factors like increased evapotranspiration of landscaping and that supply would decrease by roughly twenty percent due to increased evaporation, plant transpiration, and snow sublimation. Because of this, many South Platte water providers consider it irresponsible not to consider the potential for climate change in making water supply projections.

5.2.5 Achieving Higher Levels of Water Savings and Expanding Collaboration between Water Use Sectors

Even though the authority and role of providers in planning for and achieving defined conservation goals are limited, Metro providers plan to push the practical limit of conservation and reuse. Many of the decisions and policies required to achieve higher levels of water savings require significant political and societal buy-in as well as policy strategies that fall outside of the purview of water providers. These decisions can only be made at the broader community level, though they can be implemented at the water provider level.

Cooperative solutions will be needed to meet consumptive demands while protecting environmental and recreational needs. To achieve the higher levels of conservation, reuse, and collaboration between water sectors, a strong communications program will be needed at the State level with heavy input and support from the Metro and South Platte BRTs.

5.2.6 Cost of Developing Additional M&I Supplies

The cost of developing additional M&I supply is rapidly increasing. Most gravity-fed, high water quality options have been developed and the majority of additional supplies will require long pipelines, pumps for large elevation lifts and advanced water treatment. The CWCB's SWSI 2010 technical team developed estimates of the total life-cycle unit costs of several 100,000 and 250,000 acre-foot projects including those on the lower Yampa River, Green River at Flaming Gorge, the Gunnison at Blue Mesa, the lower Arkansas River and the South Platte River. Total life cycle cost (net present value of capital and operations and maintenance costs) range from about $80,000 to $100,000 per acre-foot of additional supply. Smaller projects like the Green Mountain and Ruedi Reservoir Pumpback cost about $40,000 per acre-foot but would only meet a subset of the South Platte and Metro gap. For comparison, a study completed in June 2011 by The Water Center of Colorado State University indicated an average cost of a new acre-foot of firm yield of nearly $21,000.[2] The study reviewed costs associated with 28 water development options across the northern, central, and southern Front Range including NISP (6 options), SMWSA: South Platte (9 options), SMWSA: Arkansas (6 options), and Southern Delivery System (7 options).

Unless there is a large new Colorado River supply project available to smaller water providers to share in the economies of scale, these smaller water providers might be unable to develop new supply and hence would use agricultural transfers instead.

Similar to supply projects, much of the "low hanging fruit" of conservation and reuse projects has been "picked". As a result, new water efficiency projects are becoming more expensive than previous projects and those being pursued at present.

The State of Colorado needs to support the continual improvement and development of water management tools. This support is important for each of the Basin Implementation Plans. As technology changes, the State should provide funding to support updating technical programs and activities which will help meet the gap. Better management tools will optimize projects to meet multiple needs, minimize cost, and protect public health and safety.

5.2.7 Need for Improved Permitting Processes

Improvements to the permitting processes for supply projects (discussed later is Section 5.5.10) will be necessary in order to meet the near term supply gap. This begins with approvals for planned supply projects including IPPs for meeting the nearer term supply gaps as well as other supply projects expected in the medium range timeframe. Projects currently in the permitting process include the Chatfield Reservoir Reallocation, Windy Gap Firming, Northern Integrated Supply Project, Halligan-Seaman Water Management Plan and the enlargement of Gross Reservoir. Near-term projects also include development of the WISE project and Thornton's Northern Project. These projects are critical to meeting near-term water needs.

There are several incremental expansions of water systems planned for helping with the gaps in the medium timeframe, including the second phase of the Prairie Waters Project, Homestake II and the Colorado River Cooperative Agreement.

[2] Kenney, Douglas. Colorado Water Institute. *Relative Costs of New Water Supply Options for Front Range Cities.* Completion Report No. 224. June 2011.

5.2.8 Social and Political Will for IPPs

It will be necessary to establish political and social support from agencies, businesses, consumers, and policy makers to implement a multifaceted approach to meeting the municipal and industrial supply gap.

Political support will be critical to the success of planned supply projects. This will include agreement between local, state, and federal agencies that when a supply projects fits under the purposes and guidelines of the Colorado Water Plan, the "purpose and need" of a supply project will be met. This will also include reforming the approval and environmental permitting processes through an interagency coordination process between local, state, and federal agencies, as well as endorsement and advocacy by all state agencies for supply projects that have received approvals and permits. This interagency coordination should extend to advocacy in the federal permitting process as well by developing a protocol to keep Colorado's congressional delegation informed and aware of the federal agency actions needed to approve and finalize planned supply projects. These political measures will help to facilitate timely approval and implementation of planned supply projects in Colorado.

Further political support will be necessary to build integrated projects comprised of new Colorado River supply, agricultural transfer and new storage. Though such projects help to minimize impacts, this type of integrated project is very expensive. Water provider's customers alone can't afford to pay for this approach. ***Broader political and financial support is essential if the state wants to use integrated projects to meet the supply gap.***

The most needed change in the near term will be to develop support for small scale supply projects and for preserving the option to build large scale supply projects if needed in the longer term. These two strategies will need local and statewide social and political support.

5.2.9 Beneficiary Support

There is a close linkage and interdependence between the economies of the various regions and business sectors of the state. Job growth along the Front Range provides economic growth in the agricultural, recreational, tourism, manufacturing and other sectors of the state's economy. These new jobs mean an increased number of people and businesses using water. To provide that water, it is imperative to leverage the support of those business communities and political leaders who promote and benefit from economic growth. Their buy-in will help build the political will to make the changes described above.

5.2.10 IBCC Leadership is Critical

The IBCC must actively support new conservation legislation, full development of IPPs, water sharing projects between the agricultural and municipal sectors, development of small scale supply projects and preservation of options to develop future supply projects on the West Slope.

Without leadership from the IBCC to build political support for this balanced plan, the basin's water providers will be left with the stopgap mechanism of pursuing large agricultural transfers for meeting their water service obligations.

5.3 The South Platte Vision

The South Platte and Metro Roundtables recognize that the SP-BIP and Colorado's Water Plan are inexorably tied and that the shared vision of the Roundtables must be consistent with the plan for the entire State. Presented below is the South Platte Basin Roundtables' joint vision in addressing four important aspects of providing reliable water supplies into the future.

5.3.1 Meeting the Municipal Supply Gap

The South Platte Basin's goal is to prepare for future water needs in a way that maximizes the state-wide beneficial use of our water resources while minimizing the impacts of additional water use on environmental and recreational resources. An integrated and managed approach to meeting the M&I supply gap will include implementing a large percentage of Basin IPPs; enhancing water use efficiencies (conservation and reuse); integrating multi-purpose projects comprised of storage, conveyance and systems integration where possible; incorporating environmental and recreational protections and enhancements; utilizing agricultural transfers using alternative methods to traditional "buy-and-dry" where feasible and reliable and while simultaneously investigating, preserving, and developing new Colorado River supply for the benefit and protection of all of Colorado.

Ideally, projects in line with this approach would be multi-purpose and address associated recreational and environmental benefits. New Colorado River supply would be developed in a manner that does not exacerbate compact obligations. Front Range storage would come from enlarging existing reservoirs, building off-river storage, and using underground storage to minimize riparian impacts. New Colorado River supplies and Front Range storage would form the base of the M&I supply. Front Range agricultural transfers and conjunctive use of the Denver Basin Aquifer would be used primarily for droughts and drought recovery. ATMs including land and water conservation easements could be used to help maintain agricultural production and the local economic benefits of agriculture.

Our vision is to develop solutions to use new Colorado River supplies and agricultural transfers in a coordinated manner to reduce the recreational, environmental, and social impacts of these projects while equitably spreading project impacts between the east and west slopes. We propose the construction of projects from both new Colorado River supplies and agricultural transfers. The use of different sources could require larger and more complex facilities, and thus, the project costs could be significantly more than the cost of having one project and may be well beyond the ability of water providers to finance. However, they may be required to equitably share the benefits and impacts of water supply development across river basins and between water uses. To offset this, supplementary funding sources will be needed. IBCC should place a strong emphasis on determining best ways to provide financial support.

5.3.1.1 A LONG-VIEW MANAGEMENT APPROACH

A long-view management approach, looking out to the next 50 years and beyond, is needed to maintain the State's capability to scale and adjust supply projects in response to future needs. To do this, it is imperative that the option to build a range of projects is preserved. For instance, a warmer climate could be managed through water banking or other demand management programs on the east and/or west slopes, while allowing additional supplies to be developed for future job and population growth.

For the near term, over the next 20 to 40 years, a large percentage of the IPPs should be successfully implemented. Smaller supply projects on the West Slope should also be investigated including those identified by SWSI, Colorado River Water Conservation District, and others. If properly designed and operated, these small supply projects should have multiple benefits for the East and West Slopes while minimizing environmental impacts. The Metro and South Platte Roundtables favor a risk management program for the Colorado River compact that addresses existing water uses and new water development and provides statewide benefit. On the East Slope, new storage could be built through enlarging existing reservoirs, building off-river reservoirs, and using underground storage in the Denver Basin Aquifer. This storage would be paired with East Slope agricultural water for use in droughts and drought recovery.

We envision meeting long term needs by preserving new Colorado River supply and agricultural transfer options for future generations to determine whether they should be developed such as:

- New Colorado River supply projects that would provide multipurpose water for both the West and East Slopes capable of producing roughly 250,000 acre-feet of M&I supply for the urban Front Range from the Green, Yampa and/or Gunnison Rivers
- East Slope agricultural transfer projects (including the use of alternative transfer methods) capable of producing roughly 250,000 acre-feet of M&I supply for the urban Front Range from the South Platte and/or Arkansas rivers
- Additional East Slope storage opportunities to maximize the use of the new Colorado River supplies

To this end, the following actions should be taken:

- Use the IBCC process as a starting point to determine where water rights might be needed to protect the options describe above, when the water rights should to be filed, how they should be filed, who should file and hold the rights, and how the water rights would be maintained for the long-term
- Consider legislation to establish a mechanism for obtaining and maintaining water rights that protect the new Colorado River supply options
- Investigate the viability of obtaining Bureau of Reclamation water contracts in lieu of water rights
- Require an allowance for these new projects in relevant Recreational In-channel Diversion projects and Wild and Scenic processes and alternative protection plans. (Note, until there would be a decision made on the merits of whether to build a supply project, the instream flows would remain unaffected; as described above, the project would be designed to minimize impacts to and, where possible, enhance instream values)
- Ensure early State involvement in these new projects, supporting project proponents in all local, state and federal processes once initial concerns are identified and addressed
- Obtain land or rights-of-way for project facilities
- Continue efforts to recover federally listed endangered species and to keep new species from becoming listed

While near term supply projects are being developed and long term projects are being preserved, water efficiency (conservation and reuse) challenges should be overcome to continue to increase urban water use efficiency and minimize the need for additional supply development.

5.3.2 The Future of Agricultural Production

While the Metro and South Platte Roundtables acknowledge that a certain amount of agricultural dry-up will be needed to meet future water demands, the preference is to minimize the impacts of agricultural transfers through integrated development of new Colorado River supply. This tandem approach seeks to equitably share the benefits and impacts of meeting the State's water supply gap among water resources and regions.

Further study of water sharing practices that can provide for continued agricultural production, while concurrently allowing municipal uses, is highly encouraged. Examples of such water sharing practices might include:

- Switching to cool weather crops
- Reducing soil moisture evaporation by utilizing mulching and drip irrigation
- Deficit irrigation
- Rotational fallowing
- Dry year leasing

While State-sponsored incentives should be used to encourage alternative transfer methods from agriculture, the South Platte and Metro Roundtables do not believe the State should seek to regulate these transactions.

Innovative transfer methods may require supportive water rights legislation to address difficulties that users have encountered in the water court process. The Roundtables support improving efficiencies in the water court process to promote water sharing practices while protecting the vested rights of water right holders.

To leverage water sharing partnerships between municipal and agriculture water uses that have reduced impacts agricultural economies, the following strategies should be implemented:

- Continuance of state funding for pilot projects for water sharing partnerships between cities and agriculture entities including alternative water transfer methods
- Reforming the water court process to encourage water sharing partnerships that continue to protect vested senior water rights
- Support of free market water sharing transaction methods without interference
- Support for agricultural conservation easements coupled with municipal water lease options

In addition to efforts made within the state of Colorado, national policies and programs could assist in limiting the buy and dry of agriculture. The state of Colorado should engage its Federal legislators to explore changes in Federal agricultural programs to help promote water sharing agreements between agricultural water users and municipalities.

5.3.3 Collaborative Statewide Approach on Colorado River Supplies, Colorado River Management and a State Water Project

The Metro Roundtable's scenario planning exercises show that a large amount of South Platte agricultural water or additional Colorado River water could be needed in the next 30 or 40 years to fill the Front Range's municipal supply gap. Further analysis is needed to determine the magnitude of the gaps that will remain once planned supply projects are completed including the amount, timing, and location of these gaps.

Some important factors affect our ability to implement large statewide projects. First, smaller water providers on the Front Range, who will likely bear the largest part of the M&I gap, do not necessarily have the capability to develop new Colorado River supplies on their own and will likely rely on conservation, reuse, and incremental agricultural transfers leading to a large loss of irrigated land in the South Platte Basin. Secondly, it cannot be assumed that cities or private investors will be able to build the Colorado River supply projects needed to avoid a large loss of South Platte agriculture. A point has been reached in our state's development where a state water project needs to be considered in order to minimize impacts of buy and dry. This is the essential trade-off that Colorado's Water Plan must recognize and address.

The Roundtables envision a state water project that would only supply water to communities with enhanced levels of conservation and reuse. It would be designed and operated to provide environmental and recreational enhancements for both the Front Range and West Slopes. For the Front Range, project water would be combined with new storage and dry year use of agricultural water to reduce the impacts across the basins while not escalating the risk of compact curtailment.

It is critical that the State take actions to identify and preserve possible future opportunities for state water projects by securing water rights, land easements, ownership or contracts. This process will also include identifying protections for West Slope consumptive, recreational, and environmental uses of water that such projects would have to meet. To benefit from these projects, recipients would have to meet identified thresholds for conservation and reuse based on achievable reductions in their current use and a consideration of unique circumstances. A trigger for determining the timing of the project would be needed as well.

To provide economies of scale, access to reliable supplies, and minimize impacts, we expect the state water project would need to be a large project in a location other than the headwaters areas where other transmountain projects have been built. One possible alternative to development of a large project might be the construction of a series of smaller, incremental projects that could provide important benefits to the West Slope.

To garner support for a statewide project, it will be necessary to address the following project-related tasks:

- Identify locations and conceptual configurations of state water projects (for example, on the Green, Yampa, and/or Gunnison Rivers)
- Identify the amounts, locations, and timing of Front Range and West Slope supply gaps that will remain after construction of the planned supply projects
- Preserve the option to build projects (for example on the Green, Yampa and Gunnison Rivers) including securing water rights and land easements or ownership
- Establish trigger mechanisms to help guide project proponents in determining when the project(s) would be needed and establish appropriate legislative and financial support
- Require an allowance for identified projects in relevant recreational in-channel diversion project and Wild and Scenic process and alternative protection plans

Prepare an objective and creative investigation of how to operate the Colorado River Storage Project Act (CRSPA) reservoirs in the state to reduce the risk of curtailment under the Colorado River Compact and how to operate the reservoirs to help meet the municipal supply gap.

5.3.4 Protecting and Enhancing Environmental and Recreational Attributes

The South Platte vision includes working to meet the M&I gap, while minimizing the impacts to agricultural uses, and while also providing protections and enhancements to environmental and recreational attributes in candidate focus areas. The South Platte Basin will continue working to identify cooperative and attribute specific projects that protect or enhance environmental and recreational attributes. The South Platte Basin will encourage funding and cooperation to leverage new projects or improvements to or replacements of structures which help provide protections. Storage within the basin is vital to meeting the needs of the basin, and including storage for environmental and recreational needs is imperative.

5.4 Alternative South Platte Portfolios

To help understand the range of options and impacts, previous work by the Metro Roundtable used a “bookends” approach to define the limits of meeting future demands. The first bookend assumed that all additional supply would be met exclusively from agricultural transfers. The second bookend assumed that all additional supply is met with new Colorado River water. While these bookends identify the expected range of possible future options, the Metro Roundtable did not advocate either extreme and concluded that a range of options between the bookends should be preserved for a future generation to decide how best to manage needs. The Metro Roundtable also concluded that a balanced and flexible approach is needed.

Three portfolios for meeting future demands chosen for this analysis (based on the estimated gap of 428,000 AFY) are presented in Figure 5-1. The three portfolios below offer strategies that the SP BIP (v1.0) is analyzing for implementability while meeting future demands (based on the estimated gap of 428,000 AFY) and accomplishing the identified Goals and Measurable Outcomes (defined in Section 1). This section includes a brief overview of the key components of each Portfolio and a conceptual scenario to represent potential implementation outcomes. These conceptual scenarios are hypothetical and are provided only for illustrative purposes. The benefits and challenges of each Portfolio will be further vetted in Section 6 by assessing the ability to meet the SP BIP’s G&MOs, as defined in Section 1.0.

5.4.1 Portfolio A

In-basin portfolio with only traditional buy-and-dry agricultural transfers

Portfolio A is conceived under the scenario for medium demand growth with, the M&I and SSI gap in 2050 estimated to be 428,000 AFY. Within this portfolio, the supply gap in the South Platte basin would only be met with traditional buy and dry of agriculture. Using the methodology from SWSI 2010 for determining the irrigated acreage needed to meet the M&I and SSI gaps, each acre foot of successful IPP yield equates to approximately one acre of irrigated agricultural land remaining under production. Under this portfolio, approximately 439,000 irrigated acres would need to be transferred to meet the anticipated medium level M&I gap of 428,000 AFY in 2050. This represents a nearly 50 percent reduction in current irrigated acreage within the South Platte Basin. The loss of irrigated acreage under these portfolios is assumed to be strictly from agricultural transfers to meet the M&I gap and does not include losses associated with urbanization, IPP implementation, or other reasons.

For Portfolio A, the location and seniority of water rights on the agricultural land being purchased for transfer would be very important to the purchaser. The most desirable water in Colorado for purchase and transfer of use, is water with the most senior prior appropriation date that is in relatively close proximity to existing water conveyance systems (pipelines and reservoirs) if additional capacity exists. With large M & I gaps anticipated in the Denver metropolitan and the South Metro areas, stress would be placed initially on existing agriculture in close proximity to Aurora Water's Prairie Waters Pipeline and ECCV Water and Sanitation District's Northern Pipeline. These water conveyance systems provide the ability for water providers in Denver, Douglas and Arapahoe Counties to deliver water for treatment and distribution. The largest gaps exist in Weld and Larimer counties, where a large portion of the Basin's agricultural production occurs (Weld County is the largest agricultural producing county in the Basin). Growing municipalities in Weld and Larimer counties are likely to have adverse affects on the agricultural economy of these counties.

Regardless of the water rights purchased and successfully transferred, as a stand alone strategy to meet the anticipated M&I and SSI water supply gaps, Portfolio A would result in the loss of nearly 50 percent current irrigated acreage within the South Platte Basin along with negative environmental and recreational impacts. As such, Portfolio A is not a desired solution and is included only to demonstrate the adverse effects should other solutions not be implemented.

5.4.2 Portfolio B

In-basin portfolio with additional conservation, and reuse, and agricultural transfers using ATMs and multipurpose/cooperative water supply projects including additional East Slope storage and conveyance infrastructure

Portfolio B includes development at a medium success rate of IPPs (60 percent) resulting in an estimated yield of 178,000 AFY by 2050. The IPPs are categorized as follows:

- Reuse
- Agricultural transfers
- Firming in-basin rights
- Regional in-basin projects
- Growth into existing supplies
- Firming transbasin rights
- New transbasin projects

In addition to IPPs, Portfolio B includes implementation of ATMs. The CWCB's ATM Grant Program has identified approximately 90,000 to 160,000 AFY of possible additional water supply available through ATMs. As outlined in Table 4-9, numerous challenges exist with the implementation of ATMs. As such, it will likely be difficult to meet the low estimate of 90,000 AFY. A conservative success rate of 30 percent would result in a yield of 30,000 AFY from future ATM projects.

In Portfolio B, the remaining anticipated demand gap of approximately 220,000 AFY would be met through a combination of (1) new in-basin multipurpose and cooperative water supply projects including additional East Slope storage and conveyance, and; (2) traditional agricultural transfers. Given that there is little to no unappropriated water in the South Platte Basin, only 10,000 AFY (approximately 5 percent) of this remaining gap might be met through new in-basin multipurpose projects supported by new conditional South Platte water rights. The remaining gap (approximately 210,000 AFY) would have to be met through traditional agricultural transfers. This equates to a loss of more than 215,000 irrigated acres (approximately 25 percent of existing irrigated acreage). This is slightly less than the estimated 235,000 acres or 19 percent loss estimated in SWSI 2010 (see Section 2.2.1.2).

Under Portfolio B, the South Platte Basin more thoroughly develops, or transfers, in-basin supplies and also firms supplies that are currently available through existing transbasin projects.

Within this scenario, the firming of transbasin water supplies in current IPPs as well as reuse supplies would be done through additional storage within the South Platte Basin. To be successful, this system would need to address the water quality ramifications of utilizing additional lower quality surface water, and how to meet these challenges through either advanced treatment (reverse osmosis), accepting delivery of lower water quality (with higher total dissolved solids (TDS) but still meeting drinking water standards) or blending with existing transbasin supplies. Currently, higher quality water sources are essentially fully tapped and municipal water suppliers are facing the challenges of using lower quality, more distant water sources. Water agencies with adequate volumes of higher quality water may be able to blend them with lower quality supplies and avoid the advanced treatment technologies that result in concentrated brine streams. However, the challenges of inland brine disposal that other water providers will face could be a major issue for South Platte both due to financial challenges and environmental impacts.

Though this scenario more fully develops the South Platte's existing IPPs, it would still require the transfer of approximately 210,000 irrigated acres to meet the M&I and SSI gaps. It can be anticipated that project proponents will first target the irrigated agriculture with the most senior water rights, closest in proximity to existing conduits to transport the water to the proponents' systems or have the most cost-effective and "permittable" pipeline routes.

5.4.3 Portfolio C

A balanced portfolio with in-basin methods and new Colorado River supplies

Portfolio C includes a combination of the strategies in Portfolio B (including implementation of 60 percent of the existing IPPs in the South Platte Basin) with an additional 150,000 AFY of new Colorado River basin supplies. This portfolio reduces the loss of irrigated acreage to approximately 62,000 acres.

Under Portfolio C, the addition of new Colorado River supplies (150,000 acre feet) would provide the water for blending (to offset water quality issues from further development of South Platte supplies and reuse supplies). In addition, the development of new storage with in the South Platte Basin would provide water providers the ability to operate reliably under wet, normal and dry hydrologic conditions. The result of this conceptual scenario would be less pressure to meet the future M&I and SSI gaps through traditional buy and dry of agriculture. However, even with additional supplies from the Colorado River, an additional 62,000 acres of irrigated agriculture would still be developed through traditional buy and dry to meet the anticipated water supply gaps.

Portfolio A, B, and C are illustrated under medium demand projections in Figure 5-1.

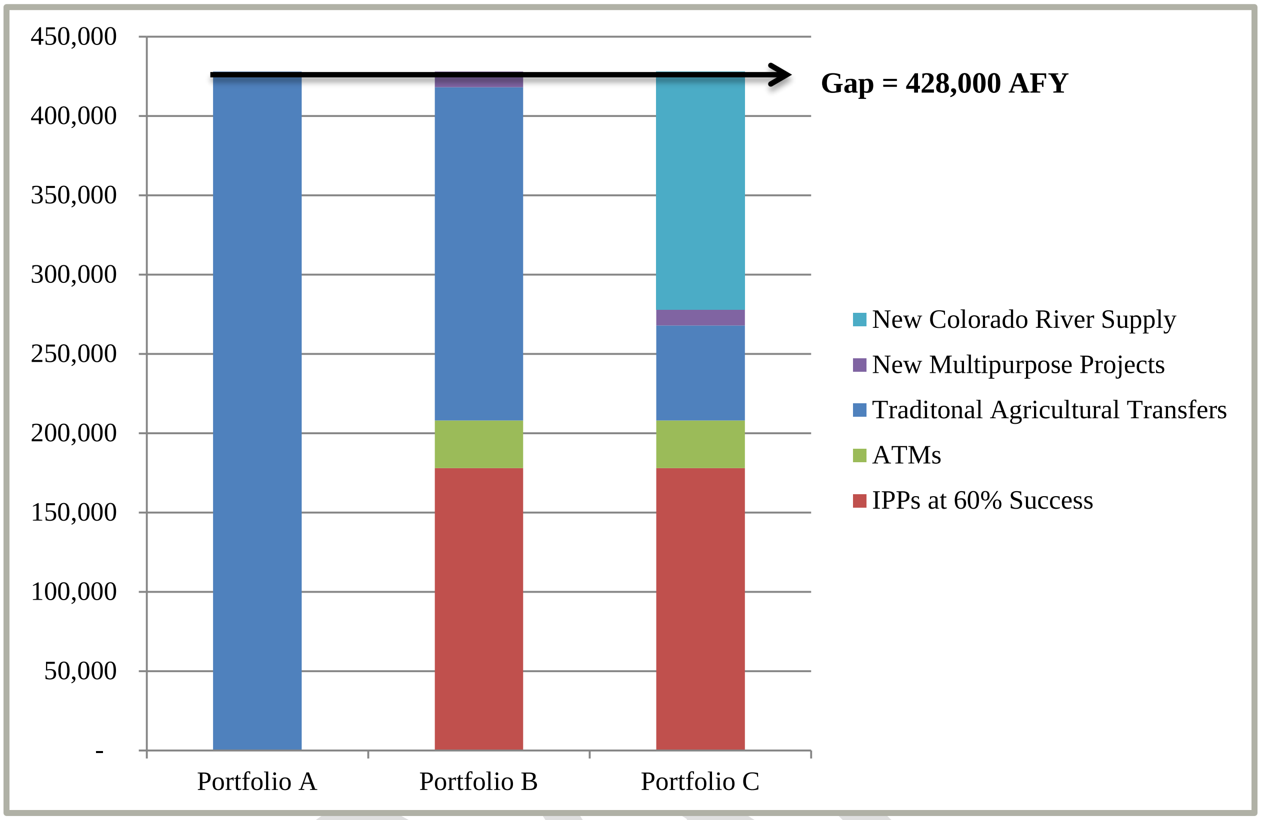

Figure 5-1. Portfolio Scenarios to Meet 2050 M&I and SSI Gap without Additional Conservation

5.4.4 Portfolios Evaluated Under Additional Conservation

As outlined in Section 4.3.1.5, up to 210,000 AFY of M&I demand reduction could be realized if the conservation levels specified in Table 4-5 are achieved. The majority of Basin water providers are relying on the application of conservation savings to improve overall system resiliency (i.e. demand hardening and drought reserves) instead of applying it towards supply for additional population and/or demand increases. During the Basin Roundtable Portfolio and Trade-off Analysis, the South Platte Basin Roundtable indicated that 10 percent of conservation savings would be applied toward meeting the gap and the Metro Basin Roundtable indicated that 36 percent of conservation savings would be applied toward the gap under their high demand with climate change scenario.[3] For this scenario, these percentages of savings applied toward the gap were used respectively for the Metro and South Platte Basins for a total reduction in demands of approximately 50,000 AFY. The potential effects of this strategy are illustrated in Figure 5-2 below.

Municipal entities within the South Platte, where possible, would expand their conservation programs. While entities in Denver, Arapahoe and Douglas County represent leaders in the State for conservation, this conceptual scenario anticipates that enhanced technology and encouragement (for example: rebates for purchasing and installing water saving fixtures or reimbursement for water savings changes—removal of turf) could result in some decreases to the overall demand, albeit limited. There are several benefits of

[3] CWCB. Basin Roundtable Portfolio and Trade-off Analysis

meeting future conservation goals. In addition, approximately 51,000 fewer irrigated acres would need to be transferred to M&I use in Portfolio B.

It should be noted however that additional conservation would reduce in-basin supplies and may impact not only the call regime within the basin but also the flows available for environmental and recreational purposes.

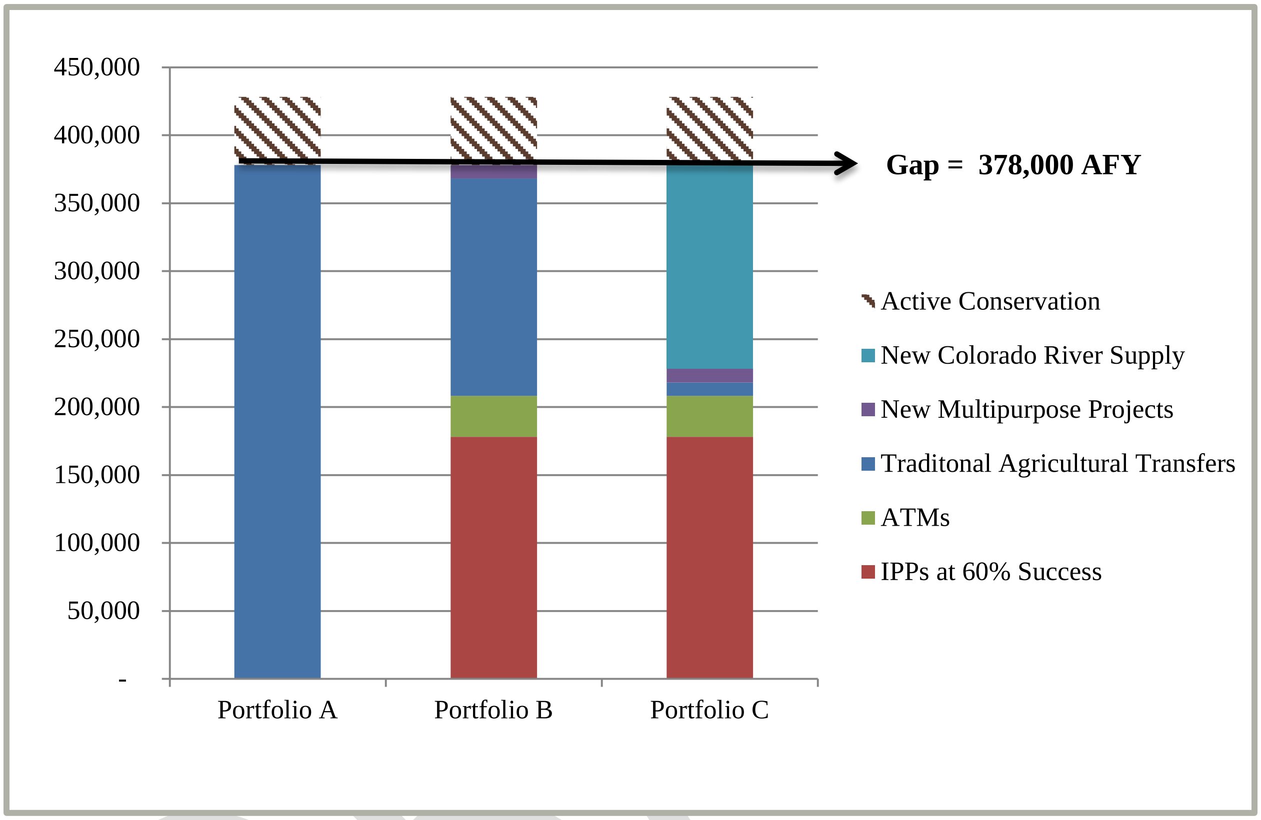

Figure 5-2. Portfolio Scenarios to Meet 2050 M&I and SSI Gap with Additional Conservation

5.4.5 Portfolios Evaluated Under Climate Change Scenario

The portfolios were also evaluated under a climate change scenario, which assumes a 20 percent decline in existing supplies and a 10 percent increase in demand as shown in Figure 5-3.

The climate change scenario, assumes an approximate five degree Fahrenheit increase in temperatures resulting in water providers experiencing a decrease in supply and increase in demand due to increased evaporation. The Basins would continue to pursue conservation levels; however, climate change would have an impact on the Basin gap and agricultural dry up. The Basin gap would increase to 642,000 AFY, and under Portfolio C, approximately 280,000 acres of irrigated land would be dried up to meet the M&I demands.

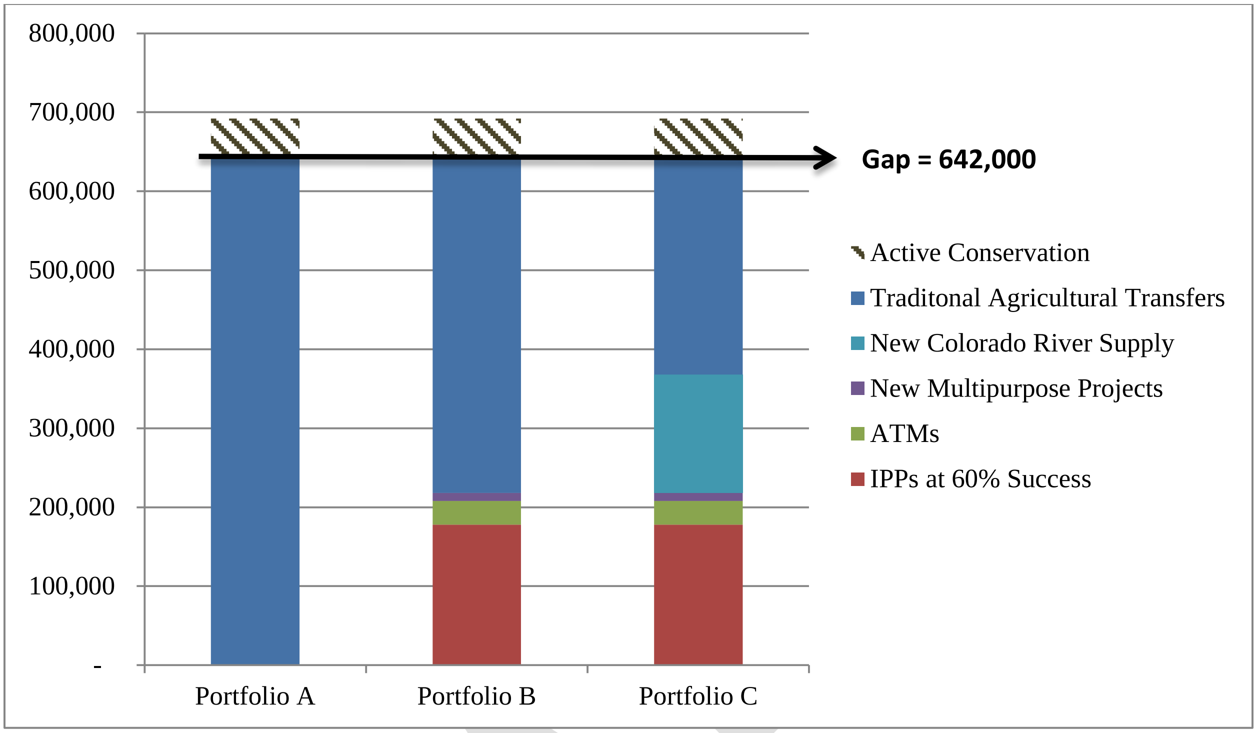

Figure 5-3. Climate Change Portfolio Scenarios to Meet 2050 M&I and SSI Gap with Additional Conservation

5.5 The South Plan Basin Implementation Plan (v1.0)

The Metro and South Platte Roundtables believe that an integrated, managed approach is needed to meet M&I, agricultural, environmental and recreational needs in both the SP-BIP and Colorado's Water Plan.

This approach includes:

1. Minimizing adverse impacts to agricultural economies
2. Developing new multipurpose projects that either offset transfers from agricultural uses or provide additional water to reduce current agricultural shortages
3. Proactively identifying methods to protect and enhance environmental and recreational water uses.

For the M&I water use sector, this approach includes: 1) development of new Colorado River supply and preservation of options to develop supplies in the future; 2) greater East Slope storage; and 3) conjunctive use of Denver Basin, foothills and mountain aquifers and South Platte alluvial aquifers to the extent permitted by Colorado Water administration. It would also utilize alternative agricultural transfers to the extent they can provide reliable long-term supplies to the M&I sector while simultaneously continuing and enhancing conservation and reuse. The foundation for all the above strategies is successful implementation of a high percentage of IPP's.

The overall goal is to maximize state-wide benefits of water resources while minimizing impacts. For example, the South Platte and Metro Roundtables seek to develop solutions to use new Colorado River supply and agricultural transfer in a coordinated manner to reduce recreational, environmental and social impacts to equitably spread project benefits and impacts between the East and West slopes. The Roundtables are proposing the building of projects that develop dual sources of supply – from new Colorado River supply and agricultural transfers – rather than focusing on either as a single source. Additionally, we support the use of water banks, additional storage and reservoir capacity expansion, as well as conjunctive use of surface and groundwater. These integrated strategies will form a balanced approach to meet supply needs, while helping to minimize impacts to specific water users or regions.

In Section 3, sixteen “Challenges and Opportunities” were identified that affect the development of strategies for implementing a South Platte plan. They are shown below in Figure 5-4 along with the 10 primary implementation strategies or Plan Elements. These 10 Plan Elements are explained following Figure 5-4.

Challenges and Opportunities

1. Lack of unappropriated South Platte and Republican River water

2.Needs for water in the South Platte Basin have long exceeded the native water supplies of the South Platte and Republican river systems

3. Degree of successive water use in the South Platte basin

4. Limitations on additional water reuse

5. Further reductions in per-capita water consumption

6. Additional use of Denver Basin Aquifer water

7. Opportunity for Groundwater Storage

8. Use of the alluvial aquifer along the South Platte River

9. Republican River Basin water use constraints

10. Programs to manage and recover protected species and their habitats

11. Water quality management

12. Time and cost to obtain regulatory decisions on new water supply projects

13. Very diverse environmental and recreational water needs and concerns

14. Vulnerability to water service disruptions

15. Opportunities for further system interconnections

16. The roles of elected officials, the business community and the general public in water supply planning

South Platte Plan

10 Plan Elements for the South Platte Basin Implementation Plan (v1.0)

1) Maximize implementation of IPPs (recognizing that not all will be achieved or obtain currently-estimated yield)

2) Maintain leadership in conservation and reuse and implement additional measures to reduce water consumption rates (see Section 4.3)

3) Maximize use and effectiveness of native South Platte supplies

4) Minimize traditional agricultural buy-and-dry and maximize use of ATMs to extent practical and reliable

5) Protect and enhance environmental and recreation attributes through collaboration with other water use sectors

6) Simultaneously advance the investigation, preservation, and development of new Colorado River supply options;

7) Manage the risk of increased demands and reduced supplies due to climate change

8) Facilitate effective South Platte communications and outreach programs that complement the State's overall program

9) Research new technologies and strategies

10) Advocate for improvements to federal and state permitting processes, without decreasing environmental protections

Figure 5-4. South Platte Basin Implementation Plan

5.5.1 Maximize the Implementation of IPPs

IPPs proposed by South Platte Basin water providers, if successful, will provide much of the water supply needed for project proponents through 2025. Implementing planned water supply projects that are currently in the permitting process will be a crucial component of meeting the future supply needs of the South Platte Basin as well as the State of Colorado. The extent of which IPPs are successful will relate directly to the magnitude of the M&I gap. Successful IPPs will lead to a smaller M&I gap while unsuccessful IPPs will increase the gap even further.

5.5.2 Maintain Leadership in Conservation and Reuse

Already, the Basin has reduced their water use by approximately 20 percent since 2000 and currently achieves one of the lowest per capita water uses in the state. Water providers in the Metro and South Platte Basins continue to seek expansion of their existing conservation and reuse programs. Providers have already implemented significant water conservation measures that are known nationally for their rigor and plan to pursue even more aggressive conservation levels in the future. There are three primary focus areas in this Plan Element as described below.

5.5.2.1 RATE DESIGN, EDUCATION, AND ENACTING REGULATIONS

Front Range water providers are national leaders in conservation and are committed to aggressively increasing efficiencies in the future. Providers encourage conservation through water rate designs, education, watering schedules, and rebate programs as well as water waste rules.

Enacting ordinances and legislation to require more efficient plumbing fixtures, appliances and landscaping — the next major steps in water conservation —falls outside the purview of water providers. The recently unsuccessful attempts to propose legislation to require the sale of more efficient toilets exemplifies this need for wider social and political will to attain better levels of efficiency. Finding effective methods to strengthen code requirements and enact stronger land use regulations will be an important factor in building efficiencies through conservation.

5.5.2.2 FOCUS ON INCREASED DENSITIES FOR NEW DEVELOPMENT

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.

5.5.2.3 IMPLEMENT ADDITIONAL REUSE

Water is used numerous times in the South Platte and Arkansas River Basins as it flows from the basin headwaters to the state's borders. The remaining water flows out of state to help meet the state's compact obligations. Nearly all unused municipal return flow is put to agricultural use in the Arkansas and South Platte Basins.

Many cities are maximizing the amount of reuse through water trades and exchanges. For many of these cities, achieving higher levels of reuse will require some form of potable reuse (see Section 5.5.9.2 for additional details) with costly pipeline, pumping, and treatment systems which have high operating costs and consume large amounts of energy.

Regional cooperation on reuse projects, like the WISE project in the Metro area, can help further stretch locally available supplies. However, some municipal supplies, including the Colorado-Big Thompson Project, are single use water supplies and cannot be reused by municipal water users.

5.5.3 Maximize Use and Effectiveness of Native South Platte Supplies

5.5.3.1 DEVELOP NEW MULTIPURPOSE WATER STORAGE AND CONVEYANCE INFRASTRUCTURE

Costs of major new Colorado River supply and system integrations infrastructure along with current permitting challenges may mean that the State needs to take a leadership role or that one or more regional water supply agencies be created.

Front Range storage implementation is imperative to managing risk and meeting future demands. The Basin advocates for the development of surface and underground storage, further research of ASR, and the investigation into additional storage and reservoir sites in the basin, particularly in the lower South Platte.

5.5.3.2 DEVELOP METHODS TO MORE EFFECTIVELY UTILIZE TRIBUTARY AND NON-TRIBUTARY GROUNDWATER

Following the initial submittal of the SP-BIP to the CWCB on July 31, the South Platte Basin plans to investigate ways that tributary and non-tributary groundwater can be more effectively managed and used within the context of Colorado's water administration system. This will build on work performed in response HB1278 by the Colorado Water Institute and may also include additional analysis of other conjunctive use and ASR opportunities in the Denver Basin Aquifer and foothills and mountain aquifers.

5.5.3.3 EXPLORE FURTHER INTEGRATION OF SOUTH PLATTE WATER SUPPLY SYSTEMS TO ENHANCE YIELD AND RELIABILITY

Similar to the above, the South Platte and Metro Roundtables may also investigate options to further integrate South Platte water supply systems by convening a series of discussions or workshops with interested parties.

5.5.4 Minimize Traditional Agricultural Buy-and-Dry and Maximize ATMs to Where Practical and Reliable

The issue of agricultural dry-up has been examined extensively by the Front Range roundtables as they have evaluated planning alternatives to meet the water supply gap and have concluded that a certain amount of agricultural dry-up will be required. In order to mitigate as much agricultural dry-up as possible water-sharing methods – often known as alternative transfer methods—are being explored.

Some examples of water sharing practices include switching to cool weather crops, reducing soil moisture evaporation through techniques like mulching and drip irrigation, deficit irrigation, rotational fallowing, and dry year leasing. The Metro and South Platte Roundtables support and are encouraged by studies investigating such methods for reducing the impacts of agricultural transfers. Additional study of practices that allow for continued agricultural production, while at the same time permitting municipal uses, is encouraged.

These and other innovative approaches to meeting the supply gap may require supportive water rights legislation to address the difficulties that have been encountered in the water court process. An important component in facilitating the use of ATMs will be reforming the water court process to encourage water sharing practices while protecting the vested rights of water right holders including the ability to sell their property rights. The Roundtables assert that arrangements between municipal and agricultural water users should remain free market transactions. While the use of State-sponsored incentives should help to encourage alternative transfer methods, the state should not seek to regulate these transactions.

5.5.4.1 CONTINUE SUPPORT OF MEASURES TO MAINTAIN THE ECONOMY AND AGRICULTURAL PRODUCTION OF THE REPUBLICAN RIVER BASIN AND LONG-TERM COMPLIANCE WITH THE INTERSTATE WATER COMPACT

The SP-BIP will continue to support the Republican River Basin's compliance program and its largely agricultural economy which is under-going dramatic changes in water management as it complies with the requirements of the interstate water compact.

5.5.4.2 CONTINUE COMPLIANCE WITH THE SOUTH PLATTE COMPACT AND THE PRRIP

The South Platte and Metro Roundtables also recognize the importance of the PRRIP and its role in allowing continuing water uses and projects throughout the South Platte Basin. The SP-BIP will continue to support this program and incorporate its provisions in the Basin's future water supply plans.

5.5.5 Protect and Enhance Environmental and Recreation Attributes

Investigation into the required protections and enhancements of environmental and recreational attributes is ongoing. The methodology discussed in this plan will assist in determining areas where protections could be most beneficial to protecting a range of environmental and recreational attributes. It is essential for the adequate review of gaps in protection of environmental and recreational attributes that the data gaps and analysis gaps are filled in the future. Filling these data and analysis gaps can help quantify needs in focus areas and help the BRTs to better understand and evaluate the adequacy of protections and projects in maintaining and enhancing the environmental and recreational attributes.

Environmental and recreational specific projects can be implemented to enhance and protect attributes to contribute to healthier rivers and increase economic benefits from recreational uses. Projects should be proactively pursued to maintain and enhance the recreational and environmental attributes in the South Platte Basin.

Cooperation with M&I and Agricultural users is important to ensure that environmental and recreational attributes are protected or potentially enhanced by multi-purpose and collaborative projects.

Some examples of cooperative projects include fish passages, modification or improvements to dry-up points or diversion structures that inhibit fish passage, stewardship programs, instream flow programs with water rights components which dedicate historic consumptive use to a downstream user while improving streamflows within a reach of concern. Other collaborative operational agreements can include environmental pools in reservoirs to assist with needed environmental or recreational flows downstream of the reservoir or cooperative operation of portfolios of water rights to maintain consumptive benefit while providing environmental or recreational benefits by the movement of those water rights.

Providing reliable funding sources to assist with environmental and recreational projects is also essential for projects to move forward. Some of these funding sources include assisting with a portion of the funding needed for multipurpose projects so that environmental and recreational stakeholders can be a partner on such projects. While the project costs of mitigation lie on the shoulders of the project proponent, providing attribute enhancement is possible on multi-purpose cooperative projects if additional funding sources can be brought to the table. Talking with environmental and recreational stakeholders at the beginning of the planning process can potentially enhance planning opportunities as well as bring potential funding partners on the front end of a project.

Proactive collaboration among water sectors, including environmental and recreational needs, can benefit both consumptive uses and help to protect or enhance environmental and recreational flows. Multi-purpose projects should reflect the needs of the community to engage locally in the planning process. Various flood control and recovery efforts are underway which may result in funding partnership opportunities for environmental and recreational enhancements. Within the context of the flood recovery process in the South Platte, there are various watershed coalitions forming to assist in engaging local stakeholders.

5.5.6 Simultaneously Advance the Investigation, Preservation, and Development of New Colorado River Supply Options

The Metro and South Platte Roundtables believe in simultaneously advancing the investigation, preservation, and development of Colorado's entitlement under the Colorado River Compact and preserving the ability to pursue agricultural transfers. While neither extreme in the bookends approach is advocated, both of these options need to be preserved for water needs through 2050 and well beyond. Closing off either bookend option would be irresponsible to future generations who should be able to choose how to best use Colorado's water resources depending on the conditions they face at the time. A balanced approach should be sought while maintaining options for future generations, preserving and enhancing environmental and recreational values, and protecting private property rights.

There are several methods that help protect river segments from new diversions and reservoir impoundments. These methods include appropriation by the State of Colorado of new water rights for instream flows, donation of existing consumptive use established under previously decreed water rights to the State of Colorado for instream flows, appropriation of new water rights for recreational in-channel diversions, and federal designation of river reaches as Wild and Scenic under the Wild and Scenic Rivers Act. Alternative management plans to Wild and Scenic designation are also increasingly relied upon by diverse stakeholders to help protect river flow values. In their joint or individual application to a particular river and stream reaches, these methods all can help maintain important environmental and recreational values.

Some east slope water providers are concerned that stream flow protection measures are taking away opportunities for new transmountain development projects (TMDs). But for all their capacity to protect values associated with specific stream reaches to which they are applied, streamflow protection measures typically do not also account for impacts that could occur by limiting or preventing TMDs. To make decisions that balance water needs across the state, the state should weigh the tradeoffs and impacts to water development needs when streamflows are protected from water development. This tradeoff analysis should include the environmental, recreational, social and economic impacts of additional loss of east slope irrigated agricultural land that could occur when opportunities for TMD projects are lost.

Ideally the basin and state water planning processes will identify TMD projects that will minimize impacts and maximize benefits and find ways to both protect important streamflow values and preserve the ability to develop important TMD projects.

5.5.7 Manage the Risk of Increased Demands and Reduced Supplies

An important component of managing risk to the Metro and South Platte water supply is awareness and planning for variations from projected supply and demand. This can be implemented through the prudent use of safety factors, consideration of the risks associated with climate change, and building resilient water storage and conveyance infrastructure to withstand changes in supply as well as to provide reliability for environmental considerations such as recent wildfires and floods.

Past experience in the South Platte Basin, including the Buffalo Creek fire and a subsequent rain event that brought intake-clogging debris into Strontia Springs reservoir (a primary intake for Denver Water and Aurora Water), highlights potential vulnerabilities of municipal water systems to service disruptions. With concerns over increasing hydrologic variability including extreme weather events and the hydrologic response of our watersheds due to diminished forest health, water supply agencies in the South Platte Basin now have broader recognition of the need for diversity in water sources, redundancies in infrastructure capacity and adequacies of stored water for adverse or emergency situations. However, with increased competition for scarce water supplies, water agencies are constrained in their options and are looking for opportunities and solutions where risks and opportunities can be shared through collaborative, regional approaches (such the WISE Project being jointly developed by Denver Water, Aurora Water, and the South Metro Water Supply Authority).

5.5.8 Facilitate South Platte Communications and Outreach Programs

Facilitate South Platte communications and outreach programs as described in Section 4.1, including support of the State's programs, IBCC leadership and broad political and societal understanding that a good South Platte solution is also good for the State. Implementation and success of future projects will require public support.

5.5.9 Research New Technologies and Strategies

The ability for South Platte Basin M&I water agencies to use lower quality water supplies is greatly hindered by current technologies and regulatory requirements regarding the disposal of waste streams from advanced membrane treatment plants. The SP-BIP supports continued research and development of new strategies to address both the technical and regulatory issues. The Colorado Water Plan should also support and fund the research and development of new technologies and strategies that can improve projects to meet multiple demands, minimize costs and protect public health and safety.

5.5.9.1 WATER QUALITY CHALLENGES

Projects that take water from the lower reaches of rivers will require costly advanced water treatment. Growth in the Metro area also results in increased wastewater discharges, lower dilution flows, and an increase in the costs to treat water from the South Platte River. Reuse projects and diversions from the

South Platte in the mid-to-lower basin will require expensive advanced water treatment to deal with high levels of TDS. The two options for dealing with TDS include blending with higher quality supplies or advanced treatment including reverse osmosis. Blending and advanced treatment have different benefits and challenges. The challenges associated with blending include the availability of higher quality supplies which would likely have to come from the development of new Colorado River water. The challenges of advanced treatment are discussed below.

5.5.9.2 INDIRECT POTABLE REUSE AND DIRECT POTABLE REUSE

One strategy that will make more efficient use of water in the South Platte Basins will be to maximize the use of lower quality water sources including wastewater.

Wastewater is a valuable product that can be treated and processed to a high level of quality for multiple uses including human consumption. IPR is essentially a process of reclaiming water that has been returned to the environment prior to its being sequestered for water supply. This process has been in practice for many years wherein wastewater facilities discharge to a lake or river upstream from a drinking water plant intake.

Additional consideration should be given to DPR, which involves the direct use of highly treated wastewater effluent within a potable water system. The American Water Works Association (AWWA), along with the Water Environment Foundation (WEF), continues to evaluate the challenges and opportunities associated with DPR.

As treatment technologies continue to advance, DPR will become more viable. Technologies such as reverse osmosis (RO) membrane filtration offer promise in wider implementation of DPR. Providers throughout the western United States have been reluctant to build RO facilities due to the uncertainty surrounding the disposal of the waste concentrate (brine). However, new technologies focused on the minimization of concentrate, and eventually zero liquid discharge (ZLD), continue to advance. The Water Environment Research Foundation (WERF) is completing an evaluation of ZLD technologies as part of their Demonstration of Membrane Zero Liquid Discharge for Drinking Water Systems project.

As the State of Colorado continues to evaluate projects and methods that more efficiently use water from all sources, maintaining a proactive role in investigating technologies capable of treating low quality water sources will better inform future water supply decisions. The State needs to direct the Colorado Water Quality Control Commission to look for ways to assist and facilitate reuse.

5.5.10 Advocate for Improvements to Federal and State Permitting Processes

The future development and security of water in the South Platte Basin is dependent, in part, on the ability of water providers and municipalities to develop water supplies and plan for current and future populations. 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.

5.5.10.1 RECOMMENDATIONS TO IMPROVE THE FEDERAL PROCESS

- The State of Colorado could support a more efficient EIS process for water supply projects. This could include the development of a framework for analysis which can be used to assess future 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, Colorado Department of Natural Resources (DNR including CWCB), and the US Environmental Protection Agency (EPA) embarked upon a process called Collaborative Approach to Water Supply Permit Evaluation (CAWS). The major outcome of CAWS was an informal agreement among the three parties that conservation should be used as a demand reducer in analyzing the purpose and need for a project rather than during the alternatives analysis portion of the NEPA process. Though this informal agreement was not publicly documented, an important policy tool going forward could be the use of conservation as a demand reducer in the purpose and need segment of the EIS process. By doing this, water providers will have greater incentive to implement proactive conservation strategies to demonstrate decreased demand and strain on existing resources.
- Scoping for 404 or NEPA permitting must follow federally required processes. Delays often result when new areas of analysis are identified late in the permitting process after scoping has occurred. By ensuring that regulating agency concerns are addressed in their entirety during the scoping process, applicants can more accurately plan for the costs associated with the analysis and avoid delays.
- The state of Colorado could encourage the Corps and EPA Region 8 to revise their 1990 memorandum of agreement (MOA) on sequencing. Their current MOA says that the Corps must determine the Least Environmentally Damaging Practicable Alternative (LEDPA) first and then look at compensatory mitigation to authorize the LEDPA. A revision would enable public works projects to use compensatory mitigation in the identification of the LEDPA. This revision could be limited to public works projects.

5.5.10.2 RECOMMENDATIONS TO IMPROVE THE STATE PROCESS

The State of Colorado’s requirement for 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.

6

Performance Against Goals and Measurable Outcomes

6 Performance against Goals and Measurable Outcomes

Key Points:

- The SP-BIP consists of ten key strategic elements and three alternative water supply portfolios. Each of these ten elements is utilized in order to achieve the goals and measurable outcomes identified in Section 1.
  - Portfolio A, which relies exclusively on traditional "buy-and-dry" transfers from agricultural to M&I supply.
  - Portfolio B, which consists of solely in-basin supplies, will not create a balanced plan that meets the water quantity and quality needs of the diverse stakeholders of the South Platte Basin.
  - Portfolio C, which incorporates development of new Colorado River supplies from the Colorado River, offers the BRTs the potential of meeting the identified G&MOs to the greatest degree. This portfolio is a balanced solution that both maximizes the use of in-basin supplies and methods, and includes new Colorado River supplies to meet the needs of the South Platte Basin and the state as a whole.
- The BRTs recommend that additional analysis be conducted to further refine this Draft South Platte BIP including:
  - Refinement of the goals and measurable outcomes
  - Additional water availability and hydrologic analysis
  - Follow up to the HB 1278 South Platte Basin Groundwater study
  - Advanced analysis of alternative transfer methods
  - Further investigation of environmental and recreational attributes including those of the IPPs
  - Development of new Colorado River Supply strategies
  - Identification of potential East slope off-river storage
- Consideration of potential criteria for "State Water Projects" and consideration of alternatives for State sponsored water projects

The purpose of Section 6 is to provide a summary of the ways that the SP-BIP helps to achieve the Goals and Measurable Outcomes defined by the Basin Roundtables. This is a requirement set forth by the State in order to provide clear linkages between the identified goals of each Roundtable and the strategies offered by the SP-BIP to achieve them.

The SP-BIP consists of 10 key strategic elements and three alternative water supply portfolios as presented in Section 5. This section will evaluate how these elements and portfolios fit within the Overarching Themes and use the projects and methods identified in Section 4 to bolster water supply and help to achieve G&MOs presented in Section 1.

The South Platte and Metro Roundtables developed four overarching themes to guide the development of the Basin's G&MOs as follows:

OVERARCHING THEMES

1. ***A Good Colorado Plan Needs a Good South Platte Plan -*** The economies of the State's river basins are closely intertwined. A comprehensive South Platte basin plan will need to be consistent with the values represented in Governor Hickenlooper's executive order. A comprehensive and reliable solution to meeting the South Platte basin's consumptive, environmental and recreational water supply gaps benefits all of Colorado and all Coloradan's share the need for a viable South Platte plan. The "default" plan of continued and possibly extensive loss of agricultural production is not in Colorado's overall interest.

2. ***Solutions must be Pragmatic, Balanced and Consistent with Colorado Law and Property Rights*** – A useful basin implementation plan must deal with the realities of obtaining regulatory approvals.

3. ***The South Platte River Basin will continue its Leadership Role in Efficient Use and Management of Water -*** No person, company or institution operates without risk/ perils of change. The State's future as a whole (and the future of each of its river basins) depends on efficient, sustainable and collaborative solutions.

4. ***A Balanced Program is needed to Plan and Preserve Colorado River Options -*** A balanced program to plan and preserve options to responsibly develop Colorado River water to benefit both east slope and west slope consumptive, 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.

The Roundtables adopted G&MOs in each of the eight (8) categories below to guide the development of the South Platte Basin Implementation Plan:

1. Agriculture
2. Municipal Water Conservation, Reuse and Efficiency
3. Identified Projects and Processes
4. South Platte Storage and Other Infrastructure
5. Water Quality
6. New Colorado River Supplies
7. Environmental and Recreational
8. Statewide Long-term

Goals and Measureable Outcomes related to environmental and recreational needs and uses were developed by the Environmental and Recreational Subcommittee established by the Roundtables with West Sage Water Consultants under separate contract.

6.1 The Strategies and Alternative Portfolios Comprising the South Platte Basin Implementation Plan

Section 5 presented the ten key elements of the SP-BIP consisting of the following strategies:

1. Maximize Implementation of IPPs (recognizing that not all will be achieved or obtain currently-estimated yield);
2. Maintain leadership in conservation and reuse and implement additional measures to reduce water consumption rates (see Section 4.3);
3. Maximize use and effectiveness of native South Platte supplies
4. Minimize traditional agricultural buy-and-dry and maximize use of ATMs to extent practical and reliable;
5. Protect and enhance environmental and recreation attributes through collaboration with other water use sectors;
6. Simultaneously advance the investigation, preservation, and development of new Colorado River supply options;
7. Manage the Risk of Increased Demands and Reduced Supplies due to Climate Change
8. Facilitate effective South Platte communications and outreach programs that complement the State's overall program
9. Research new technologies and strategies
10. Advocate for Improvements to Federal and State Permitting Processes without lessening environmental protections

The SP-BIP also includes three portfolios of alternative water supply strategies as follows. Portfolios A-C offer unique benefits and challenges for future water supply in the South Platte Basin. Table 6-1 offers a comparative analysis of the advantages and disadvantages of each Portfolio. The key elements of each Portfolio are summarized below. Each Portfolio is also described in greater detail in Section 5.4.1.

Portfolio A – This is a "business-as-usual portfolio". It focuses only on traditional buy-and-dry agricultural transfers would likely result in an undesired loss of irrigated agriculture to meet the anticipated future M&I and SSI Gaps. Under medium demand growth, the M&I and SSI gap in 2050 is estimated to be 412,000 AFY. Using the methodology from SWSI 2010 for determining the irrigated acreage needed to meet the M&I and SSI gap, approximately 422,000 irrigated acres would need to be transferred. This represents a nearly 50 percent reduction in the current irrigated acreage within the South Platte Basin.

Portfolio B –This is primarily an in-basin portfolio utilizing additional conservation, reuse, agricultural transfers using ATMs, and multipurpose/ cooperative water supply projects including additional east slope storage and conveyance infrastructure. Under a medium success rate (60 percent), the implementation of IPPs is estimated to yield 178,000 AFY by 2050. The only transbasin projects and methods anticipated in Portfolio B are current IPPs under development or existing projects

Portfolio C **–** This is a balanced portfolio with in-basin methods and new Colorado River supplies. Portfolio C anticipates the successful implementation of IPPs under development or already existing, as well as in basin surface storage and conservation measures. In addition, under Portfolio C new Colorado River basin supplies would be developed. Previous work considered a wide range of options. For this portfolio, with approximately 150,000 AFY from the Colorado River Basin, the reduction in agricultural irrigation will be approximately 45,000 acres or approximately 5 percent of current irrigated acres in the Basin.

Portfolio	Benefits	Challenges
A	• Many municipal suppliers have considerable experience in identifying willing sellers for agricultural water acquisitions and negotiating price and conditions for the transactions • Reliable assessments of yield can generally be made based on historic diversion and crop data • Transactional costs for water right change cases can generally be made • Agricultural transfers typically require little to no permitting	• Significant decrease in total irrigated acreage in the South Platte Basin (approximately 50% decrease) • Change of use proceedings in water court are costly and time consuming • Treatment of lower South Platte River supplies may require advanced processes such as reverse osmosis, adding significant cost for planning, design, and construction and operations • Disposal of treatment waste streams (brine) may pose difficult permitting challenges • Social costs associated with the loss of half of the irrigated agriculture in the South Platte Basin could be substantial and heavily impact funding for existing public services to decreased economic activity and assessed valuations • Agricultural processing in the South Platte Basin supports agricultural production statewide. The lost revenue associated with buy and dry would adversely affect the economic of the entire state • Potential harm to environmental attributes of the South Platte Basin including wildlife habitat, erosion, water quality and biological diversity.
B	• Storing water during high runoff or free river conditions would increase firm yield and allow greater operational flexibility in droughts. • Flood reduction benefits if projects can be configured to skim high water levels. • More fully developing the existing transbasin supplies for the South Platte Basin could provide valuable blending opportunities and delay or reduce costs for advanced treatment of lower South Platte River water • Firming supplies through conjunctive use of groundwater supplies would provide greater water supply security for drought conditions	• A substantial amount of water would still need to be acquired through traditional buy and dry practices • Anticipated loss of irrigated agriculture due to buy and dry could result in economic, social and environmental impacts to the greater South Platte Basin as well as the state of Colorado • Treatment of supplies taken from the South Platte River could challenge municipal and industrial water providers. More advanced treatment may be necessary such as reverse osmosis, which requires significant costs for planning, development, and disposal of brine or other by products from these facilities • The permitting time required to fully develop IPPs and additional storage within the South Platte could be significant. If both state and federal permitting requirements are triggered, the processes could delay the availability of water supplies for many years

C	• Would provide a large amount of water in one increment rather than many smaller projects that could be delayed or halted • Partnerships for large scale projects would provide greater economy of scale and overall benefit • The development of a Colorado River Basin project could be an economic benefit to all of Colorado by providing a more reliable water supply and developing major new infrastructure • Conjunctive use of groundwater and surface water would allow for a more secure water supply when Colorado River supplies are not available • The State of Colorado could better utilize its allocation of the Colorado River water • Additional higher quality water will allow more extensive blending with lower quality water resulting in lower capital and long-term treatment costs and more predictable project permitting	• The time required to plan, permit, design and implement a new Colorado River project would take many years • While environmental benefits in the South Platte would be improved through developing additional water from the Colorado River Basin, major environmental and recreational components on the West Slope would need to be thoroughly evaluated. • Though development of Colorado River supplies would improve the reliability of water within the State of Colorado, there are political controversies that result in implementation challenges.

6.2 Performance of the Plan Elements and Alternative Portfolios

Table 6-1 below rates the degree to which the 10 Elements of the South Platte BIP and the Alternative Portfolios described in Section 5 meet the G&MOs identified in Section 1. The colors (green, yellow, and red) offer a guideline as to the extent to which each element contributes to meeting the cross-referenced MO.

⬆ (green)	Significantly contributes to G&MO
▬ (yellow)	Somewhat contributes to G&MO
⬇ (red)	Does not contribute to G&MO
White	Does not apply to G&MO

The ratings are generally qualitative in nature considering that the G&MOs developed to date are not yet numerical criteria and the performance of the alternative portfolios are also not yet quantified.

The Alternative Portfolios "with additional conservation" have ratings matching those of the Medium Demand Scenario. Although the magnitude of the M&I gap is reduced with additional conservation, the general compatibility with the G&MOs is unchanged. If future work leads to quantifiable G&MOs and Portfolio performance is further evaluated these ratings may change. The portfolios with climate change also show similar performance. Climate change is projected to increase hydrologic variability, the frequency of droughts in Colorado, and, as a result of increasing temperatures, water yields may, in general, decrease. Warmer temperatures will likely result in precipitation occurring as rain rather than snow, an earlier spring melt, more intense precipitation events, and increased evapotranspiration. Consequently, runoff would start earlier and reservoirs would fill earlier. The water that cannot be stored in the spring and early summer will be unavailable when agricultural and lawn irrigation highest in mid to late summer. Decreased runoff in the summer could result in additional reservoir drawdown and many studies agree that higher temperatures and lower precipitation during summer months will further increase agricultural demands, thus causing even more stress on reservoir storage. The CWCB anticipates publication of update to their previous climate change report soon and a detailed description of potential effects is available in Appendix I of the SWSI 2010 Report. The G&MOs currently do not address climate change, however, climate change was considered in the alternative portfolios.

Table 6-1. How the Plan Meets the Goals and Measureable Outcomes

Overarching Theme, Goal and Measurable Outcome	The Ten Elements of the SP-BIP										Alternative Portfolios								
											Medium Demand Scenario			With Additional Conservation			With Climate Change		
	1	2	3	4	5	6	7	8	9	10	A	B	C	A	B	C	A	B	C
Overarching Themes	*Identified Projects and Processes*	*Conservation, Efficiency, and Reuse*	*Effectiveness of Native South Platte supplies*	*Minimize "buy and dry" through use of ATMs*	*Environmental and Recreational Protection*	*New Colorado River supply Options*	*Climate Change Impacts (1)*	*South Platte Outreach and Education*	*New Technologies and Strategies*	*Improved Permitting Processes*	*Traditional "Buy & Dry"*	*Maximize South Platte Supply*	*Maximize South Platte Supply and Develop Colorado River Supplies*	*Traditional "Buy & Dry"*	*Maximize South Platte Supply*	*Maximize South Platte Supply and Develop Colorado River Supplies*	*Traditional "Buy & Dry"*	*Maximize South Platte Supply*	*Maximize South Platte Supply and Develop Colorado River Supplies*
A Good Colorado Plan Needs a Good South Platte Plan											↓	▬	↑	↓	▬	↑	↓	↓	↑
Solutions must be Pragmatic, Balanced and Consistent with Colorado Law and Property Rights											↓	▬	▬	↓	▬	▬	↓	▬	▬
The South Platte River Basin will continue its Leadership Role in Efficient Use and Management of Water											↓	↑	↑	▬	↑	↑	▬	↑	↑
A Balanced Program is needed to Plan and Preserve Colorado River Options											↓	↓	↑	↓	↓	↑	↓	↓	↑
1. Agricultural G&MOs	***Goal***: Fully recognize the importance of agriculture to Colorado's future well-being and support its continued success																		
Measurable Outcomes:																			
Reduce dry-up of irrigated acreage & use ATMs to maintain agricultural production and rural economies.	↑		↑	↑	▬	↑			↑	▬	↓	▬	↑	↓	▬	↑	↓	↓	↑
Support strategies by municipalities and other local and state land use authorities that reduce urbanization on irrigated acreage	↑		↑	↑	▬	↑		↑	↑	↑	↓	▬	↑	↓	▬	↑	↓	↓	↑
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.				▬	↑	▬					↓	▬	▬	↓	↓	▬	↓	↓	▬
2. M&I G&MOs	***Goal***: Continue the South Platte River Basin's leadership in wise water use																		
Measurable Outcomes:																			
Quantify past successes & establish baseline		↑	↑		▬			↑			↓	↓	↑	↓	↑	↑	↓	↑	↑
Encourage adoption of "best management practices" as "guidelines"	↑	↑	↑	↑	▬			↑	↑		↓	↑	↑	↓	↑	↑	↓	↑	↑
Maintain and enhance current levels of reuse & consider studies to quantify the effects of additional reuse	↑	↑	↑	↑				▬	↑	▬	↓	↑	↑	↓	↑	↑	↓	↑	↑
Ensure conservation, reuse and drought management plans consider environment and recreation					↑						↓	▬	▬	↓	↓	▬	↓	↓	▬
3. IPP Implementation G&MOs	***Goal:*** Bring a high percentage of updated IPPs on-line																		
Measurable Outcomes:																			
Maximize implementation of the updated IPP list.	↑	▬	↑	↑	▬	↑			↑	↑	↓	▬	↑	↓	▬	↑	↓	▬	↑
Encourage projects that also provide environmental and recreational considerations	▬			▬	↑						▬	▬	▬	▬	▬	▬	▬	▬	▬
Take into consideration environmental and recreational attributes when incorporating IPPs	▬			▬	↑						▬	▬	▬	▬	▬	▬	▬	▬	▬

Overarching Theme, Goal and Measurable Outcome	The Ten Elements of the SP-BIP										Alternative Portfolios								
											Medium Demand Scenario			With Additional Conservation			With Climate Change		
	1	2	3	4	5	6	7	8	9	10	A	B	C	A	B	C	A	B	C
Overarching Themes	*Identified Projects and Processes*	*Conservation, Efficiency, and Reuse*	*Effectiveness of Native South Platte supplies*	*Minimize "buy and dry" through use of ATMs*	*Environmental and Recreational Protection*	*New Colorado River supply Options*	*Climate Change Impacts (1)*	*South Platte Outreach and Education*	*New Technologies and Strategies*	*Improved Permitting Processes*	*Traditional "Buy & Dry"*	*Maximize South Platte Supply*	*Maximize South Platte Supply and Develop Colorado River Supplies*	*Traditional "Buy & Dry"*	*Maximize South Platte Supply*	*Maximize South Platte Supply and Develop Colorado River Supplies*	*Traditional "Buy & Dry"*	*Maximize South Platte Supply*	*Maximize South Platte Supply and Develop Colorado River Supplies*
4. South Platte Storage & Infrastructure G&MOs	***Goal:*** To the extent possible, develop multipurpose storage, conveyance, system interconnections and other infrastructure projects																		
Measurable Outcomes:																			
Maximize yield from additional South Platte basin strategic and multipurpose storage and other infrastructure	↑	↑	↑	↑	▬				↑	↑	↓	▬	↑	↓	▬	↑	↓	▬	↑
Encourage multipurpose projects that provide environmental and recreational considerations	▬			▬	↑						▬	▬	▬	▬	▬	▬	▬	▬	▬
Take into consideration environmental and recreational attributes	▬			▬	↑						▬	▬	▬	▬	▬	▬	▬	▬	▬
5. Water Quality G&MOs	***Goal:*** Maintain, enhance and proactively manage water quality for all use classifications																		
Measurable Outcomes:																			
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					↑						↓	▬	▬	↓	↓	▬	↓	↓	▬
6. New Colorado River Supply G&MOs	***Goal:*** Develop processes and/or agreements governing additional transbasin water imports																		
Measurable Outcomes:																			
Negotiate a conceptual agreement with the West Slope BRTs on planning and preserving potential options	↑	↑		↑	↑	↑			↑	↑	↓	↓	↑	↓	↓	↑	↓	↓	↑
Encourage multipurpose projects that provide environmental and recreational considerations	▬			▬	↑	▬					↓	↓	▬	↓	↓	▬	↓	↓	▬
7. Environmental & Recreational G&MOs	***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. (2)																		
Measurable Outcomes:																			
Promote Restoration, Recovery, and Sustainability of Endangered, Threatened, and Imperiled Aquatic, Riparian and Wetland Dependent Species and Plant Communities	▬			▬	↑	▬		▬	▬	▬	↓	↓	▬	↓	↓	▬	↓	↓	▬
Protect and Enhance Economic Values to Local and Statewide Economies Derived from Environmental and Recreational Water Uses	▬			▬	↑	▬		▬	▬	▬	↓	↓	▬	↓	↓	▬	↓	↓	▬
Protect, Maintain, and Improve Conditions of Streams, Lakes, Wetlands, and Riparian Areas to Promote Self-Sustaining Fisheries and Functional Riparian and Wetland Habitat	▬			▬	↑	▬		▬	▬	▬	↓	↓	▬	↓	↓	▬	↓	↓	▬

Overarching Theme, Goal and Measurable Outcome	The Ten Elements of the SP-BIP										Alternative Portfolios								
											Medium Demand Scenario			With Additional Conservation			With Climate Change		
	1	2	3	4	5	6	7	8	9	10	A	B	C	A	B	C	A	B	C
Overarching Themes	*Identified Projects and Processes*	*Conservation, Efficiency, and Reuse*	*Effectiveness of Native South Platte supplies*	*Minimize "buy and dry" through use of ATMs*	*Environmental and Recreational Protection*	*New Colorado River supply Options*	*Climate Change Impacts (1)*	*South Platte Outreach and Education*	*New Technologies and Strategies*	*Improved Permitting Processes*	*Traditional "Buy & Dry"*	*Maximize South Platte Supply*	*Maximize South Platte Supply and Develop Colorado River Supplies*	*Traditional "Buy & Dry"*	*Maximize South Platte Supply*	*Maximize South Platte Supply and Develop Colorado River Supplies*	*Traditional "Buy & Dry"*	*Maximize South Platte Supply*	*Maximize South Platte Supply and Develop Colorado River Supplies*
8. Statewide Long-term G&MOs (per the Executive Order)																			
Goal #1: Meet Community Water Needs throughout Colorado	↑		▬	↑	▬	↑		▬	↑	↑	↓	↓	↑	↓	↓	↑	↓	↓	▬
Goal #2: Meet Colorado's Agricultural Needs	▬		▬	▬	▬	▬			▬	▬	↓	▬	▬	↓	▬	▬	↓	↓	▬
Goal #3: Meet Colorado's Environmental and Recreational Needs	↑	▬		▬	↑	▬		↑	↑	▬	↓	▬	▬	↓	▬	▬	↓	▬	▬
Goal #4: Meet Colorado's Water Quality Management	▬		▬	▬	↑	↑			↑	↑	↓	↓	↑	↓	↓	↑	↓	↓	↑

(1) The G&MOs currently do not address climate change, however, climate change was considered in the alternative portfolios.

(2) Please note the inclusion of existing projects below is to encourage cooperative agreements when and where possible. This language does not suggest scrutinizing existing projects but rather continuing to keep the focus areas in mind when possible cooperative re-operation or enhancements with willing project owners may benefit the environmental and recreational attributes.

6.3 Environmental and Recreational Performance against Goals and Measureable Outcomes

The projects described in the plan are examples that can be used in other areas in the basin. The methodology presented in Appendix D can be used to further refine the GMOs to assist in determining of the plan meets the measurable outcomes. The projects go toward meeting the specific goal or measurable outcome that is specified within the discussion on each project.

6.4 Conclusions

Through the development of the G&MOs, the Roundtables expressed the importance of an integrated approach that meets the Basin's M&I, agricultural, and environmental and recreations needs. Table 6.1 (above) demonstrates that, for each of the MOs, at least one of the ten elements of the SP-BIP contributes significantly to accomplishing it (signified by at least one green box in each row). In this sense, each of the MOs adopted at the outset of the SP-BIP has been covered by a strategy in the Plan.

Comparing the alternative water supply portfolios (A, B and C) in relation to the MOs shows the deficiencies of the Portfolio A. It relies exclusively on traditional "buy-and-dry" transfers from agricultural to M&I supply. As explained in Section 5, Portfolio A's approach is not recommended by the Roundtables'. Portfolio B, which consists of solely in-basin supplies, will not create a balanced plan that meets the water quantity and quality needs of the diverse stakeholders of the South Platte Basin. This is demonstrated by the inability of Portfolio B to significantly contribute to the MOs in the above table. Portfolio C, which incorporates development of new Colorado River supplies, offers the Roundtables the best opportunity to meet the identified G&MOs. This portfolio is a balanced solution that both maximizes the use of in-basin supplies and methods, and includes new Colorado River supplies to meet the needs of the South Platte Basin.

6.5 Recommendations for Additional SP-BIP Analysis and Refinement

The SP-BIP (v. 1.0) defines the South Platte and Metro Basin Roundtable's Goals and Measurable Outcomes and the strategies developed to meet them. These strategies are derived from previous water supply studies, information produced by specific water providers, and data from by the CWCB. As such, the Roundtables recommend that additional analysis be conducted to further refine the South Platte BIP.

Additional analysis and refinements to the South Platte BIP Include:

- ***Refinement of SP Goals and Measurable Outcomes***—The South Platte BRT and Metro BRT recommend further refinement of the G&MO identified in the SP-BIP. The Roundtables will coordinate with CWCB staff in an attempt to better frame the South Platte's G&MO's for inclusion in the Draft CWP.

- ***Water Availability/Hydrologic Modeling***—further analysis of the availability of water supplies in the South Platte Basin through additional hydrologic modeling, water rights analysis and yield analysis will provide for a greater definition of the limitations facing the South Platte Basin. Additionally, modeling of the agricultural shortages will provide data that is not presently available but is necessary to more fully understand the total demands of the basin. Without clearer definition of agricultural shortages, the amount of water needed to meet the G&MO's is not known.

- ***Follow up to HB 1278 South Platte Basin Groundwater Study***—The South Platte Basin Roundtable and Metro Basin Roundtable adopted "Proposed Plan for the South Platte Basin Roundtable follow-up to HB 1278 Study Report" at their April 8, 2014 and April 9, 2014 meetings, respectfully. The HB 1278 Study of the South Platte River Alluvial Aquifer was performed to help address issues with groundwater wells lacking court-adjudicated augmentation plans to replace out of priority depletions. The study reviewed the water management history, diversion history and recharge into the alluvial aquifer of the South Platte Basin. The study concluded that changes in water administration (specifically the curtailment of wells) has protected senior surface water owners but also resulted in "increasing groundwater levels in the basin" (Executive Summary, HB 1278 South Platte Groundwater Study, 12). The roundtables plan to "identify some specific steps that [they] will take and a proposed timetable for taking them, to follow up the HB 1278 [South Platte Groundwater] Study" (Proposed Plan for SP BRT follow up to HB 1278 Study Report, April 8, 2014).

- ***Advanced Analysis of ATMs***—The South Platte BRT and Metro BRT's overarching goal to support the continued success of agriculture can be partially accomplished by expanding ATMs. However, additional information is needed for the effective, efficient and most beneficial implementation of ATMs. Specifically, the BRT's recommend continued research, testing and documentation of strategies for agricultural and M&I water-sharing partnerships through ATMs.

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

- ***Further Geographic, Quantitative and Temporal Disaggregation of the M&I Gap***—The M&I gap in the South Platte Basin presented in Section 4 was initially divided into six regional subbasins in SWSI 2010: Upper Mountain, Denver Metro, South Metro, Northern, Lower Platte, and High Plains. For the purpose of the draft SP BIP, each subbasin was further disaggregated to the county level. Further disaggregation of the M&I gap is essential information for the BRTs to develop potential alternatives for meeting the M&I gap. This disaggregation should identify specific geographic, quantitative, and temporal elements of the M&I gap in the counties and areas spanning county boundaries of the basin with the highest projected gaps (such as Arapahoe, Adams, Broomfield, Boulder, Denver, Douglas, Jefferson, Larimer, and Weld), BRTs recommend using available information to the extent possible, additional data collection, and, to the extent necessary, the development of planning assumptions consistent with SWSI 2010.

- ***Investigation of Environmental and Recreational Attributes of IPP's***— The South Platte BRT and Metro BRT recommend the further development, investigation and documentation of projects and methods and the presence and sufficiency of those projects and methods in enhancing and protecting environmental and recreational attributes. This should be done first for all South Platte Focus Areas where opportunities arise for new or additional projects or methods to be planned or implemented. Additional data that is properly linked to existing data is key to reviewing the sufficiency of projects and protections of environmental and recreational attributes.

- ***Develop New Colorado River Supply Strategies***—The South Platte BRT and Metro BRT recommend continued consideration of new Colorado River supply strategies through IBCC representatives. In addition, the integration of new Colorado River supply as proposed in Portfolio C should be further refined.

- ***Identification of Potential East Slope Off-River Storage***— The ability to store water as it is available is of paramount importance for South Platte water users. To meet the South Platte BIP GMO of maximizing use and effectiveness of native South Platte supplies, additional east slope storage is needed. The South Platte BIP recommends the investigation and identification of potential additional East Slope off-river storage opportunities including potential ASR projects. Portfolios B and C could both benefit from additional East Slope storage.

- ***Consider Potential Criteria for "State Water Projects"***—The South Platte BIP recommends further analysis and elaboration on criteria for a water project to be endorsed by the Colorado as a "State Water Project". This analysis would include benefits and challenges associated with state endorsement of a water project. Potential benefits could include: funding through state issued grants or loans, improved permitting processes, and other benefits.

- ***Consider Alternatives to State Sponsored Water Project(s)***—The South Platte BIP recommends further analysis of alternatives to state sponsorship including the possibility of a regional entity or entities to implement solutions including the financing of up front capital costs.

Appendix A – Draft SWSI Glossary

The following is an excerpt from the DRAFT SWSI 2016 Glossary with definitions specific to the South Platte Basin Implementation Plan and changes indicated by strikethroughs/brackets and italics.

DRAFT SWSI GLOSSARY:

- **Municipal and Industrial Related Terms:**
  - **Municipal and Industrial (M&I) Demand:** Water demand for municipal and industrial uses within a municipal distribution system that can be potable, raw and/or reuse water. This includes residential (single family and multi-family) and non-residential (commercial, industrial, institutional) uses of water within a water provider's service area in addition to water loss present in the distribution system.
  - **Current M&I Water Demands:** Current treated water deliveries reflective of a typical water year.
  - **M&I Water Usage Rate:** gallons per capita per day
  - **Municipal and Industrial (M&I) Water Efficiency:** Water efficiency includes the practices, techniques and technologies that extend water supplies either directly through water savings or through substituting alternative supplies such as reuse. M&I water efficiency includes both system demands and customer water demands within a water provider's system.
  - **Passive Conservation:** Reductions to the M & I water demand from the natural replacement of indoor plumbing fixtures due to the impacts of plumbing codes, ordinances and standards that change the marketplace and improve the efficiency of water use.
  - **Future Population Projection:** One of the low, medium or high population projections dependent on which scenario is used.
  - **Future Municipal and Industrial (M&I) Demand:** Water demands for municipal and industrial uses in 2050. This will vary for low, medium, and high project*[ion]*s dependent on the drivers in the scenarios. This variable is defined by M&I water usage rates applied to future population projections while subtracting passive conservation.
  - **M&I Identified Projects and Processes (IPPs):** IPPs must meet the following criteria
    - The project or method has a project or method proponent.
    - When the proponent is a retail water provider, the project or method is being used to meet the water supply needs of its customers by 2050.
    - When the project proponent is a wholesale water provider, at least one retail water provider must express interest in writing and plan on using the project or method to meet the water supply needs of its customers by 2050.
    - The project or method must have at least preliminary planning, design, conditional or absolute water rights, rights of way, and/or negotiations captured in writing with local governments that the water project could affect.
    - The water supply needs must be identified and included in the Basin Implementation Plans and/or SWSI documents.
  - **M&I Gap:** The amount of future M&I demands not met by *[IPPs and passive conservation]* ~~*the no and low regrets*~~. This varies both by scenario and by how much the *[IPPs]* ~~*no and low regrets*~~ are implemented.
- **Self Supplied Industrial Related Terms**
  - **Self Supplied Industrial (SSI) Needs:** Water needs for self supplied industrial uses in 2050. This includes demands for large industry, snowmaking, thermoelectric power generation, energy development, and other extraction industries. This will vary for low, medium, and high projects dependent on the drivers in the scenarios.
  - **SSI Identified Projects and Processes (IPPs):** IPPs must meet the following criteria

        - The project or method has a project or method proponent.
        - The proponent plans for the project or method to be used to meet the water supply needs of its SSI needs by 2050.
        - The project or method must have at least preliminary planning, design, conditional or absolute water rights, rights of way, and/or negotiations captured in writing with local governments which the water project could effect.
        - The water supply needs must be identified and included in the Basin Implementation Plans and/or SWSI documents.
    - **SSI Gap:** The amount of future SSI needs not met by the SSI IPPs. This varies both by scenario and by how much the IPPs are implemented.

- **Agricultural Related Terms:**
    - **Current Irrigated Acres:** Acres under irrigation by either surface or groundwater as identified by the most recent inventory.
    - **Future Irrigated Acres:** Anticipated acres under irrigation by either surface or groundwater.
    - **Irrigation Water Requirement:** Volume of irrigation water required from surface or ground water diversions to completely satisfy a crop's consumptive needs associated with a specific acreage. Calculated as potential evapotranspiration less effective precipitation and stored winter precipitation.
    - **Water Supply Limited Consumptive Use:** The amount of water actually used by the crop, limited by water availability; both legal and physical.
    - **Agricultural Irrigation *~~Shortage~~ [Gap]*:** The difference between Water Supply Limited Consumptive Use and Irrigation Water Requirement. A shortage reflects the fact that consumption to the full extent of IWR was not realized, and reveals the difference between what could be achieved if yields and irrigable acreage were maximized and what is actually produced under existing legal and physical conditions.
    - **Non-irrigation Agricultural Demand:** Agricultural demand that is not directly associated with crop consumption that includes three other types of consumptive use that are associated with agricultural activity: 1) livestock consumptive use, 2) stockpond evaporation, 3) losses incidental to delivering irrigation water (incidental losses).
    - **Current Agricultural Demand:** The average amount of water consumptively used by crops on lands currently under irrigation.
    - **Future Agricultural Demand:** The average amount of water projected to be consumptively used by crops on lands expected to be under irrigation at some point in the future.
    - **Agricultural IPPs (for both irrigation and non-irrigation demand):** IPPs must meet the following criteria:
        - The project or method has a project or method proponent.
        - When the proponent is a retail water provider, the project or method is being used to meet the water supply needs of its customers by 2050.
        - When the project proponent is a wholesale water provider, at least one retail water provider must express interest in writing and plan on using the project or method to meet the water supply needs of its customers by 2050.
        - The project or method must have at least preliminary planning, design, conditional or absolute water rights, rights of way, and/or negotiations captured in writing with local governments that the water project could affect.
        - The water supply needs must be identified and included in the Basin Implementation Plans and/or SWSI documents.
    -

- **Total Consumptive Needs Related Terms**
  - **Total ~~*Consumptive*~~ *[M&I and SSI]* Needs:** Water needs for municipal and industrial (M&I)~~,~~ *[and]* self supplied industrial (SSI)~~, *and agricultural uses*~~ in 2050. This will vary for low, medium, and high project*[ion]*s dependent on the drivers in the scenarios.
  - **Total ~~*Consumptive*~~ Identified Projects and Processes (IPPs):** The sum of IPPs for M&I~~,~~ *[and]* SSI, ~~and agriculture~~.
  - **Total ~~*Consumptive Needs*~~ *[M&I and SSI]* Gap:** The amount of future ~~*consumptive*~~ *[M&I and SSI]* needs not met by the IPPs or *[passive conservation]* ~~*no and low regrets*~~. This varies both by scenario and by how much the IPPs ~~*and no and low regrets*~~ are implemented.
- **Scenario Planning Relate*[d]* Terms:**
  - **Scenarios:** Plausible alternative futures
  - **Portfolios:** Different combinations of strategies to address future M&I demands
  - **Drivers:** Drivers are forces or the factors beyond the control of the water community that will likely have the greatest influence on the future state or scenario of Colorado and thereby Colorado's water management over time. Because not all driving forces influence the system to the same degree or contribute the same level of uncertainty, primary drivers that represent the most uncertain and are of the most importance were developed. Primary drivers are water supply, water demand, and social values. Secondary drivers influence the primary drivers and include population growth, climate change, and other influencing factors.
- **BIP Related Terms *[per CWCB]***
  - **Goals:** Broad objectives each basin would like to accomplish in order to meet its consumptive and nonconsumptive needs as well as other topics critical to the basin.
  - **Measurable Outcomes:** How each goal can be measurably achieved.
- **Water Supply Related Terms:**
  - **Climate Change:** Climate change refers to a change in the state of the climate (e.g. temperature, precipitation, or hydrology) that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as: 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'. The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes.
  - **Climate Variability:** Climate variability refers to variations in the mean state and other statistics (such as standard deviations, statistics of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forces (external variability).
  - **Historical hydrology-** Recorded streamflows from the observed time period.
  - **Climate-adjusted Hydrology -** An adjustment to the historical natural streamflow regime to reflect conditions that may occur under an altered climate.
  - **Surface Water Supply Availability:** Water that is legally and physically available to meet current or future consumptive or nonconsumptive water needs. The availability of water varies depending on whether a scenario is considering 20th century observed hydrology, hot and dry climate change, or somewhere in between the two.

- **Groundwater Supply Availability-** Water located below ground that is legally and physically available to meet current or future consumptive or nonconsumptive water needs.

- **Nonconsumptive Related Terms:**
  - **Nonconsumptive Attribute:** An environmental or recreational value, such as species, community of species, or other value deemed as important to the basin roundtable. Examples include Colorado cutthroat trout, important fishing area, rare wetland plant community, and important boating area.
  - **Nonconsumptive Need:** The physical and chemical demand needed to sustain a nonconsumptive attribute in a specific location defined by the basin roundtables as being important. This could include flow, channel morphology, or temperature levels.
  - **Focus Area:** A stream reach or watershed identified by the basin roundtables as having important nonconsumptive attributes.
  - **Nonconsumptive IPP:** Nonconsumptive IPPs must have the following criteria:
    - The project or method has a project or method proponent.
    - The project proponent plans to utilize the project to meet nonconsumptive needs by 2050.
    - The project or method must have at least one of the following: preliminary planning, design, conditional or absolute water rights, rights of way, and/or negotiations captured in writing with local governments or consumptive water users that the project could affect.
    - The nonconsumptive needs must be identified and included in the Basin Implementation Plans and/or SWSI documents.
  - **Nonconsumptive New Proposed Project or Method:** Additional projects and methods identified by the roundtables that could meet future water needs, but don't meet the criteria of IPPs.
  - **Nonconsumptive Gap:** The difference between what the basin indicates it wants to achieve with regard to meeting its nonconsumptive needs, as defined in its goals and measurable outcomes, and what projects and methods it has determined could be implemented to meet those needs.

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Appendix B – Environmental and Recreational Focus Area Mapping Update

Contents

Environmental and Recreational Focus Area Mapping Update

The Focus Areas developed in Statewide Water Supply Initiative (SWSI) 2010 for the South Platte Basin were updated for inclusion into the South Platte Basin Implementation Plan. The methodology for the update of the focus area mapping is described in detail in this technical memorandum.

1 SWSI 2010 Focus Area Mapping

Reference Documents

The following discussion is based upon:

SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- South Platte Basin Needs Assessment and Appendix C of SWSI 2010

As part of the Water for the 21st Century Act, the basin roundtables were required to complete Nonconsumptive Needs Assessments (NCNAs). The SWSI efforts have produced some NCNAs and mapping of environmental and recreational attributes. This effort has included an extensive inventory, analysis, and synthesized mapping effort that built upon the SWSI 2 environmental and recreational attribute mapping as a common technical platform for the basin roundtables. The basin roundtables have utilized environmental and recreational mapping to identify where the nonconsumptive focus areas exist within the basin. The basin roundtables' nonconsumptive focus areas and further study efforts are intended to facilitate the identification of projects and methods to address environmental and recreational water needs.

The Focus Area maps developed by each basin roundtable are based on a common set of environmental and recreational attributes representing where Colorado's important water-based environmental and recreational attributes are located. The maps are reflective of stakeholder input for the focus areas and also reflect stream reaches and subwatersheds with higher concentrations of environmental and recreational qualities. These maps were generated to provide information to the basin roundtables on important environmental and recreational areas in their basins but were not intended to dictate future actions. It should be noted, and as will be shown in this section, that this effort has not identified all streams as important. The NCNAs are not intended to create a water right for the environment and will not diminish, impair, or cause injury to existing absolute or conditional water rights. The CWCB and basin roundtable developed the environmental and recreational focus area mapping for the following purposes:

- The maps are intended to provide useful information for water supply planning so that future conflicts over environmental and recreational needs can be avoided.
- The maps can assist in identifying environmental and recreational water needs status, such as where needs are being met, where additional future study may need to take place, or where implementation projects in the basin are needed.
- The maps can help basins plan for the water needs of species of special concern so that they do not become state or federally-listed as endangered or threatened in the future.
- The maps can provide opportunity for collaborative efforts for future multi-objective projects.

The South Platte Basin Roundtable and Metro Roundtable reviewed all available data layers for their basin, and based on stakeholder knowledge and outreach, selected stream reaches that represented the majority of environmental and recreational activity in their basins. The environmental and recreational data layers for each basin were selected using the SWSI 2 GIS data layers as a starting point. The basin roundtables reviewed the available data layers compiled during SWSI 2 and then suggested and contributed additional data layers as deemed appropriate for each basin. The SWSI 2010 Report's Appendix C contains the Nonconsumptive Needs Assessment Focus Mapping Final Report that provides the detailed methodology utilized by each basin roundtable in developing their focus area map.

The South Platte Basin examined their collected environmental and recreational data layers and utilized a stakeholder process to establish what the environmental and recreational Focus Areas should be for their respective basins. The basin roundtables summarized their environmental and recreational attributes on a map and created a table summarizing why the segment was included as a focus area and important attributes for each segment.

The South Platte Basin NCNA subcommittee opted to use the term "Candidate Focus Areas" for its major segments with environmental, recreational, and environmental and recreational nonconsumptive water attributes. The South Platte Basin also divided the basin into the following sub-basins—High Plains, Lower South Platte, Northern, Denver Metro, Upper Mountain, and South Metro.

More information regarding the methodology used by CDM and CWCB to produce the original focus areas can be found in the South Platte Basin Needs Assessment and Appendix C of SWSI 2010. Included below are the Focus Area map and table from Appendix C of SWSI 2010.

Figure 1 - SWSI 2010 South Platte Focus Area Map

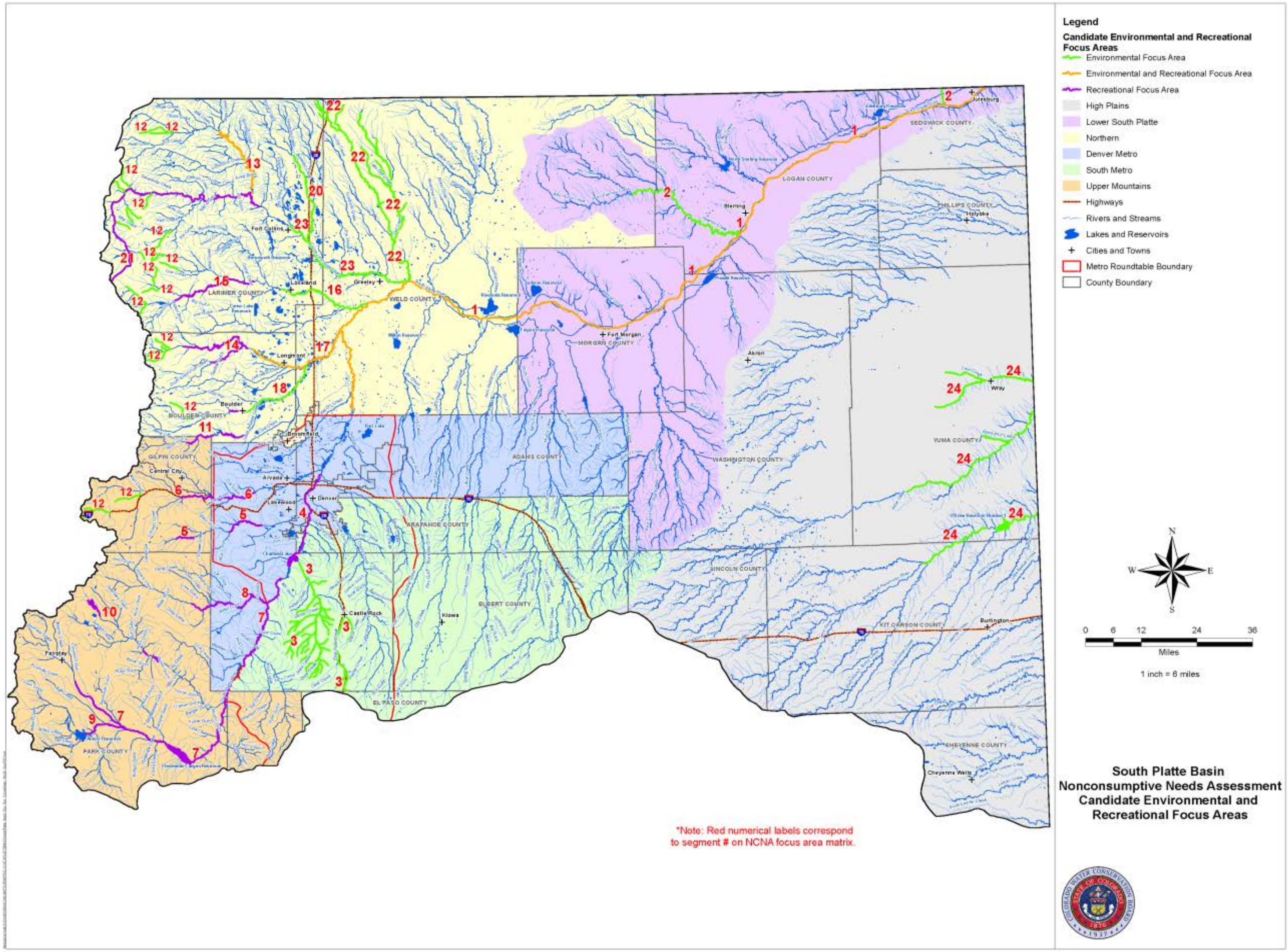

Table 1- SWSI 2010 South Platte Focus Areas Table

South Platte Nonconsumptive Needs Assessment Focus Reaches					DRAFT
GEOGRAPHIC AREA	Segment #	Segment Description	Environmental	Recreational	RATIONALE FOR CONSIDERATION
Lower South Platte/Northern	1	South Platte River: South boundary of Weld County to state line.	X	X	Waterfowl Hunting and Viewing Recreation. Habitat for plains fish that are listed as state endangered, threatened and species of concern. This segment contains rare or imperiled riparian plant communities.
Lower South Platte	2	Lodgepole Creek and Pawnee Creek.	X		Habitat for plains fish that are listed as state endangered, threatened and species of concern.
South Metro	3	Plum Creek Watershed, including East and West Plum Creek and all tributaries	X		Habitat for plains fish that are listed as state endangered, threatened and species of concern. This segment contains rare or imperiled riparian plant communities.
Denver Metro/South Metro	4	South Platte River: Below Chatfield Reservoir to Sand Creek		X	Whitewater Boating. Municipal Recreational Corridor
Upper Mountain/Denver Metro	5	Bear Creek: Truesdell to Indian Creek and Evergreen Lake to Bear Creek Lake		X	Fishing. Whitewater Boating
Upper Mountain/Denver Metro	6	Clear Creek: Idaho Springs to Golden Whitewater Park		X	Whitewater Boating. Fishing
Upper Mountain/Denver Metro/ South Metro	7	South Platte River: Middle and South Fork Confluence to Chatfield Reservoir. Middle Fork: Upstream end of Gold Medal reach to confluence with South Fork South Platte River		X	Gold Medal Fisheries. Whitewater Boating.

Upper Mountain	8	North Fork South Platte River: Bailey to confluence with South Platte River		X	**Fishing. Whitewater Boating.**
Upper Mountain	9	South Fork South Platte River below Antero Res.		X	**Fishing**
Upper Mountain	10	Michigan Creek and Taryall Creek. Those segments within State Wildlife Areas		X	**Fishing**
Northern/Upper Mountain	11	South Boulder Creek: Gamble Gulch to Shadow Canyon		X	**Fishing. Whitewater Boating**
Northern/Upper Mountain	12	All mountain tributaries with Greenback Cutthroat Trout populations.	X		**Habitat for federal/state threatened species.**
Northern	13	North Fork Poudre River: Dale Creek to confluence with Poudre River	X	X	**Fishing recreation. Habitat for plains fish that are listed as state endangered, threatened and species of concern.**
Northern	14	North Saint Vrain Creek: Horse Creek to Hwy 36. South Saint Vrain: from Middle Saint Vrain to confluence with North Saint Vrain.		X	**Whitewater Boating. Fishing**
Northern	15	Big Thompson River: Estes Park to mouth of canyon.		X	**Fishing. Whitewater Boating**
Northern	16	Big Thompson River: Just above Big Thompson Ditch #2 to confluence with South Platte.	X		**Habitat for plains fish that are listed as state endangered, threatened and species of concern.**

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Northern	17	Saint Vrain Creek: James Ditch to confluence with South Platte River.	**X**	**X**	**Habitat for plains fish that are listed as state endangered, threatened and species of concern. Municipal Recreational Corridor, RICDs**
Northern	18	Boulder Creek: Hwy 36 to confluence with Saint Vrain Creek.	**X**		**Habitat for plains fish that are listed as state endangered, threatened and species of concern. Municipal Recreational Corridor**
Northern	19	Boulder Creek: Fourmile Creek to Hwy 36		**X**	**Whitewater Boating. Municipal Recreational Corridor. Fishing**
Northern	20	Boxelder Creek	**X**		**Habitat for plains fish that are listed as state endangered, threatened and species of concern.**
Northern	21	Cache la Poudre River: Headwaters to Lewstone Creek		**X**	**Recreation. Whitewater boating. The Upper Poudre contains rare or imperiled riparian plant communities.**
Northern	22	Lonetree Creek Drainage	**X**		**Habitat for plains fish that are listed as state endangered, threatened and species of concern.**
Northern	23	Poudre River: Hwy 287 to confluence with South Platte	**X**		**Habitat for plains fish that are listed as state endangered, threatened and species of concern. Municipal Recreational Corridor.**
High Plains	24	Republican Drainage Arikaree River: Adler Creek to state line. Black Wolf Creek. Chief Creek. North Fork Republican River. South Fork Republican River: Hell Creek to state line.	**X**		**Habitat for plains fish that are listed as state endangered, threatened and species of concern. The Arikaree contains rare or imperiled riparian plant communities.**

2 Updates to SWSI 2010 Focus Area Mapping

The SWSI 2010 Focus Area mapping needed to be updated to include data links to other data sources, as well as to include additional focus areas that were approved by the South Platte and Metro Basin Roundtables.

2.1 Linking Focus Areas to Other Data Sources

The evaluation of the existing data to determine environmental and recreational needs and opportunities used the SWSI 2010 data and the new data sets supplied by CWCB. The evaluation included use of two separate data sources, 1) the GIS shapefiles which contains spatial information regarding focus areas attributes and projects, and 2) the MS Access database, which contains more detailed information on some attributes and projects and allows for detailed analysis of the nexus of the focus areas and projects. The SWSI 2010 Focus Segments have numeric and descriptive labels. The GIS data contains both the numeric and descriptive label for each SWSI 2010 focus segment. The MS Access database provided by CWCB contained the descriptive labels but not the numeric label. Both databases have a common data field labeled “COMID”. The COMIDs also have a specific length associated with each COMID. These two data sources were joined adding the numeric label to the descriptive labels in the MS Access database. The joined database could then be used to evaluate the attributes within each individual Focus Area to better address the priorities set by the South Platte BRT and Nonconsumptive Needs Subcommittee.

2.2 Addition of Focus Areas

The SWSI 2010 NCNA mapping approved by the Basin Roundtables (BRTs) included the selection of 24 river Focus Areas. Since SWSI 2010 was released, the South Platte and Metro BRTs have approved several new Focus Areas. These new areas include reaches in Park County and several reaches along the Front Range rivers and streams that connect the mountain river Focus Areas to the plains river Focus Areas. These areas were added using the following methodology.

Due to the various sources of data received, multiple steps must be taken to include the Focus Areas in the GIS shapefiles and the MS Access database. In general, those steps required work including digitizing map layers and preparing the data fields for the new Focus Areas for use in the analysis. It was necessary to add common data labels for each new data set for relational queries with the existing databases. In addition, the Focus Area numeric labels were linked to the numeric descriptors of the Focus Area in a table added to the MS Access database.

2.2.1 Canyon Mouth Focus Areas

The South Platte and Metro Roundtables approved the inclusion of several focus areas that connect Focus Areas in the foothills and mountains to the plains river Focus Areas, areas in and near the mouths of several canyons. These Focus Areas are located along the Big Thompson River, the North Fork of the Big Thompson River (and tributaries), Cache la Poudre River, South Boulder Creek, Middle Boulder Creek, and Left Hand Creek. The Focus Areas were approved for inclusion by the BRTs in Spring 2011.

Through this BIP effort, the Focus Areas were added to the GIS shapefiles and are in the process of being added to the MS Access database. These data were initially provided to the consultant as email correspondence between Colorado Parks and Wildlife (CPW) staff and the nonconsumptive subcommittee. CPW digitized the focus areas approved by the BRTs in ArcGIS to create a shapefile of the areas. The specific rationale and Focus Area information was added to the GIS shapefile attribute tables from the email information by the consultants. The CPW data included many segments that were not approved by the BRTs, only the segments that were approved were included. The information for these Focus Areas will then be added to the NCNA database to ensure the Focus Areas will be included in all data assessments utilizing the database queries.

2.2.2 Park County Focus Areas

The South Platte Roundtable approved the inclusion of several Focus Areas in Park County with significant riparian communities. These Focus Areas were approved by the South Platte Basin Roundtable in January 2014. The Park County Focus Areas were added to the GIS and are in the process of being added to the MS Access database. These data were initially provided to the consultant as a pdf of the additional and associated table of rationale. The consultants digitized the pdf map in ArcGIS to create a shapefile of the areas. The specific rationale and Focus Area information was added to the GIS shapefile attribute tables. The information for these Focus Areas will then be added to the NCNA database to ensure the Focus Areas will be included in all data assessments utilizing the database queries.

3 BIP Focus Area Mapping

The Focus Areas used in the preparation of the South Platte Basin Implementation Plan (SP–BIP) include the updates described above. The SP-BIP Mapping and associated Focus Area table are shown on the following pages and available electronically.

Figure 2 - Updated South Platte Environmental and Recreational Focus Areas Map

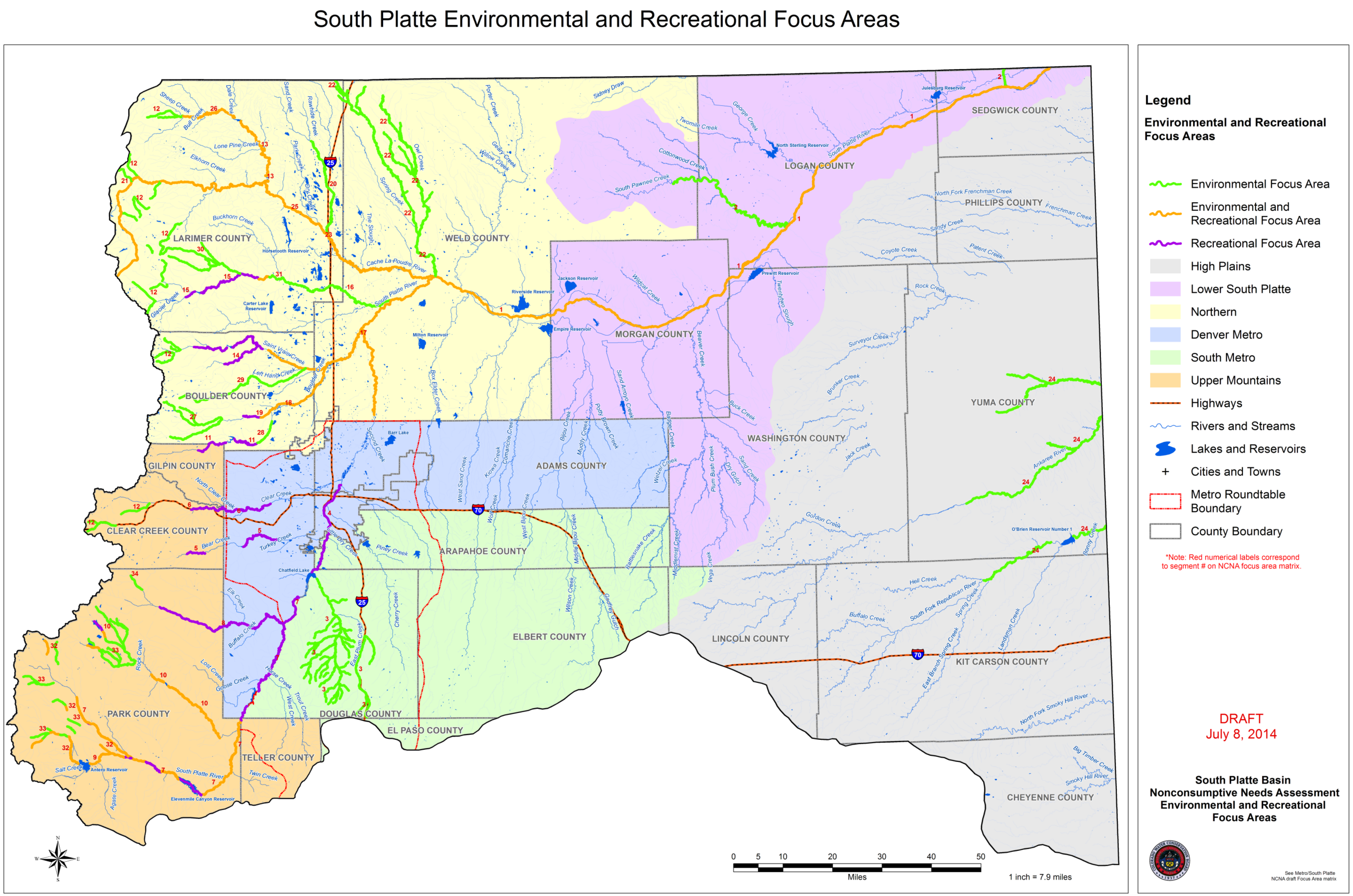


Table 2 – Updated South Platte Focus Areas Table

Geographic Area	*Segment #*	*Segment Description*	*Environmental*	*Recreational*	*Rationale*
Lower South Platte Northern	**1**	South Platte River South boundary of Weld County to state line	X	X	Waterfowl Hunting and Viewing Recreation. Habitat for plains fish that are listed as state endangered, threatened and species of concern. This segment contains rare or imperiled riparian plant communities.
Lower South Platte	**2**	Lodgepole Creek and Pawnee Creek	X		Habitat for plains fish that are listed as state endangered, threatened and species of concern.
South Metro	**3**	Plum Creek Watershed including East and West Plum Creek and all tributaries	X		Habitat for plains fish that are listed as state endangered, threatened and species of concern. This segment contains rare or imperiled riparian plant communities.
Denver Metro South Metro	**4**	South Platte River Below Chatfield Reservoir to Sand Creek		X	Whitewater Boating. Municipal Recreational Corridor.
Upper Mountain Denver Metro	**5**	Bear Creek Truesdell to Indian Creek and Evergreen Lake to Bear Creek Lake		X	Fishing. Whitewater Boating.
Upper Mountain Denver Metro	**6**	Clear Creek Idaho Springs to Golden Whitewater Park		X	Whitewater Boating. Fishing.
Upper Mountain Denver Metro South Metro	**7**	South Platte River: Middle and South Fork Confluence to Chatfield Reservoir Middle Fork: From Crooked Creek confluence to confluence with South Fork South Platte River	X	X	Gold Medal Fisheries. Whitewater Boating. State Wildlife Areas, Eleven Mile Canyon National Forest Recreation Area. Imperiled & rare riparian/wetland plant species & plant communities
Upper Mountain	**8**	North Fork South Platte River: Camp Santa Maria from just below Geneva Creek confluence to confluence with South Platte River.		X	Fishing. Whitewater Boating.
Upper Mountain	**9**	South Fork South Platte River below Antero Reservoir.	X	X	Fishing. Waterfowl hunting/viewing. State Wildlife Areas. Significant riparian/wetland plant communities.
Upper Mountain	**10**	Michigan Creek, Tarryall Creek and tributaries.	X	X	Fishing. Waterfowl hunting/viewing. State Wildlife Areas. Significant riparian/wetland plant communities.
Northern Upper Mountain	**11**	South Boulder Creek Gamble Gulch to Shadow Canyon		X	Fishing. Whitewater Boating.

Table 2 – Updated South Platte Focus Areas Table

Geographic Area	*Segment #*	*Segment Description*	*Environmental*	*Recreational*	*Rationale*
Northern Upper Mountain	**12**	All mountain tributaries with Greenback Cutthroat Trout populations	X		Habitat for federal/state threatened species.
Northern	**13**	North Fork Poudre River Dale Creek to confluence with Poudre River	X	X	Fishing recreation. Habitat for plains fish that are listed as state endangered, threatened and species of concern.
Northern	**14**	North Saint Vrain Creek Horse Creek to Hwy 36 South Saint Vrain from Middle Saint Vrain to confluence with North Saint Vrain		X	Whitewater Boating. Fishing.
Northern	**15**	Big Thompson River Estes Park to mouth of canyon		X	Fishing. Whitewater Boating.
Northern	**16**	Big Thompson River Just above Big Thompson Ditch 2 to confluence with South Platte	X		Habitat for plains fish that are listed as state endangered, threatened and species of concern.
Northern	**17**	Saint Vrain Creek James Ditch to confluence with South Platte River	X	X	Habitat for plains fish that are listed as state endangered, threatened and species of concern. Municipal Recreational Corridor. RICDs.
Northern	**18**	Boulder Creek Hwy 36 to confluence with Saint Vrain Creek	X	X	Habitat for plains fish that are listed as state endangered, threatened and species of concern. Municipal Recreational Corridor.
Northern	**19**	Boulder Creek Fourmile Creek to Hwy 36		X	Whitewater Boating. Municipal Recreational Corridor. Fishing.
Northern	**20**	Boxelder Creek	X		Habitat for plains fish that are listed as state endangered, threatened and species of concern.
Northern	**21**	Cache la Poudre River Headwaters to Lewstone Creek	X	X	Wild and Scenic River. Recreation. Whitewater boating. The Upper Poudre contains rare or imperiled riparian plant communities.
Northern	**22**	Lonetree Creek Drainage	X		Habitat for plains fish that are listed as state endangered, threatened and species of concern.
Northern	**23**	Poudre River Hwy 287 to confluence with South Platte	X	X	Habitat for plains fish that are listed as state endangered, threatened and species of concern. Municipal Recreational Corridor. Additional Greenway benefit.

Table 2 – Updated South Platte Focus Areas Table

Geographic Area	*Segment #*	*Segment Description*	*Environmental*	*Recreational*	*Rationale*
High Plains	**24**	Republican Drainage Arikaree River Adler Creek to state line Black Wolf Creek Chief Creek North Fork Republican River South Fork Republican River Hell Creek to state line	X		Habitat for plains fish that are listed as state endangered, threatened and species of concern. The Arikaree contains rare or imperiled riparian plant communities.
Northern	**25**	Cache la Poudre River Canyon mouth to confluence of South Platte River	X	X	Habitat for plains fish that are listed as state endangered, threatened and species of concern. Fishing. Boating.
Northern	**26**	Cache la Poudre River Halligan Reservoir to Sheep Creek	X	X	Fishing . State Wildlife Areas.
Northern Upper Mountain	**27**	All mountain tributaries with Greenback Cutthroat Trout populations	X		Habitat for federal and state endangered, threatened and species of concern including cutthroat trout and lake chub.
Northern Upper Mountain	**28**	South Boulder Creek: Coverage extended to Baseline Reservoir	X		Habitat for state endangered, threatened and species of concern including native minnow species and trout.
Northern	**29**	Left Hand Creek	X		Habitat for state endangered, threatened and species of concern including common shiner, stonecat, and brassy minnow.
Northern Upper Mountain	**30**	North Fork Big Thompson and tributaries (West Creek, Miller Fork, Dunraven-Glade)	X		Habitat for federal and state endangered, threatened and species of concern including cutthroat trout.
Northern	**31**	Big Thompson River upstream Loveland to Cedar Creek	X	X	Habitat for state endangered, threatened and species of concern including trout. Fishing. Whitewater Boating.
Upper Mountain	**32**	Middle & South Forks of the South Platte and tributaries	X	X	Fishing . State Wildlife Areas. Significant, imperiled & rare wetland/riparian plant species and plant communities
Upper Mountain	**33**	South Fork of the South Platte & tributaries above Antero Reservoir, Upper Middle Fork tributaries, Upper Tarryall Creek & tributaries	X		Significant, imperiled & rare wetland/riparian plant species and plant communities.
Upper Mountain	**34**	Portion of Geneva Creek	X		Significant & imperiled rare wetland/riparian plant species and plant communities.

Figure 3 –South Platte Environmental and Recreational Focus Areas Map - Upper Mountain Region

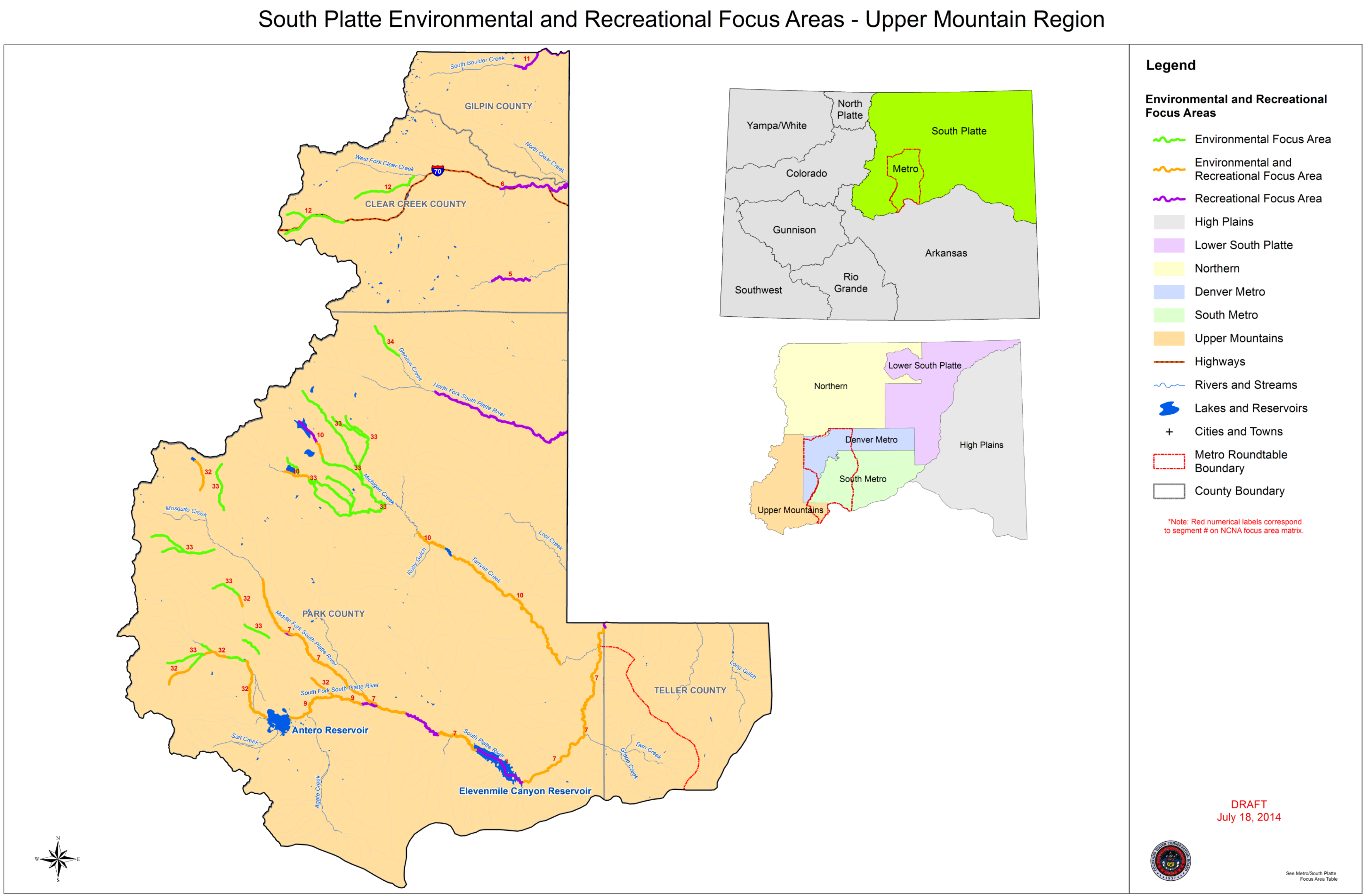


Figure 4 - South Platte Environmental and Recreational Focus Areas Map – Northern South Platte Region

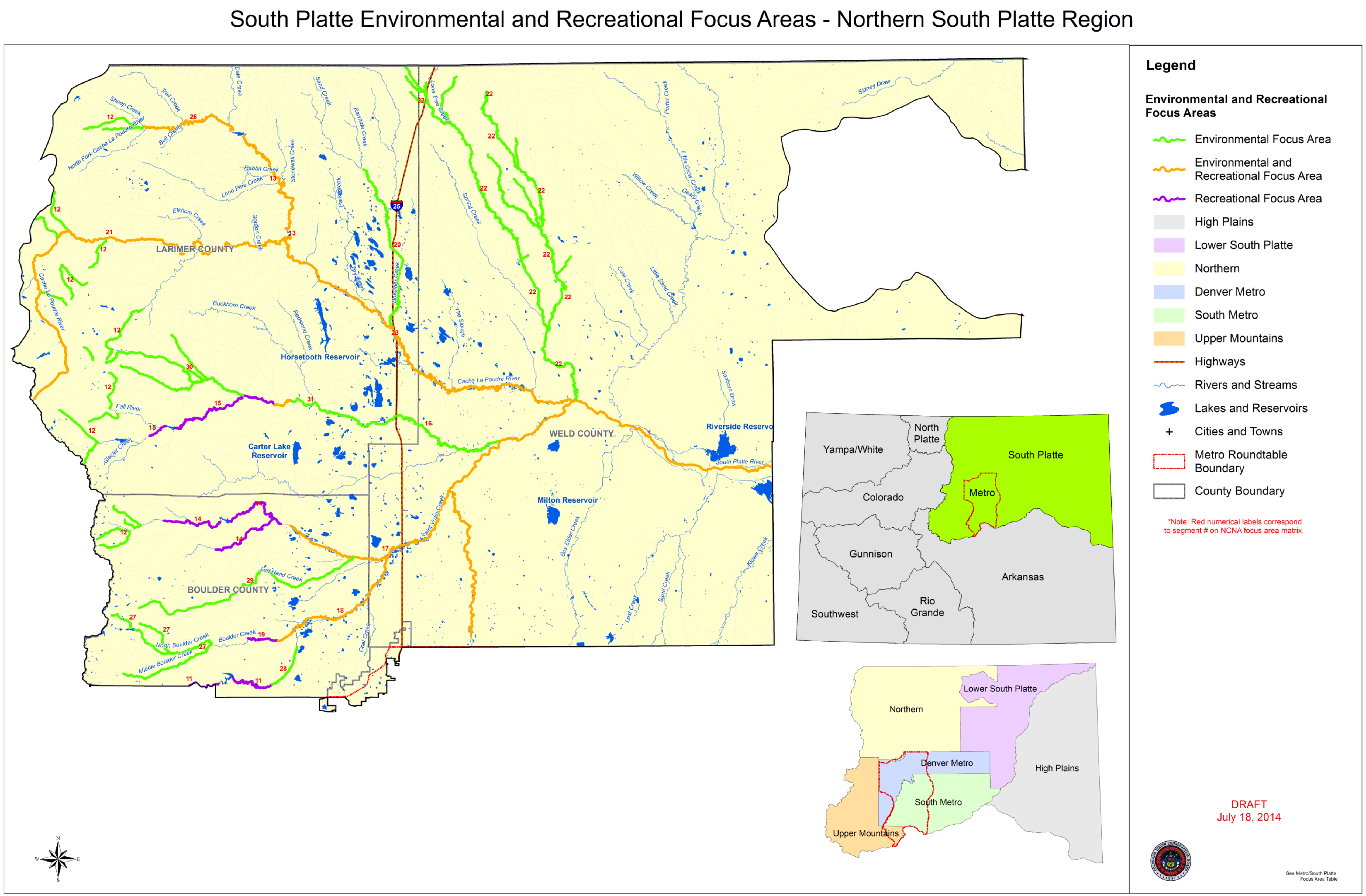


Figure 5 - South Platte Environmental and Recreational Focus Areas Map – Metro Region

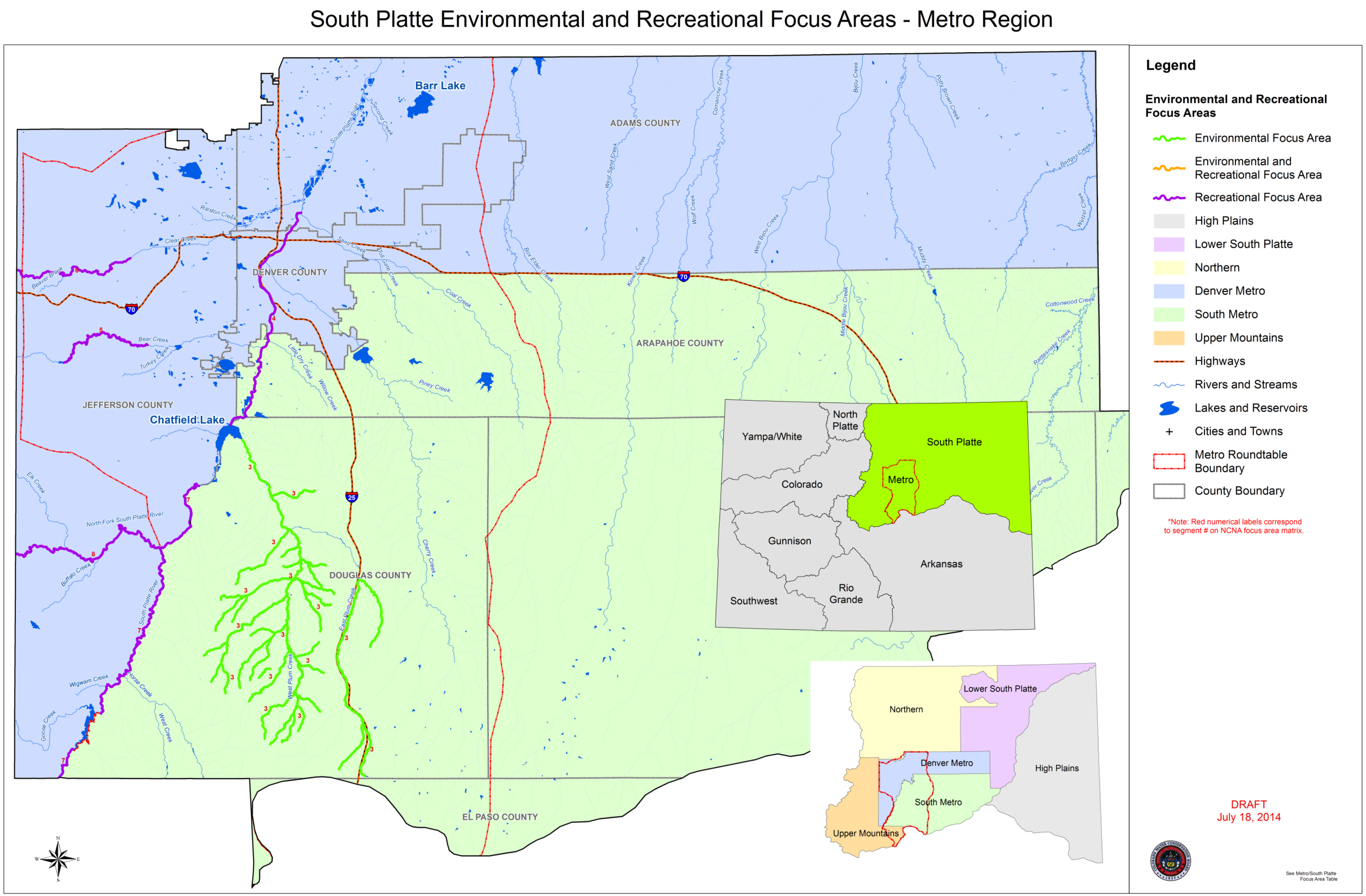


Figure 6 - South Platte Environmental and Recreational Focus Areas Map – Lower South Platte Region

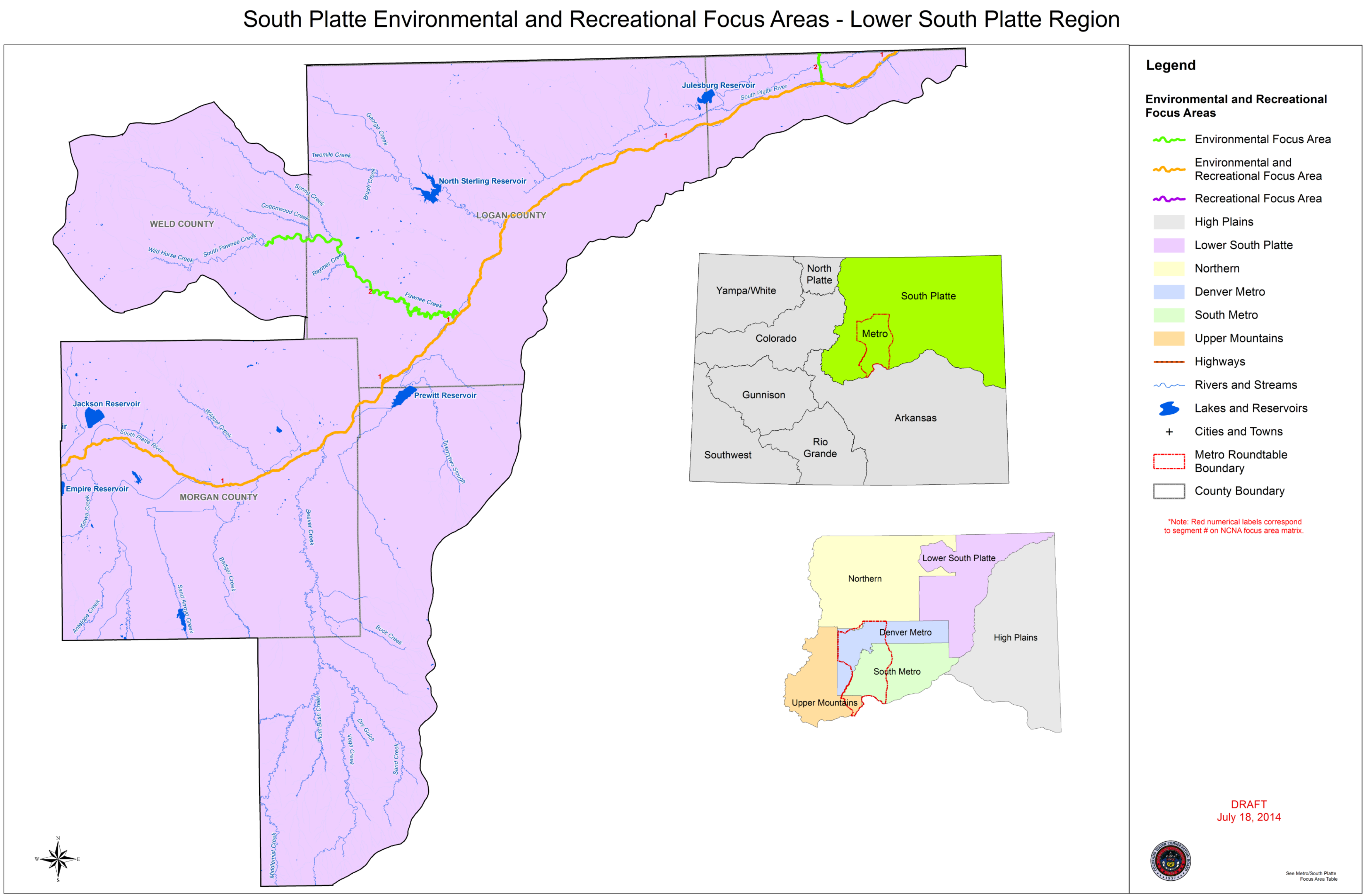
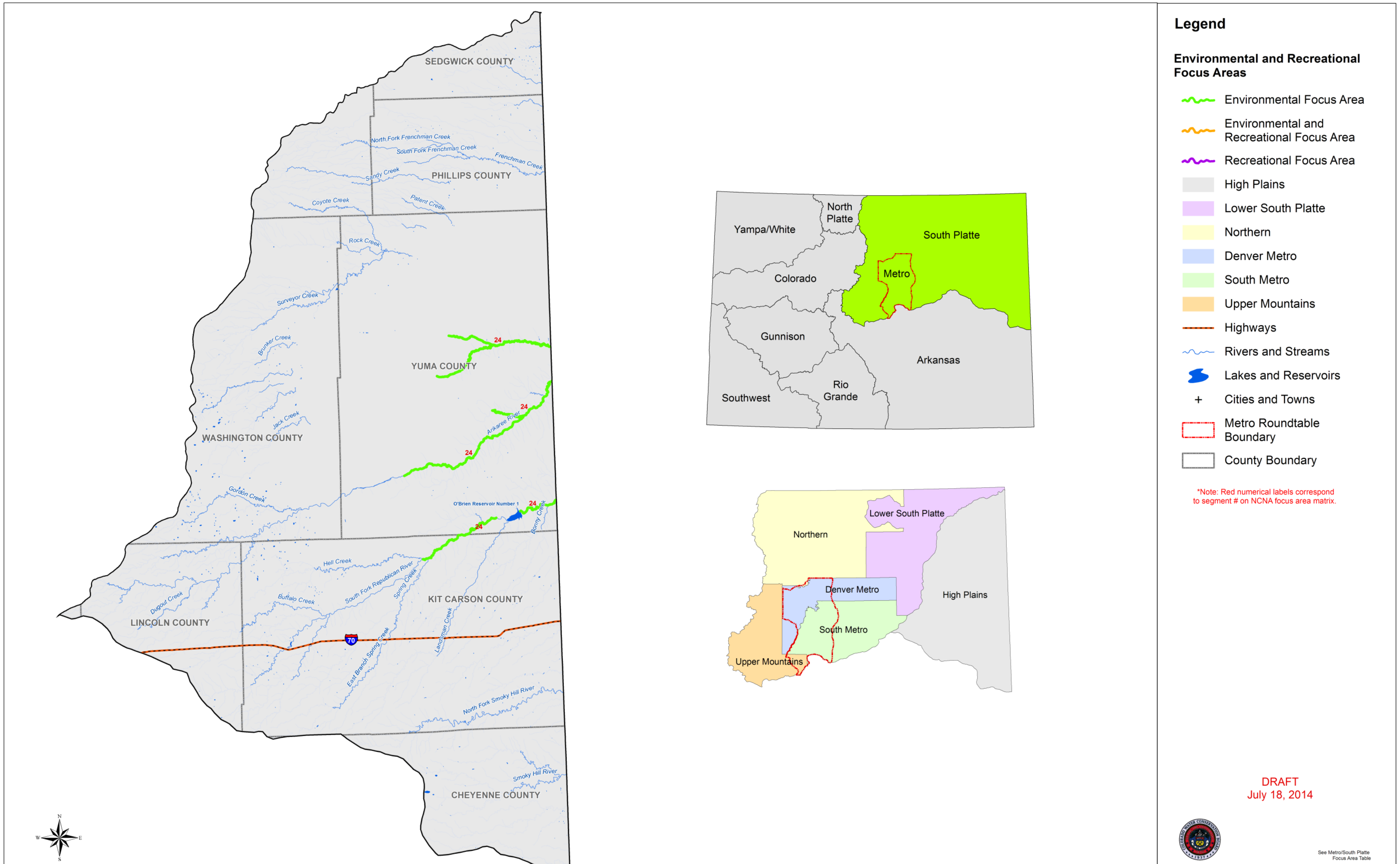


Figure 7 - South Platte Environmental and Recreational Focus Areas Map – High Plains Region

South Platte Environmental and Recreational Focus Areas - High Plains Region



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Appendix C – Environmental and Recreational Impact from Agricultural and Urbanization Trends

Contents

Environmental and Recreational Impact from Agricultural and Urbanization Trends

The agricultural and urbanization historical and future trends in the South Platte River were analyzed to assess the potential impact to environmental and recreational attributes currently and in the future. The review and analysis of these trends is described in detail in this technical memorandum.

1 Agricultural Dry-Up Trends

Section 2.2.2.2 describes the SWSI analysis used to estimate the projected amount of irrigated acres dried up in the South Platte and Metro Basins by 2050. The BIP planning effort developed an additional approach for projecting future dry-up trends based on the historical rate of dry-up. Historical rates of dry-up were estimated on a county-by-county basis and applied to project the future dry-up of irrigated acres by 2050. This appendix provides the details of this approach.

The SWSI 2010 estimated irrigated dry-up acreage is greater than that identified by the historical trends. Therefore this methodology was used to determine an estimate of where dry-up may occur in the future.

Reference Documents

The following discussion is based upon:
SWSI 2010 South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply Needs Assessments- and the Colorado Decision Support System Irrigated Agriculture spatial data.

1.1 Historical Trends

The historical dry-up of irrigated acres was evaluated from 1950 to 2010 using the Colorado Decision Support System (CDSS) GIS coverages of irrigated acres. The CDSS GIS coverages provide snapshots of irrigated acres in 1956, 1976, 1987, 2001, 2005 and 2010. Table 1 shows the total amount of acres irrigated with surface water and groundwater within each county of the South Platte and Metro Basins.

Table 1 - Historical Irrigated Acres by County

Counties	1956	1976	1987	2001	2005	2010
Adams	44,304	46,556	42,098	32,028	27,717	28,273
Arapahoe	3,950	3,251	2,676	3,081	2,977	2,576
Boulder	71,103	62,947	60,920	46,244	42,521	44,665
Broomfield	2,992	2,462	3,034	1,677	955	1,121
Clear Creek	156	156	144	23	23	23
Denver	1,282	1,188	1,543	591	365	365
Douglas	6,434	6,295	6,994	2,666	2,180	2,492
El Paso	-	8	253	135	133	142
Elbert	1,279	3,532	3,406	2,732	2,323	3,163
Jefferson	11,111	5,468	5,227	4,374	3,431	3,623
Larimer	122,236	109,302	104,195	89,186	83,480	83,684

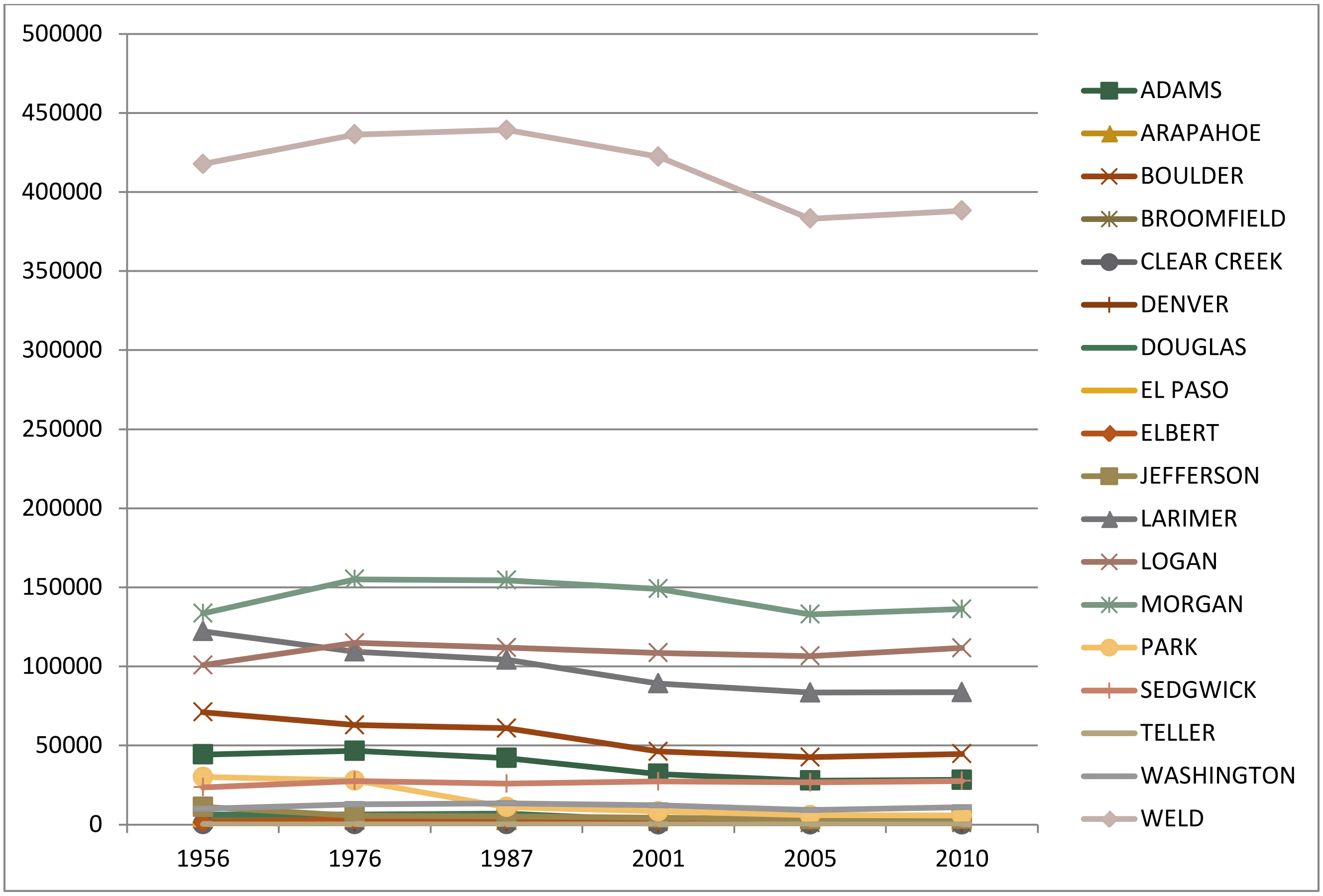
Counties	1956	1976	1987	2001	2005	2010
Logan	100,769	114,854	111,869	108,548	106,486	111,642
Morgan	133,485	155,069	154,510	148,994	132,946	136,196
Park	30,050	27,901	11,009	8,363	5,897	5,779
Sedgwick	23,496	27,568	25,858	27,220	26,683	27,590
Teller	157	135	103	64	60	68
Washington	9,945	12,820	13,445	12,176	9,156	10,896
Weld	417,647	436,323	439,219	422,288	383,084	388,123
Total	980,394	1,015,834	986,502	910,391	830,416	850,422

Source: CDSS Irrigated Acres GIS Data. Accessed at: http://cdss.state.co.us/GIS/Pages/Division1SouthPlatte.aspx

Irrigation tended to increase from 1950 to 1976 as irrigators started to rely on groundwater pumping. In the 1970s, the increase in pumping leveled off, yet the urban Front Range continued to grow. This resulted in a decrease in irrigated acres. Urban areas were developed on lands formerly used for irrigated agriculture and municipalities began to purchase senior agricultural water rights to meet growing demands. These senior agricultural water rights were transferred from irrigation to municipal use, resulting in the permanent dry-up of the irrigated lands.

Beginning in 2002 due to the drought and stricter water rights administration, the requirement to replace depletions from junior groundwater pumping in the South Platte Basin was strictly enforced, resulting in the curtailment of junior groundwater users who did not have a temporary substitute water supply plan or an augmentation plan to replace out-of-priority pumping depletions. Initially, many groundwater users were required to cease pumping. This is reflected in Table 1 and Figure 1, where the irrigated acres for some counties are relatively low in 2005. However, the irrigated acreage increases in 2010 once some groundwater users were able to obtain augmentation plans and again pump wells for irrigation.

Figure 1 - Irrigated Acreages by County and Year (based on CDSS GIS coverages)



For purposes of the BIP agricultural dry-up projection trends, the historical period of 1976 to 2010 was selected as the timeframe most conducive for projecting future agricultural dry-up. This period excludes the development of groundwater pumping in the 1950s and 1960s. Also, using 2010, rather than the year with the least irrigated acreage (2005), excludes the lowering in groundwater use that was seen in 2005, due to the drought and stricter administration.

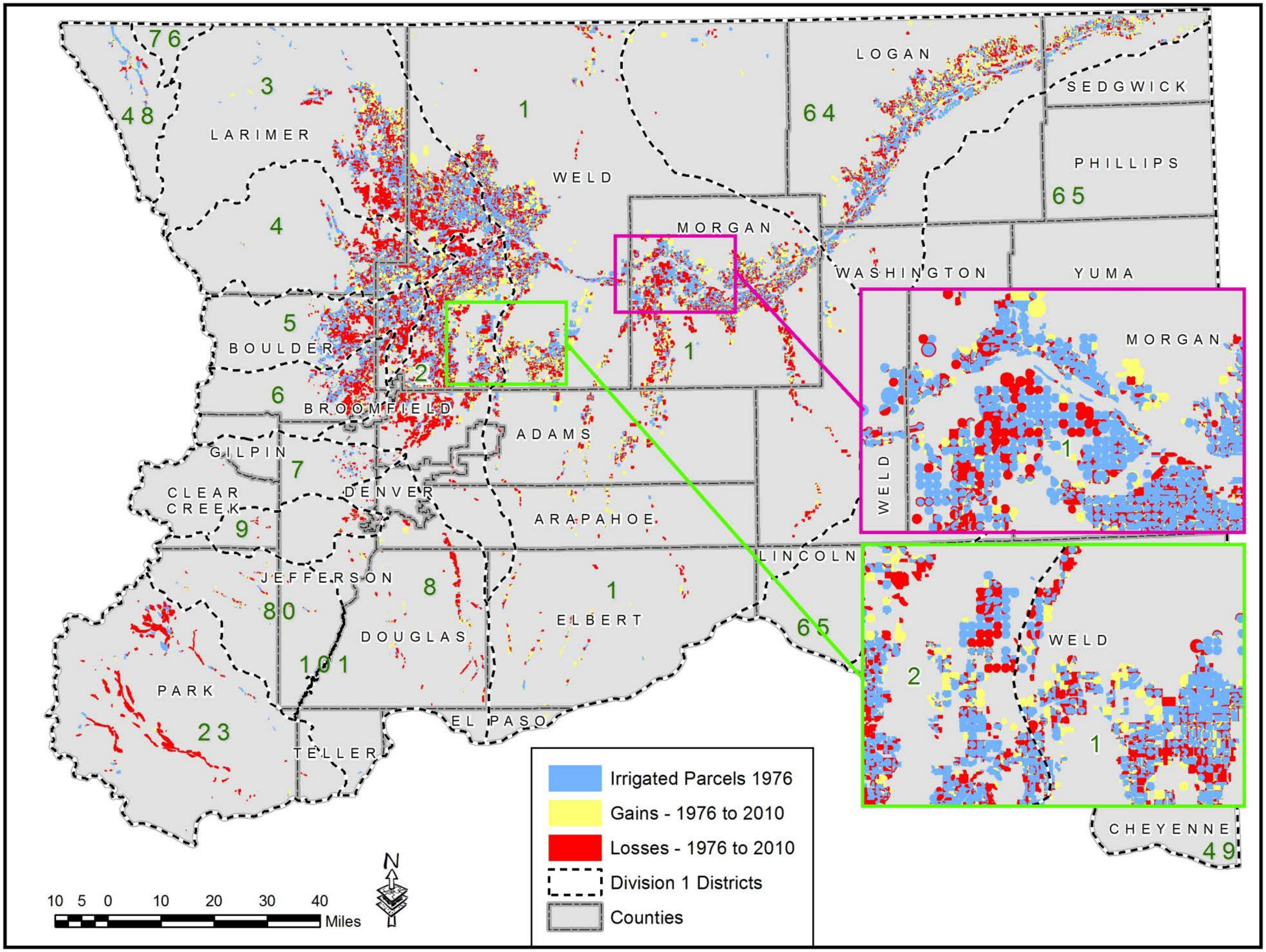
Figure 2 shows the changes in irrigated acres in the South Platte and Metro Basins from 1976 to 2010. The areas highlighted in yellow and red, show the areas where new irrigation was developed and where formerly irrigated areas were dried up, respectively. Table 2 shows the average annual rate of acres dried up and the percentage of irrigated acres dried up per county from 1976 to 2010. The counties with the largest percentage of dry up tend to be the counties that experienced the largest amount of urban growth or where municipalities purchased senior agricultural water rights to meet their needs. These include Adams, Broomfield, Clear Creek, Denver, Douglas, Park and Teller counties.

Table 2 - Rates of Irrigated Acre Dry-Up from 1976 to 2010

Counties	Acre-feet per year	% per year
Adams	538	1.2%
Arapahoe	20	0.6%
Boulder	538	0.9%
Broomfield	39	1.6%
Clear Creek	4	2.5%
Denver	24	2.0%
Douglas	112	1.8%
El Paso	0	0.0%
Elbert	11	0.3%
Jefferson	54	1.0%
Larimer	753	0.7%
Logan	94	0.1%
Morgan	555	0.4%
Park	651	2.3%
Sedgwick	0	0.0%
Teller	2	1.4%
Washington	57	0.4%
Weld	1,418	0.3%
Total	4,870	n/a

Source of irrigated acres: CDSS Irrigated Acres GIS Data.
Accessed at: http://cdss.state.co.us/GIS/Pages/Division1SouthPlatte.aspx

Figure 2 - Dry-Up of Irrigated Acres from 1976 to 2010



1.2 Projection of Future Agricultural Dry-Up

Future agricultural dry-up in 2050 was projected using the historical 1976-2010 rates of irrigation dry-up provided in Table 2. For each county, projections were developed based on the following historical rates:

- Acres per year methodology - The average amount of historical dry-up (acres per year shown in Table 2) was multiplied by the number of years between 2050 and 2010 (40 years) and subtracted from the amount of irrigated acres in 2010.
- % per year methodology– The average amount of historical dry-up (% per year shown in Table 2) was multiplied by the number of 2010 acres and by the number of years between 2050 and 2010 (40 years) and then subtracted from the amount of irrigated acres in 2010.

The results, presented in Figure 3, shows the total amount of irrigated acre dried up (in acres) and the % of irrigation acres in the county dried up for the two methods described above. These results indicate that the methodology using the % per year rate resulted in a lower projected dry-up than the methodology using the acres per year rate.

The results also indicate that there is a distinct difference between the number of acres dried up and the percentage of irrigated acres dried up per county. As shown in Figure 3, the greatest amount of dry-up on an acre basis is projected to occur in Weld County although the dry-up may only account for 13% to 15% of the county's total irrigated acres. In contrast, the projected number of acres dried-up in Clear Creek County is minimal, yet, if the amount of dry-up continues at the same rate as historically observed, all of the irrigated acres in Clear Creek County will be dried up.

Figures 4 and 5 spatially show the magnitude of dry-up for each county, for both the acres per year and % per year methodologies. The counties highlighted in red are anticipated to experience the largest percentage of dry-up whereas the green counties are projected to experience no dry-up. Counties highlighted in gray were not included in the analysis. These counties rely on very little to no surface water irrigation and are not included in the CDSS irrigated acres database.

It is important to emphasize that this approach to projecting future irrigation dry-up based on historical trends simply assumes that future dry-up will continue at the average rate observed between 1976 and 2010. Factors that contributed to the historical agricultural dry-up such as water market conditions, urbanization and the transfer of agricultural to municipal water transfer are assumed to be similar to historical conditions. Future efforts to slow or abate the rates of dry-up such as conservation easements and alternative agricultural transfers were not considered in the analysis.

Figure 3 - Projected Dry-up of Irrigated Acres Based on Historical Trends

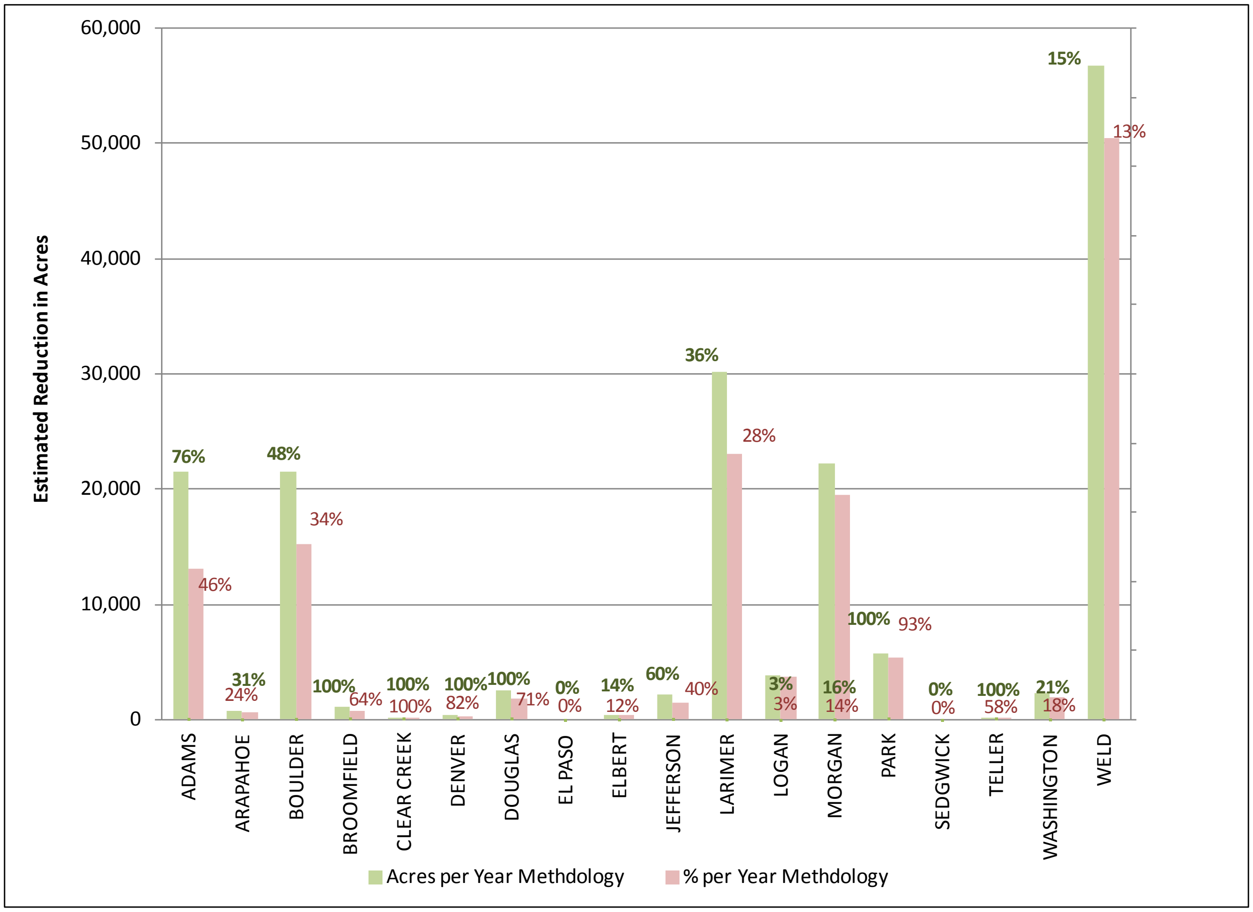


Figure 4 - Map of Projected Dry-Up for the "Acres per Year" Methodology

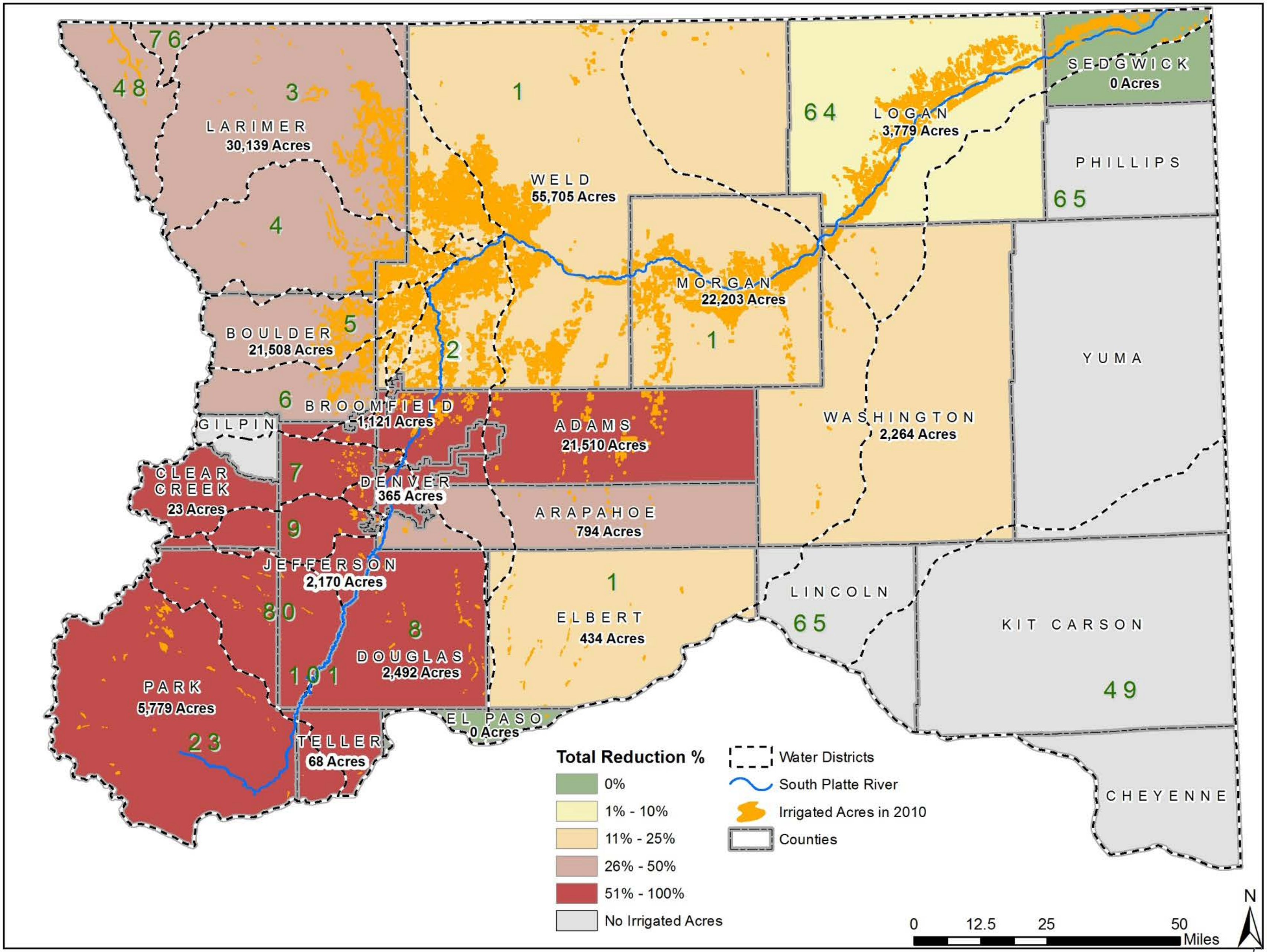
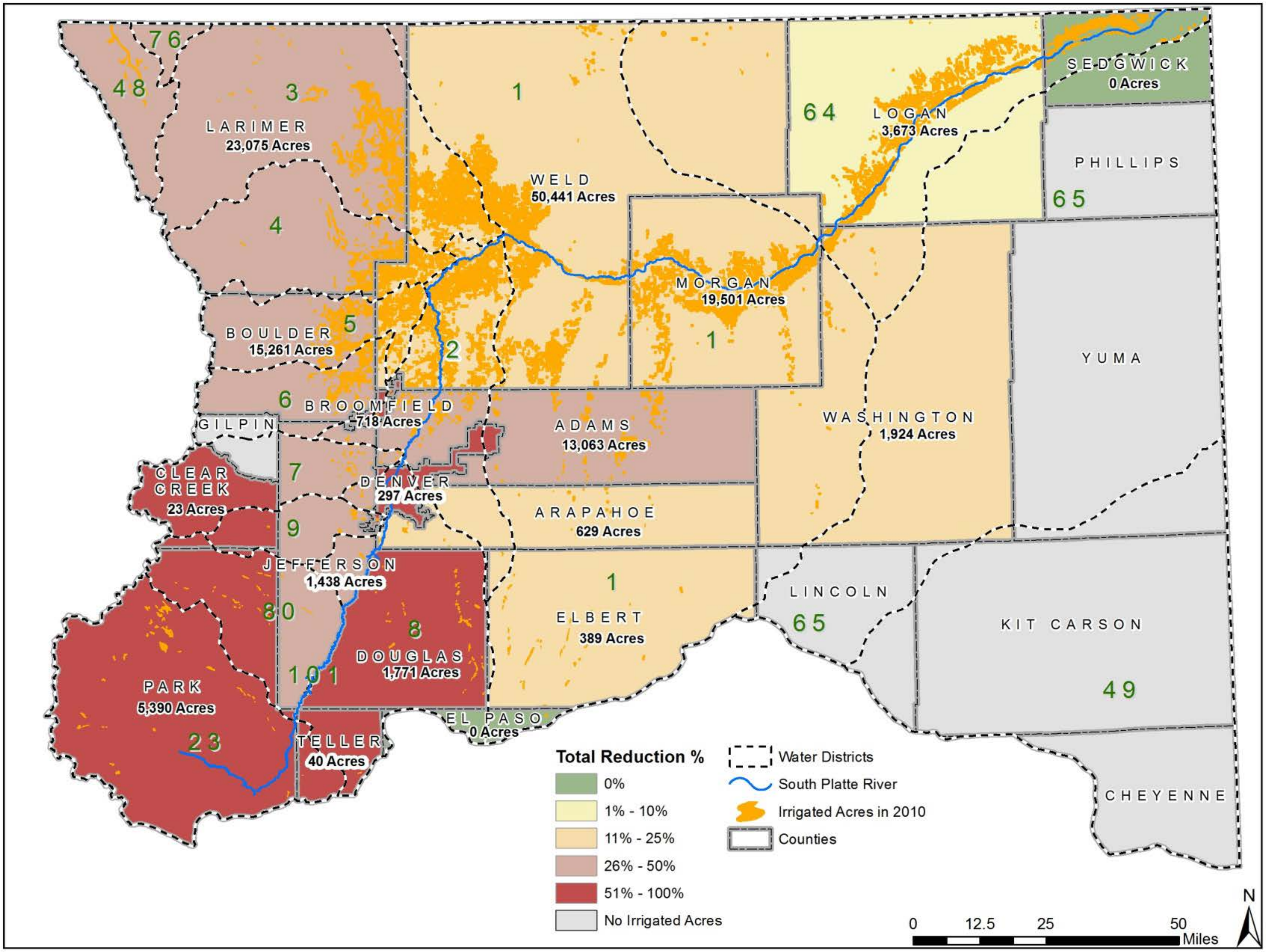


Figure 5 - Map of Projected Dry-Up for the "% per Year" Methodology



1.3 Comparison with SWSI's Estimates of Irrigation Dry-Up

SWSI 2010 developed estimates of agricultural dry-up through 2010. These results are summarized in Table 3. The reductions in irrigated acres associated with urbanization [column 3] and agricultural to municipal transfers to meet the gap [column 6] were quantified based on projections of population and the M&I gap in 2050. The remaining reductions [columns 4 and 5] were based on interviews throughout the South Platte and Metro Basins. With exception to urbanization, which was assessed at a county-level, the SWSI projections in Table 3 were conducted on a basin-level. Additional information on the specific methodologies applied to develop these estimates is described in Appendix I of SWSI 2010.

Table 3 - SWSI 2010 Estimates of Irrigation Dry-up in 2050

Basins [1]	Current Irrigated Acres [2]	Decrease in Irrigated Acres Due to Urbanization* [3]		Decrease in Irrigated Acres Due to Agricultural to Municipal Transfers [4]	Decreases in Irrigated Acres Due to Other Reasons [5]	Decreases in Irrigated Acres Due to Ag Transfers to Meet Gap** [6]		2050 Irrigated Acres Decreases [7]	
		Low	High			Low	High	Low	High
Metro South Platte Basin	831,000	46,939	58,425	19,000	14,000	82,157	144,287	162,157	235,287
Republican Basin	550,000	262	506	0	109,000	0	0	109,262	109,506
SWSI 2010 Total	**1,381,000**	**47,202**	**58,931**	**19,000**	**123,000**	**82,157**	**144,287**	**271,359**	**345,218**

Source: Table 4-9 SWSI 2010 South Platte Basin Report Basinwide Consumptive and Con-consumptive Water Supply Needs

* The decrease in irrigated acres due to urbanization was updated to match the county-wide assessment of irrigated dry-up due to urbanization. (CDM, Excel file: All Basins Urbanization Irrigated Acres Calculations(SMTedits060410).xlsx).

**The dry-up of acres due to agricultural transfers to meet the gap has been updated since the SWSI 2010 publication to correct a former spreadsheet error.

As shown in Table 4, the BIP projection using historical trends is less than SWSI's 2010 projections. Therefore, the SWSI 2010 numbers were allocated based upon the SWSI 2010

Table 4 - Comparison of the SWSI 2010 and BIP Historical Trend Results for the Metro South Platte Basin

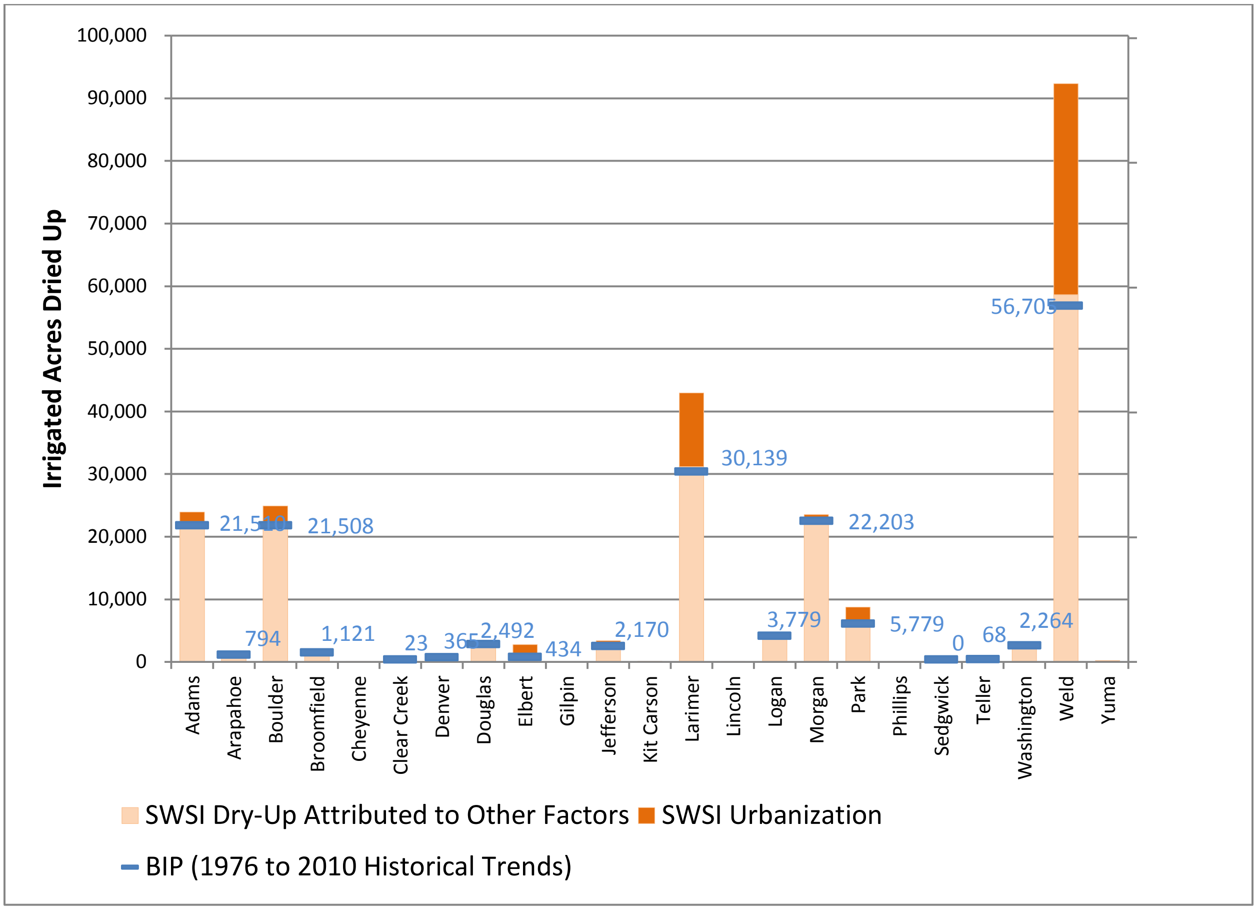
Source	2050 Irrigated Acres Decreases	
	Low	High
SWSI 2010	162,157	235,287
BIP (1976 to 2010 trends)	137,634	171,354

Note: These data do not include the Republican Basin.

Figure 6 further refines the BIP and SWSI 2010 projections on a county level showing the amount of SWSI 2010 dry-up acres due to urbanization, the BIP historical projections (using the acres per year methodology) and SWSI's additional estimates of dry-up (itemized in Table 3) that do not including urbanization. SWSI's estimate of dry-up (with the exception of urbanization) was prorated on a county-basis using the BIP's county projections of dry-up relative to the total number of acres dried up in the Basin.

This figure provides a possible indication of how many acres might be lost due to urbanization using SWSI's county urbanization data. The figure further indicates the amount of dry-up that might occur if the rates observed for the historical period between 1976 to 2010continue. Please note, this figure is based upon the proration of SWSI data and individual estimate of dry-up (with the exception of urbanization) has not been done on an individual county level.

Figure 6 - Comparison of the SWSI 2010 and BIP Historical Trend Results (High Scenario)



1.4 Potential Impacts on Environmental and Recreational Attributes Due to Irrigation Dry-Up Trends

This analysis shows the possible location of future dry-up based upon historical trends. Additional work may be done in further BIP work after the DRAFT BIP to investigate the impacts of these trends. In general, those areas with significant amounts of potential agricultural dry-up could see a reduction in river flows due to changes in water rights out of the area for use in more urbanized areas. While return flows must be maintained for downstream senior calling water rights, those return flows do not need to be replaced if there is not a calling right within a reach of concern. Less agricultural consumptive use downstream could result in reduced streamflows due to the changed water use no longer using the river system to convey the historical agricultural water to the historical agricultural users. Additional work to assess some of these impacts may be done for the revision of the BIP. In addition, increased agricultural dry-up could impact wildlife habitat and wetlands which exist in certain areas as a result of irrigation practices.

Appendix D – Environmental and Recreational Protections Assessment Methodology

Contents

Environmental and Recreational Protections Assessment Methodology

In order to assess the protections existing in environmental and recreational focus areas as well as determine and assess goals and measurable outcomes, a complex methodology was developed to analyze the overlap of focus areas, attributes, protections or projects and potential habitat. The Implementation of M&I projects and methods, whether represented in analysis data as IPPs or other projects, increasingly must consider the impacts on other parts of the water system, including environment, recreation, and agriculture, in particular if multi-purpose projects are being evaluated. Methodologies to assess the protections and the impacts of projects on environmental and recreational attributes are described in detail in this technical memorandum.

1 Projects Assessment

While the Statewide Water Supply Initiative (SWSI) 2010 considered each demand component, including M&I, agriculture, environmental and recreational, the level of detail for M&I needs was much higher than other considerations. There are two fundamental approaches to answer the question "How will Project or Method X impact the environment, in particular environmental and recreational focus areas and attributes?" The first approach is to evaluate each M&I project and method for potential impacts (positive and negative), including some level of impact. For example, "Project X may decrease flows in Stream Y" or "Project X may decrease flows in Stream Y by 10 CFS during the period May-Sep". If permitting is required, then such evaluations are already occurring.

Reference Documents

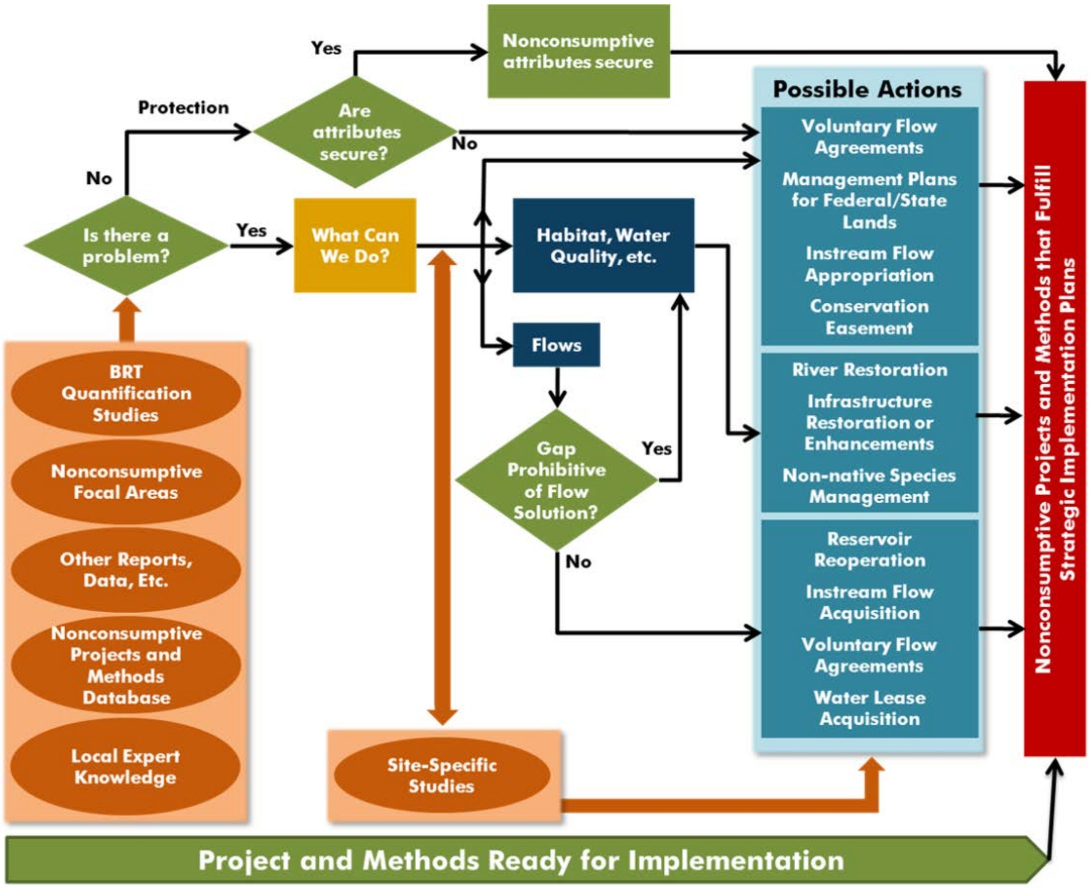
The following discussion is based upon:
SWSI 2010 South Platte Basin Report Basinwide Consumptive, Nonconsumptive Water Supply Needs Assessments, and SWSI Nonconsumptive Toolbox

For other projects, an evaluation of impacts could be included in project data, in particular if there is motivation for a multi-purpose project. Although project proponents may be aware of specific values that need protection, they may not be tracking such information consistent with the SWSI Non-Consumptive Needs Assessment (NCNA) attributes, and there may be a data gap for NCNA attributes when an attribute is omitted from an area. The second option for analysis is to evaluate for each focus area or attribute what might be the impacts of each planned project. It is likely that advocates for focus areas (such as conservation organizations operating in the area) monitor potential impacts of NCNA attributes and take action accordingly. However, detailed analysis and monitoring may be difficult and more general goals of maintaining and improving water quality, streamflow volumes, or habitat extent, may be easier metrics to evaluate. Advocacy may be absent if no organization exists in the area of concern, although State or Federal agencies may be present.

The SWSI Nonconsumptive Toolbox includes a decision tree for evaluating and planning "nonconsumptive" projects.[1] The decision tree is shown in Figure 1-1.

[1] Nonconsumptive Toolbox, CWCB, 2011

Figure 1-1 Projects and Methods Nonconsumptive Decision Tree



The toolbox focuses on new projects to address an existing environmental and/or recreational need. However, a similar decision tree could be used to address the impacts of a planned M&I (or agricultural) project. In this case, the initial question of "Is there a problem?" is asked through the lens of "What impact will Project X have?" The toolbox could therefore be utilized to evaluate enhancing any project, perhaps converting into the definition of a multi-purpose project.

2 Protections Assessment Methodology

In order to assess whether or not a project is needed in a particular focus area, a methodology based on data regarding attributes and projects was developed. The evaluation of the existing data to determine environmental and recreational needs and opportunities used the SWSI 2010 data as well as the new data sets supplied by CDM, the SWSI consultant for the CWCB. The evaluation and methodology described herein implements queries and analyses of two separate data sources, 1) GIS shapefiles, which contain spatial information regarding focus areas, attributes, and projects, and 2) the MS Access Nonconsumptive Needs Assessment (NCNA) database, which contains more detailed information on some attributes, projects, and protection categories for the projects. The GIS shapefiles were created for SWSI, however, the MS Access database was used for project and protection data analysis.

Based on a review of both data sources during the BIP project, there are significant differences between the data contained in the GIS data and NCNA database that preclude a complete analysis of focus areas, attributes, projects and protections. The one common variable that could be used to crosslink both data bases is the COMID. This is a unique identifier for smaller stream segments taken from the National

Hydrography Dataset (NHD). Some of the differences between the NCNA database and the GIS shapefiles have been rectified to be able to conduct some preliminary analyses, however, additional work is needed to fully incorporate new focus area and project data into the Access database to ensure consistency between the database and GIS.

A method was devised to link the Focus Area identifier (a unique number) with the MS Access database. The GIS shapefiles contained the unique identifier included for all Focus Areas. The GIS data included a COMID for all stream segments in each Focus Area and the narrative description of the Focus Area. The Focus Area identifiers and names are being added to the MS Access database and additionally a table relating Focus Area to segment are also being added to relate the focus areas to existing data in the database. This data joining provides a means to link the common variable of COMID in the MS Access and GIS data. A number of queries can be executed once the MS Access database is fully updated to list focus area, attribute, segment, and project combinations details and summaries.

The attributes evaluated for each Focus Area in the South Platte Basin were approved by the South Platte and Metro Roundtables (BRTs) in 2010 (Table 1) as part of the SWSI process. The SWSI 2010 Focus Segments have numeric and descriptive labels. The GIS database contains both the numeric and descriptive label for each SWSI 2010 focus segment.

Table 1 - South Platte Basin Attributes

South Platte Attributes	Attribute Type		Data Availability		Attribute Inclusion Approved	
Attributes	Environmental	Recreational	SWSI 2010 shapfile	Quantitative data	Yes/No	Date
Boreal Toad	X		Y	Y	Y	SWSI 2010
Greenback Cutthroat Trout	X		Y	Y	Y	SWSI 2010
Brassy Minnow	X		Y	Y	Y	SWSI 2010
Common Shiner	X		Y	Y	Y	SWSI 2010
Lake Chub	X		Y	Y	Y	SWSI 2010
Northern Redbelly Dace	X		Y	Y	Y	SWSI 2010
Plains Minnow	X		Y	Y	Y	SWSI 2010
River Otter	X		Y	Y	Y	SWSI 2010
Stonecat	X		Y	Y	Y	SWSI 2010
Suckermouth Minnow	X		Y	Y	Y	SWSI 2010
Yellow Mud Turtle	X		Y	Y	Y	SWSI 2010
Iowa Darter	X		Y	Y	Y	SWSI 2010
Northern Leopard Frog	X		Y	Y	Y	SWSI 2010
Plains Orangethroat Darter	X		Y	Y	Y	SWSI 2010
Colorado Outstanding Waters		X	Y	Y	Y	SWSI 2010
CWCB Instream Flow Water Rights	X		Y	Y	Y	SWSI 2010
CWCB Natural Lake Level Water Rights	X		Y	Y	Y	SWSI 2010
Ducks unlimited projects		X	Y	Y	Y	SWSI 2010
Eligible Wild and Scenic	X		Y	Y	Y	SWSI 2010
Flatwater Boating		X	Y	Y	Y	SWSI 2010
Gold Medal Trout Lakes		X	Y	Y	Y	SWSI 2010
Gold Medal Trout Streams		X	Y	Y	Y	SWSI 2010
Northern Cricket Frog	X		Y	Y	Y	SWSI 2010
Plains Leopard Frog	X		Y	Y	Y	SWSI 2010
Rare Aquatic-dependent plants	X		Y	Y	Y	SWSI 2010
Recreational In-Channel Diversion Structures		X	Y	Y	Y	SWSI 2010
Reservoir and Lake Fishing		X	Y	Y	Y	SWSI 2010
River and stream fishing		X	Y	Y	Y	SWSI 2010
Waterfowl Hunting / Viewing		X	Y	Y	Y	SWSI 2010
Whitewater Boating		X	Y	Y	Y	SWSI 2010
Preble's Meadow Jumping Mouse	X		Y	Y	Y	SWSI 2010
Common Garter Snake	X		Y	Y	Y	SWSI 2010
Active Bald Eagle Nests	X		Y	Y	Y	SWSI 2010
Audubon important bird areas	X		Y	Y	Y	SWSI 2010
Significant Plant Communities	X		Y	Y	Y	SWSI 2010
Wilderness Waters	X		Y	Y	Y	SWSI 2010
Wood Frog	X		Y	Y	Y	SWSI 2010

The NCNA attributes also are listed in each Focus Area by the COMID label. The total reach length for each attribute within a Focus Area was used to determine the amount of each attribute (length and percent) by Focus Area in the South Platte Basin. These data can provide the existing amount of the attribute in the Focus Area. In addition, the data contains some information regarding the current protections in the Focus Areas, although more information is needed. Analyses to determine where the focus areas, attributes and projects overlap can allow for the possible determination of the amount of potential increase for a given attribute and the potential for future projects and protections.

For example, Focus Area 12 has the descriptive label “all mountain tributaries with greenback cutthroat trout”. These tributaries include 122 miles of streams. Greenback cutthroat trout are present in 89 miles (69%) of the Focus Area. Protections in the Focus Area include CWCB instream flow (ISF) protections. There are 56 miles (45%) of the Focus Area protected by CWCB ISF.

The data for each Focus Segment can be used in the future to set more specific measurable goals and outcomes for attributes in the South Platte Basin based on the priorities of the BRT. The data for the occurrence of each attribute by Focus Segment can be used to quantify each attribute. One goal in the South Platte is to maintain the attributes at their present levels and if possible increase the attributes. Table 2 shows the percent occurrence in the basin by attribute in all focus areas as described in Appendix B, based upon the data available in the GIS shapefiles.

Table 2 - South Platte Basin Percent Occurrence by Attribute in Focus Areas

State Endangered, Threatened, and Species of Concern		
	Greenback Cutthroat Trout	5%
	Brassy Minnow	47%
	Common Shiner	27%
	Iowa Darter	47%
	Lake Chub	3%
	Northern Redbelly Dace	14%
	Plains Orangethroat Darter	8%
	Plains Minnow	7%
	Suckermouth Minnow	8%
	Stonecat	8%
	Boreal Toad	4%
	Bald Eagle Active Nest Sites	3%
	River Otter Confirmed Sightings	2%
	Yellow Mud Turtle	2%
	Common Garter Snake	10%
	Preble's Meadow Jumping Mouse	53%
	Northern Leopard Frog	19%
	Northern Cricket Frog	4%
	Plains Leopard Frog	3%
	Wood Frog	1%
Rare Plants and Significant Plant Communities		
	Rare Plants	20%
	Significant Plant Communities	49%
Special Value Waters		
	Colorado Outstanding Waters	5%
	Eligible/Suitable Wild and Scenic	12%
	CWCB Instream Flow Water Rights	27%
	CWCB Natural Lake Level Water Rights	4%
	Wilderness Area Waters	6%
Whitewater and Flatwater Boating		
	Whitewater Boating	20%
	Flatwater Boating	1%
	Recreational In-Channel Diversion Structures	0%
Important Cold and Warm-Water Fishing		
	Gold Medal Streams and Lakes	4%
	River and Stream Fishing	21%
	Reservoir and Lake Fishing	2%
Waterfowl Hunting/Viewing		
	Audubon Important Bird Areas	3%
	Waterfowl Hunting/Viewing Parcels	14%
	Ducks Unlimited Projects	20%
High Recreation Areas		
	High Recreation Corridors	4%

The attributes were grouped into subcategories in SWSI 2010 Table 3. These subcategories simplified the analysis. Figure 2and Figure 3 illustrate the grouping for environmental and recreational attributes. These subsets were obtained from the CWCB database distributed in December 2013 and refined by the nonconsumptive subcommittee in 2014 to more clearly categorize the attributes. The categorization of the attributes is shown in Table 3.

Figure 2 - Relationship between Environmental Attributes

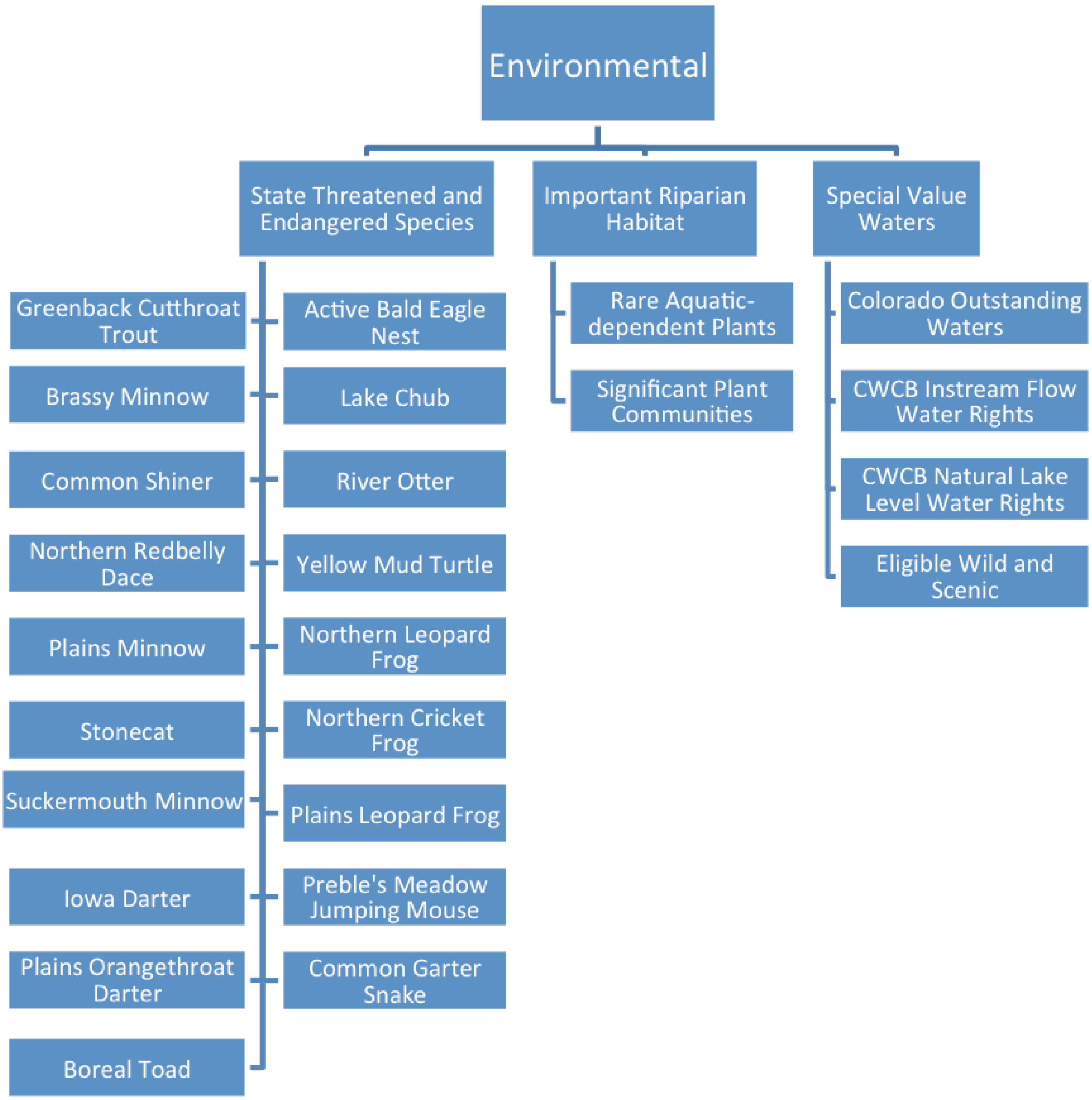


Figure 3 - Relationship between Recreational Attributes

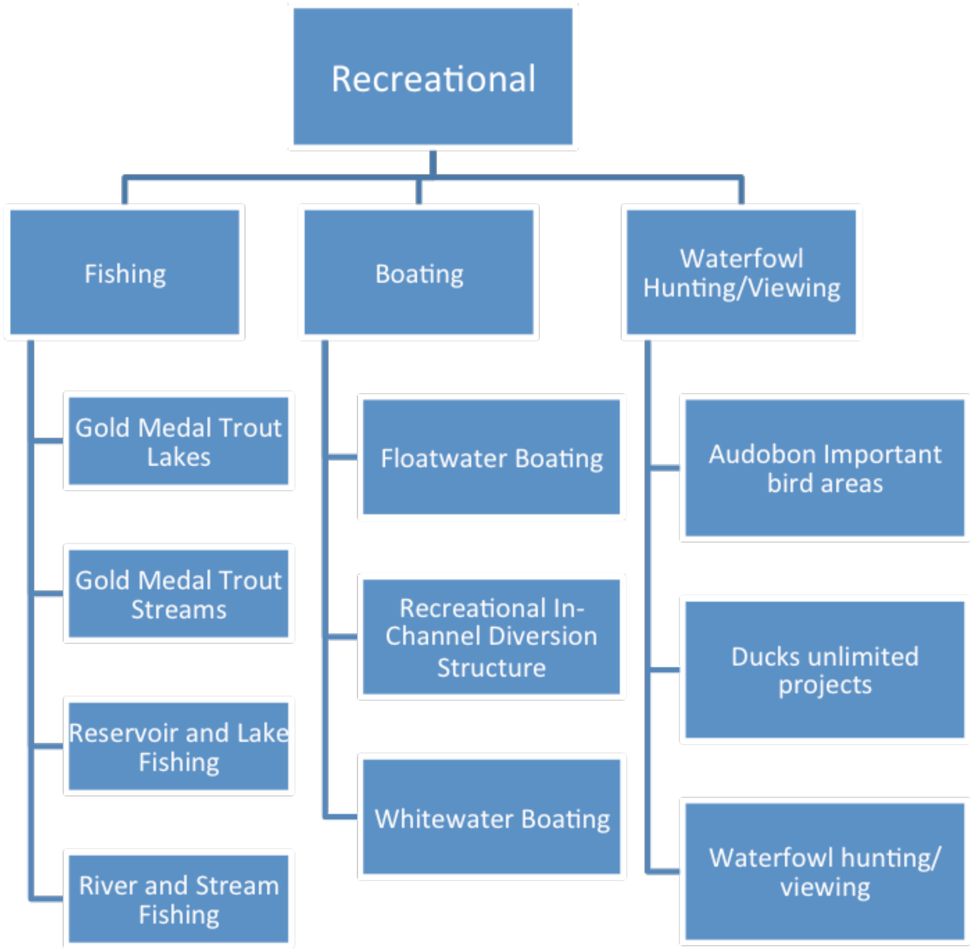


Table 3 - Attributes by Category

Attributes	***Category***
Gold Medal Trout Lakes	Fishing
Gold Medal Trout Streams	Fishing
Reservoir and Lake Fishing	Fishing
River and stream fishing	Fishing
Greenback Cutthroat Trout	Greenback Cutthroat Trout
Rare Aquatic-dependent plants	Important Riparian Habitat
Significant Plant Communities	Important Riparian Habitat
Brassy Minnow	Plains Fish State Endangered, Threatened, Species of Special Concern
Common Shiner	Plains Fish State Endangered, Threatened, Species of Special Concern
Northern Redbelly Dace	Plains Fish State Endangered, Threatened, Species of Special Concern
Plains Minnow	Plains Fish State Endangered, Threatened, Species of Special Concern
Stonecat	Plains Fish State Endangered, Threatened, Species of Special Concern
Suckermouth Minnow	Plains Fish State Endangered, Threatened, Species of Special Concern
Iowa Darter	Plains Fish State Endangered, Threatened, Species of Special Concern
Plains Orangethroat Darter	Plains Fish State Endangered, Threatened, Species of Special Concern
Flatwater Boating	Recreation
Recreational In-Channel Diversion Structures	Recreation
Whitewater Boating	Recreation
Boreal Toad	State Endangered, Threatened, Species of Special Concern
Lake Chub	State Endangered, Threatened, Species of Special Concern
River Otter	State Endangered, Threatened, Species of Special Concern
Yellow Mud Turtle	State Endangered, Threatened, Species of Special Concern
Northern Leopard Frog	State Endangered, Threatened, Species of Special Concern
Northern Cricket Frog	State Endangered, Threatened, Species of Special Concern
Plains Leopard Frog	State Endangered, Threatened, Species of Special Concern
Preble's Meadow Jumping Mouse	State Endangered, Threatened, Species of Special Concern
Common Garter Snake	State Endangered, Threatened, Species of Special Concern
Wood Frog	State Endangered, Threatened, Species of Special Concern
Waterfowl Hunting / Viewing	Waterfowl Hunting/Viewing
Ducks unlimited projects	Waterfowl Hunting/Viewing
Audubon important bird areas	Waterfowl Hunting/Viewing
Colorado Outstanding Waters	
CWCB Instream Flow Water Rights	
CWCB Natural Lake Level Water Rights	
Eligible Wild and Scenic	
Active Bald Eagle Nests	
Wilderness Waters	

Since SWSI 2010, the Greenback Cutthroat Trout has been determined to only be located in the Arkansas Basin, with what was previously considered the Greenback Cutthroat Trout actually being another native cutthroat trout. This categorization and attribute will be updated with the new native cutthroat trout species name, once determined. (*Historical stocking data and 19th century DNA reveal human-induced changes to native diversity and distribution of cutthroat trout*. Metcalf, Stowell, Kennedy, Rogers, McDonald, Epp, Keepers, Cooper, Austin, and Martin. Molecular Ecology, Vol 21, Issue 21, pages 5194-5207, Nov 2012.)

The addition of the Focus Area number to the CWCB database provides a means to quantify the attributes by Focus Area. This approach provides a means to determine the quantity of each attribute in each Focus Area but does not create a spatial reference for the attribute’s occurrence. For example, the database queries summarized stream segments to give totals for focus area, attribute, and project but do not indicate when project protections overlap at a COMID stream segment level. The spatial linkage must be made using the COMID and attributes.

The spatial locations can be used to determine where there are gaps in the projects and protections for each attribute or group of attributes. A generic example of this is shown in Figure 3

The MS Access database includes the list of current and planned projects within the South Platte basin. Several queries were made on the database to extract the list of projects by Focus Area and attribute. The entire list includes projects listed at “Stewardship: and “Instream Flow”. These types of projects cover large portions of the South Platte Basin but may not have specific protections to address threats to the attributes. For example, an instream flow right does not ensure adequate streamflow because such rights are typically junior to other water rights, and water flowing through public lands (considered stewardship) simply means that there is some level of land stewardship, as discussed below. These types of projects cover broad areas for the purpose of a general protection of aquatic attributes.

The database can also be queried for all projects in the South Platte Basin, excluding Stewardship and Instream Flow projects. The queries run to date result in fewer projects, which could be compared to attributes. Database queries can provide the total amount of the Focus Area covered by the project but not the location. The spatial location of each project can be identified using GIS.

Future projects and protections can be evaluated using the approach listed above with the addition of other data. These other data include diversion structures, dry-up locations, flow and other project data. Diversion structures can be impediments to upstream migration by many of the fish species listed in the attribute table. The species have both downstream and upstream migration requirements in the life cycle. The young, larval fish drift downstream as they develop. The older life stages of fish move upstream during their life cycle. Any barriers to movement disrupt these migrations and can be a factor in decreasing population sizes. An example of a project that provides protection for these fish species is modification of diversions to accommodate fish passage. These modifications may range from change to the physical configuration of the structure to allow fish to swim upstream of the structure or the complete removal of structures that are no longer needed for diversion of the water. Two recent projects that illustrate these examples are the modification of the Green Ditch Diversion on Boulder Creek and the removal of the Josh Ames Diversion on the Cache la Poudre River. These individual projects may be very localized and change the physical features on a very short section of river but allow the aquatic species access to many miles of rivers.

Another type of future project that can provide protections for the environmental attributes is the modification of dry-up points in the rivers. Like the diversion projects above, dry-up points can impact much larger river reaches. Projects that work to modify dry-up points provide continuous segments of habitat where discontinuous habitat now exists. Ideally, some additional streamflow monitoring stations could be implemented at river locations to determine flows in the river and facilitate administration of diversions and bypass flows. The methodology is illustrated in Figure 4 and Figure 5 .

Figure 4- Illustration of Methodology

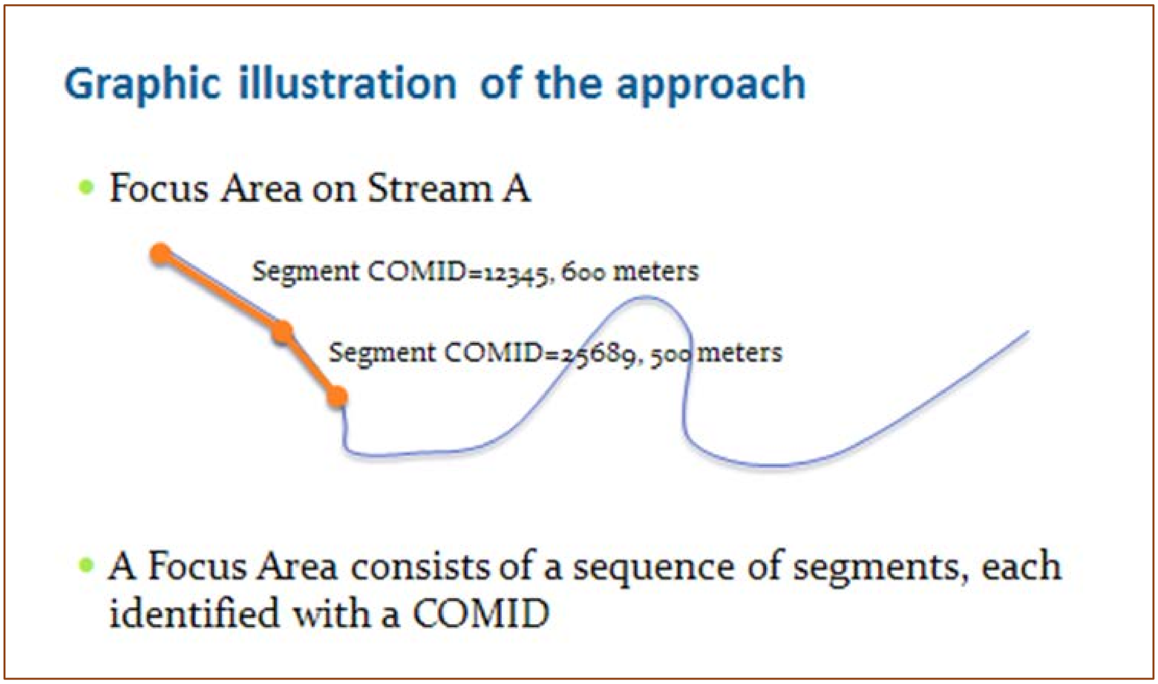
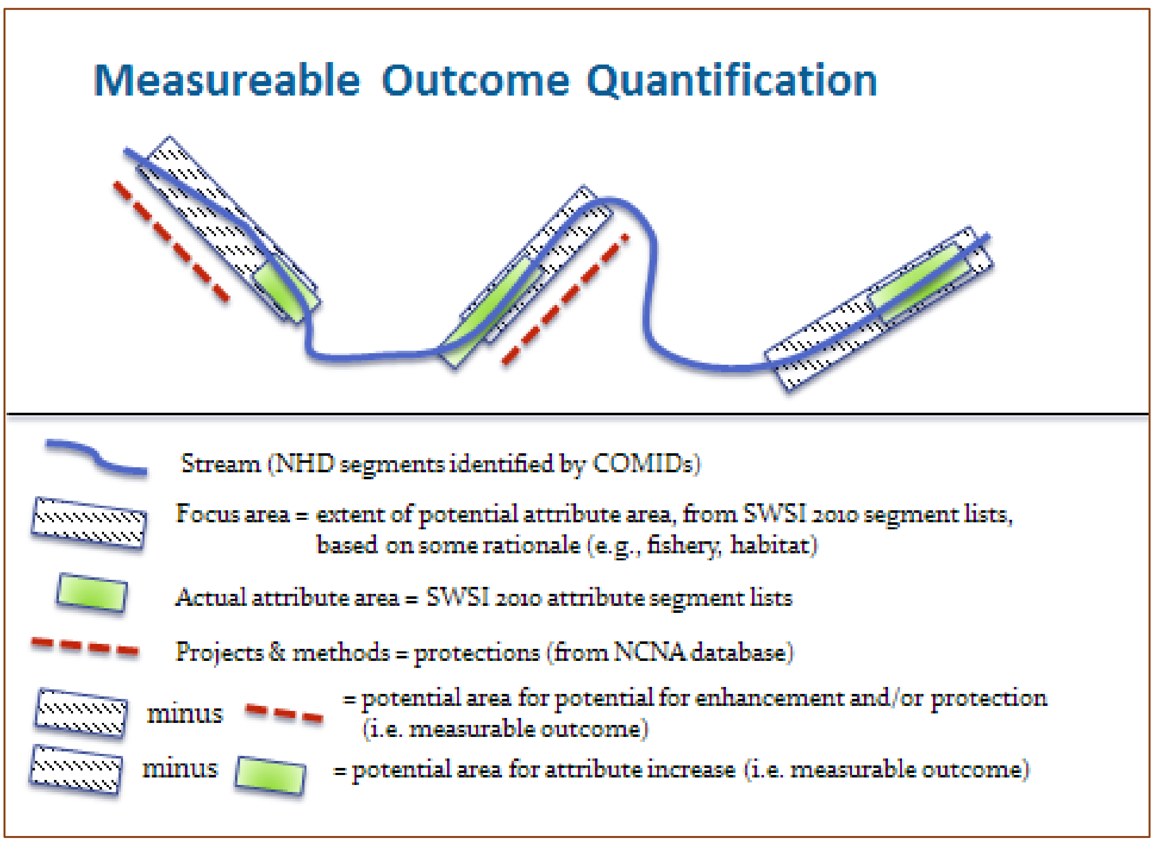


Figure 5 - Measurable Outcome Quantification



3 Projects

There are various types of projects which protect or enhance environmental and recreational attributes. These projects include CWCB instream flows, channel restoration, stewardship, species re-introductions, and cooperative or multi-purpose projects.

3.1 Instream Flows

Instream flow water rights and lake level water rights can only be held by the Colorado Water Conservation Board (CWCB). These water rights allow for the CWCB to hold a water right for a specific amount of instream flow within a specified reach or a specified lake level to assist in protecting the environment. An instream flow water right (ISF) is a relatively junior water right that can call for water to benefit instream flows within a specified reach. However, instream flow water rights can also be donated to the CWCB and converted for instream flow use. The Colorado Water Trust is a non-profit organization that raises funds to buy water rights in identified reaches with needed flows that can be changed in water court and donated to the CWCB for instream flow purposes. The presence of an instream flow right in a reach does not guarantee streamflows, however, and does not necessarily translate into adequate protection in the reach.

3.2 Channel Restoration

Channel restoration projects can benefit both in-stream aquatic habitat and species as well as riparian species such as wetlands and significant plant communities. In addition stream restoration can also benefit recreational uses such as fishing, flatwater boating, and kayaking. Channel restoration projects can also help to improve water quality in certain areas.

3.3 Stewardship Projects

Stewardship projects have protections that include areas near stream riparian areas and protect stream attributes for multiple uses. Examples of stewardship projects include areas protected by federal or state agencies, landowner agreements, and non-governmental organizations (NGOs). These protections cover multiple attributes in the areas where they are in place.

During the SWSI 2010 process, CWCB incorporated data from the Southwest Regional Gap Analysis Project (SRGAP)3[2], coordinated by U.S. Geological Survey (USGS) into the projects and methods database. The SRGAP created GIS data layers of land cover, native terrestrial vertebrate species, land stewardship, and management status values. The management status values quantify the relationship between land management and biodiversity throughout the state of Colorado. The four management status values are as described below (USGS 2010):

- Status 4 lands are where there are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.
- Status 3 lands comprise areas having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type

[2] United States Geological Survey. 2010. Southwest Regional Gap Analysis Project. http://fwsnmcfwru.nmsu.edu/swregap/Stewardship/Categorization.htm

(e.g., logging) or localized intense type (e.g., mining). It also confers protection to federally listed endangered and threatened species throughout the area.

- Status 2 lands are areas having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.
- Status 1 lands include areas having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.
- The stewardship projects currently included in the NCNA database have little information regarding which attributes the "stewardship" project is intended to protect. The only direct protections indicated by the stewardship projects are to riparian habitats, with all other attributes included as being indirectly protected. As the stewardship projects are land-focused and not stream focused, the level of protection afforded any specific attribute with respect to streamflows is cannot be determined without significant additional work identifying and quantifying specific possible protections from specific stewardship projects.

3.4 Species Reintroduction

Species reintroduction projects allow for species to be reintroduced to habitat areas where their numbers may have declined. At times additional projects are needed to ensure protection along with species reintroduction projects. Examples of species reintroductions in the South Platte Basin include reintroductions of the Boreal toad, cutthroat trout, and plains fish species.

3.5 Cooperative and Multi-Purpose Projects

There are various other types of projects that can assist in protecting or enhancing environmental and recreational attributes. Many of these projects include multipurpose projects and partnerships which can assist in the cooperative operation and construction of projects. Project proponents of M&I projects and new Colorado River supply projects can work with environmental and recreational interests to potentially identify additional funding sources to construct projects that enhance attributes in the project area. Irrigation of agricultural lands and return flows from such irrigation often provide habitat or streamflows that can benefit environmental and recreational uses. Opportunities also exist for cooperative operation, optimization and enhancement of infrastructure to assist in enhancing environmental and recreational attributes. Some examples of cooperative or multi-purpose projects include:

- Recharge projects which provide wetland areas and wildlife habitat, specifically various Ducks Unlimited programs throughout the basin.
- Environmental or recreational pools or cooperative agreements with respect to storage reservoirs, providing streamflows that enhance or protect recreational or environmental instream flow needs.
- Diversion structure modification to continue operations benefiting the consumptive use, while maintaining flows or connectivity for environmental and recreational attributes near the diversion structure.

3.6 Sufficiency of Projects

The sufficiency of the protections for many projects is unknown. The protection for a specific project and the attribute targeted is not included in either the GIS database or MS Access database. It appears from the previous work on SWSI 2010 and recent work completed by the CWCB contractors that the terms "projects" and "protections" were considered synonymous. If a project is present in a Focus Area then it is assumed that a protection was in place. An example of this is the attribute of CWCB instream flow, which can also be considered a protection. The sufficiency of the protection from the ISF is directly related to whether it can protect the streamflows during times of low flow. If there are water rights on the same stream reach that are senior to the ISF, they may legally reduce flow below the specified minimum and therefor the ISF would result in a physical protection of flows. Evaluation of these types of protections requires an analysis of streamflows at specific locations in the focus area. The analysis of the sufficiency of the protection could be done in specific reaches with significant additional resources, but cannot currently be determined with the existing data.

4 Project Examples

The proposed methodology was applied in a limited manner to determine example projects in each geographic area to illustrate how the attributes (or categories) and projects can meet the over-arching environmental and recreational goals. There remain some discrepancies between the GIS data and the MS database with regards to projects (i.e. protection) as they relate to attributes within each Focus Area. The total stream miles generated using both data sources for a common attribute in a single Focus Area does not match. For example, a summary of the "Ducks Unlimited Projects" attribute generated from the GIS data base (SWSI 2010) results in identification of 161.5 miles in Focus Area 1 (lower South Platte River) with the attribute present. The query on the MS Access database for the "Ducks Unlimited Projects" resulted in no miles in Focus Area 1 (lower South Platte River) with the attribute present. Ducks Unlimited Projects appear to be attributes, not projects in the database. This is one example of the discrepancies between the older and newer databases that need to reconciled to ensure that the data contained in the newest database is correct.

There is also a data gap for background data to determine the project status, project proponent, and the specific environmental or recreational benefit intended from the project. The level of detail available for the analysis is typically limited to a single line in a spreadsheet or data base with no citation to background data or original contact, interviewer, or proponent. These data should be provided to the BRT by CWCB or its contractor. The acquisition of these types of data is not in the scope of the current BIP.

The following sections include examples demonstrating a range of projects that have the potential to maintain or enhance environmental and recreational attributes in the candidate focus areas. Some of the data needed for a complete analysis and evaluation are missing; however, professional judgment was used to review some of the examples to illustrate the process for environmental and recreational benefits. Additional examples will be analyzed in the future with specific direction from the subcommittee and BRTs.

4.1 Headwater areas (Upper Mountain area)

There are seven Focus Areas in Park County as shown in Figure 6. The rationale for inclusion of many of these Focus Areas is the presence of significant, imperiled and rare/wetland plant species and plant communities. These plant communities are the result of the natural stream systems in the area, topography, and geology. There are also areas with recreational attributes including boating, fishing and

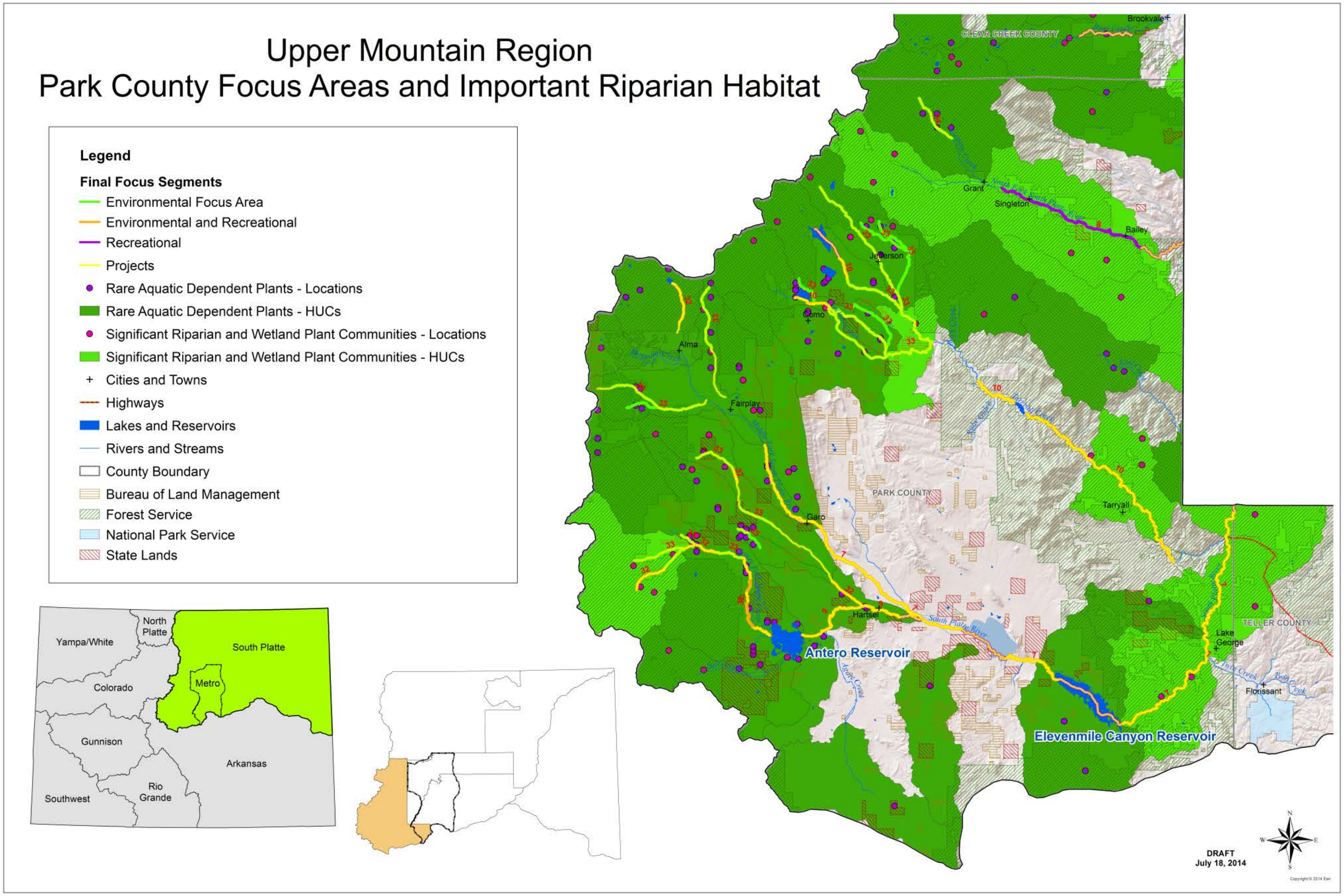
Gold Medal fisheries. There are a total of 325 miles of the South Platte Basin with the rare plant communities attribute present and a total of 156 miles in the Park County Focus Areas. Projects including CPW, CWCB, NCNA interviewed, stewardship, and ISF in Park County are present in most of the Park County Focus Areas, however the sufficiency of these projects for protecting the attributes has not been assessed.

These projects may provide protection for the rare plants and significant plant communities attributes in the following ways. Future projects that can provide protections to these plant communities include maintaining the hydrologic conditions that formed and support these plant communities. These protections include continued irrigation on parcels where the plant communities may be irrigation-dependent due to lowering groundwater tables in the area and maintaining the natural surface water – groundwater interactions where those natural characteristics protect the plant communities. These types of projects can also provide benefit to recreational uses in the area, including fishing and boating.

Some examples of current projects that currently provide some protections to these plant communities include stewardship programs in the area, instream flow water rights, stream restoration projects (including Lower Tarryall Creek, Middle Fork at Buffalo Peaks State Wildlife Area, and Five-Mile Creek), and the South Platte Protection Plan. There are other similar planned projects in the area.

These types of projects address the goals of maintaining and enhancing important wetland and riparian plant communities. Figure 6 shows the environmental and recreational focus areas and locations of the rare aquatic-dependent plants in Park County.

Figure 6 Park County Important Riparian Habitat



4.2 Metro Corridor

There are several projects in the Metro Corridor that focus on the Metro Denver Greenways. These projects range from recreational and riparian improvements along the South Platte to flow protection with Chatfield Reallocation. Specific projects from the GIS data include Chatfield Reallocation Program, expansion/enhancement to Confluence Park, recreational and riparian improvements along the South Platte, River North Greenway Master Plan, River South Greenway Master Plan, and Westerly Creek Greenway Master Plan.

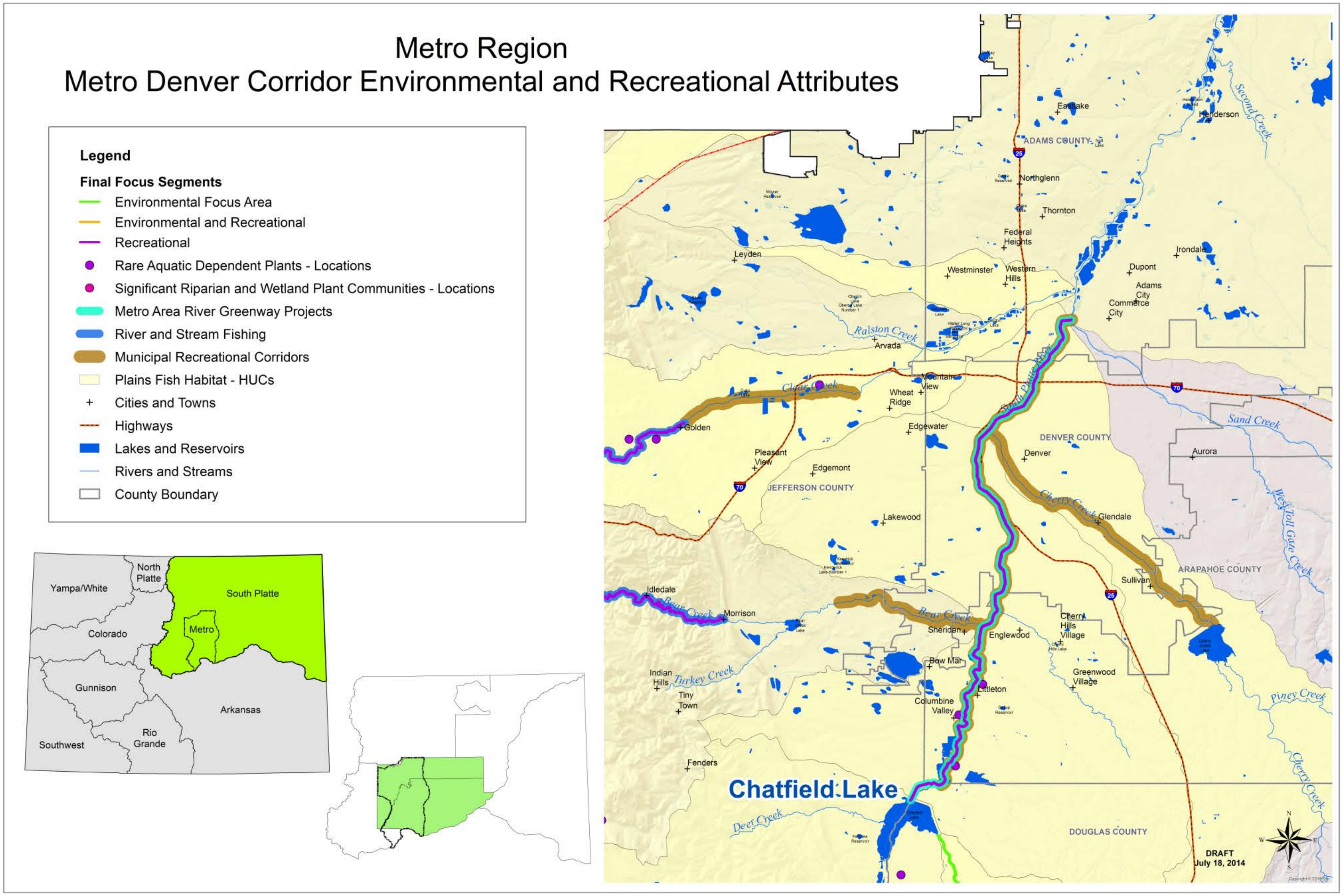
The projects listed above account for a total of approximately 15 miles in the Metro Corridor with restoration programs out of a total of approximately 23 miles in the South Denver Metro Corridor Focus Area. These types of projects provide protections for multiple attributes including riparian plant communities, recreation, and fishing. These projects also directly address the recreational goals of the plan as well as water quality concerns along the Metro Corridor.

Some specific examples of these types of projects include:

- The Big Dry Creek Greenway Project which included creek corridor clean up and bank stabilization, habitat rehabilitation, access to parks as well as wetland and riparian forest enhancements. The project does not specifically state which attributes would be the focal point of the project, however, attributes such as rare aquatic dependent plants, fishing and recreational corridors would likely benefit.
- Stream habitat work at the Carson Nature Center, which helps to improve riparian conditions. This project enhances plant, fish and wildlife attributes, as well as greenway usage along the stream corridor.

Figure 7 shows the environmental and recreational focus areas and locations of the rare aquatic-dependent plant, fishing and recreational corridors in the Metro Corridor.

Figure 7 South Platte Metro Corridor Environmental and Recreational Enhancements



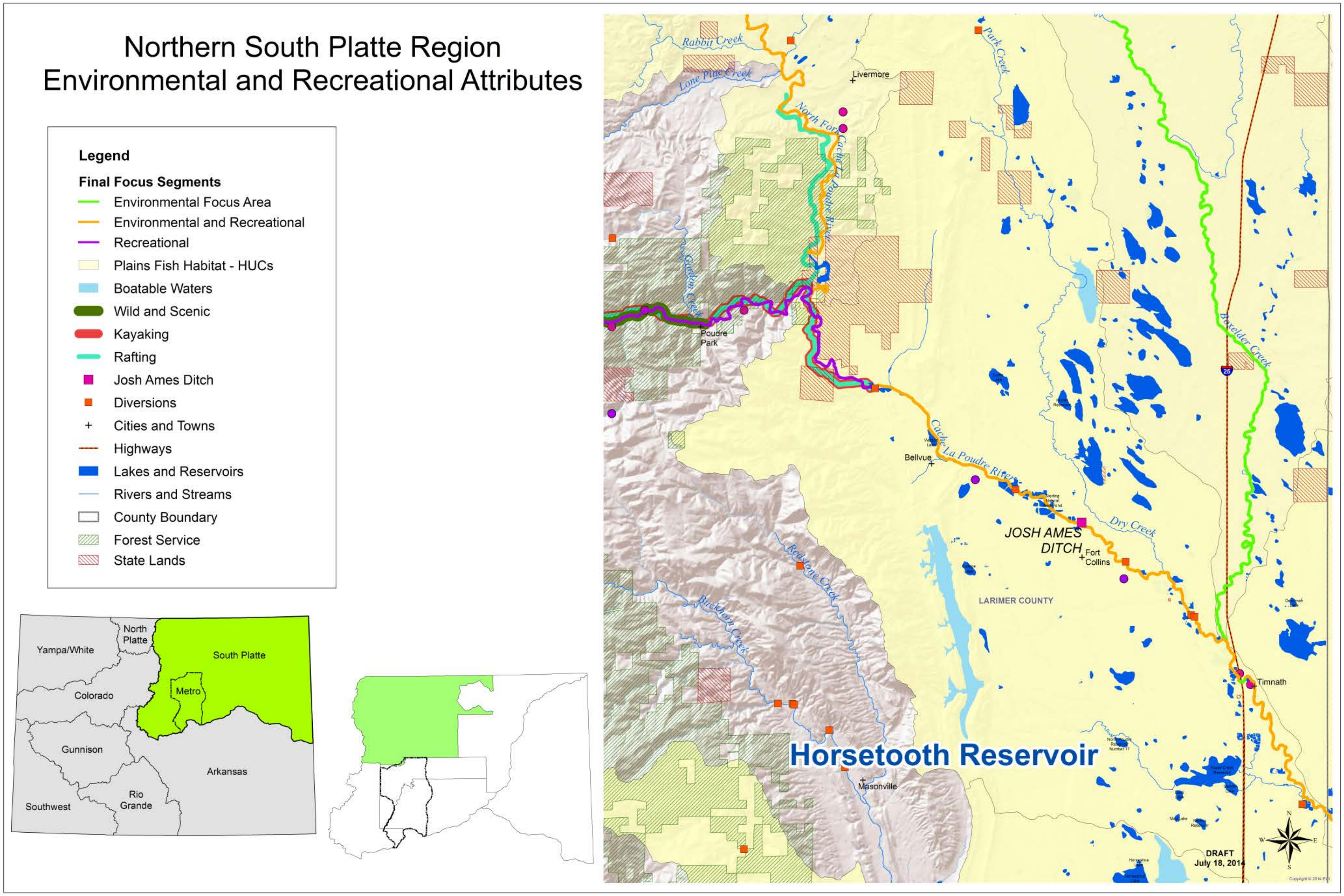
4.3 Boulder/Fort Collins (Northern Area)

An example project that includes protection to both environmental and recreational attributes is the diversion structure modification project in the Cache La Poudre River from near the mouth of Poudre Canyon to the eastern edge of Fort Collins. Several individual projects are planned or ongoing to modify existing diversion structures in this section of river for fish passage. Some projects are removing structures that are no longer needed for diversion. Each structure modified provides additional miles of continuous aquatic habitat or recreational opportunities. The modification of the structures provides the opportunity for native non-game species, to have continuous habitat connectivity. While these individual projects may open several miles of the river, other structures are still present and could be modified in the future. Many of these species are on the state threatened and endangered list. The continuous habitat provides additional protection for these attributes. In addition, the removal of structures and some modifications provide additional flat water boating opportunities in the urban corridor of the river. These projects directly address both environmental and recreational goals.

Some examples of these projects throughout the basin include the Green Ditch on Boulder Creek and the Josh Ames Ditch on the Cache la Poudre River.

Figure 8 shows the environmental and recreational focus areas and locations of the rare fish habitat, and recreational boating areas in the Northern portions of the South Platte Basin. The data to evaluate the function of each structure in terms of fish or recreational passage is not in the current database and is beyond the scope of this BIP.

Figure 8 South Platte Northern Environmental and Recreational Enhancements



4.4 Plains (Lower South Platte)

There are various example projects in the lower South Platte, including recharge projects, reservoirs and a species reintroduction project. The Colorado Parks and Wildlife (CPW) Tamarack recharge project retimes water flows that occur during high flow periods to times when flows are needed to meet Colorado's requirements under the Three States Agreement for the Platte River Recovery and Implementation Program (PRRIP). The (PRRIP) allows for water users within Colorado to continue to develop new supplies while still meeting the needs of downstream federally listed endangered species. The Ducks Unlimited recharge projects throughout the area cooperatively provide replacement water to wells in augmentation plans while also providing wildlife habitat and recharge flows that can benefit environmental and recreational needs. These and various other recharge projects in the region have the potential to increase wetland habitat and streamflows in the area. The Ducks Unlimited projects are currently indicated in the available data to affect the stream reaches in approximately 161 miles of the 212 miles present in the focus area in this region.[3] Julesburg Reservoir and North Sterling Reservoir are examples of water supply reservoirs for agricultural users on the lower South Platte River that also provide flatwater boating and waterfowl hunting and viewing.

The plains fish reintroduction project in the lower South Platte reintroduces several species, including common shiner, brassy minnow, plains minnow and suckermouth minnow to the lower South Platte where they are not currently present. These species are all on the state threatened and endangered species list. The common shiner is currently present in 19 miles out of the total 212 miles in the lower South Platte focus area. Plains minnow is currently present in 61 miles out of 212 miles. This project is intended to increase the amount of area with these species. The plains fish reintroduction is listed in 172 miles of the focus areas.

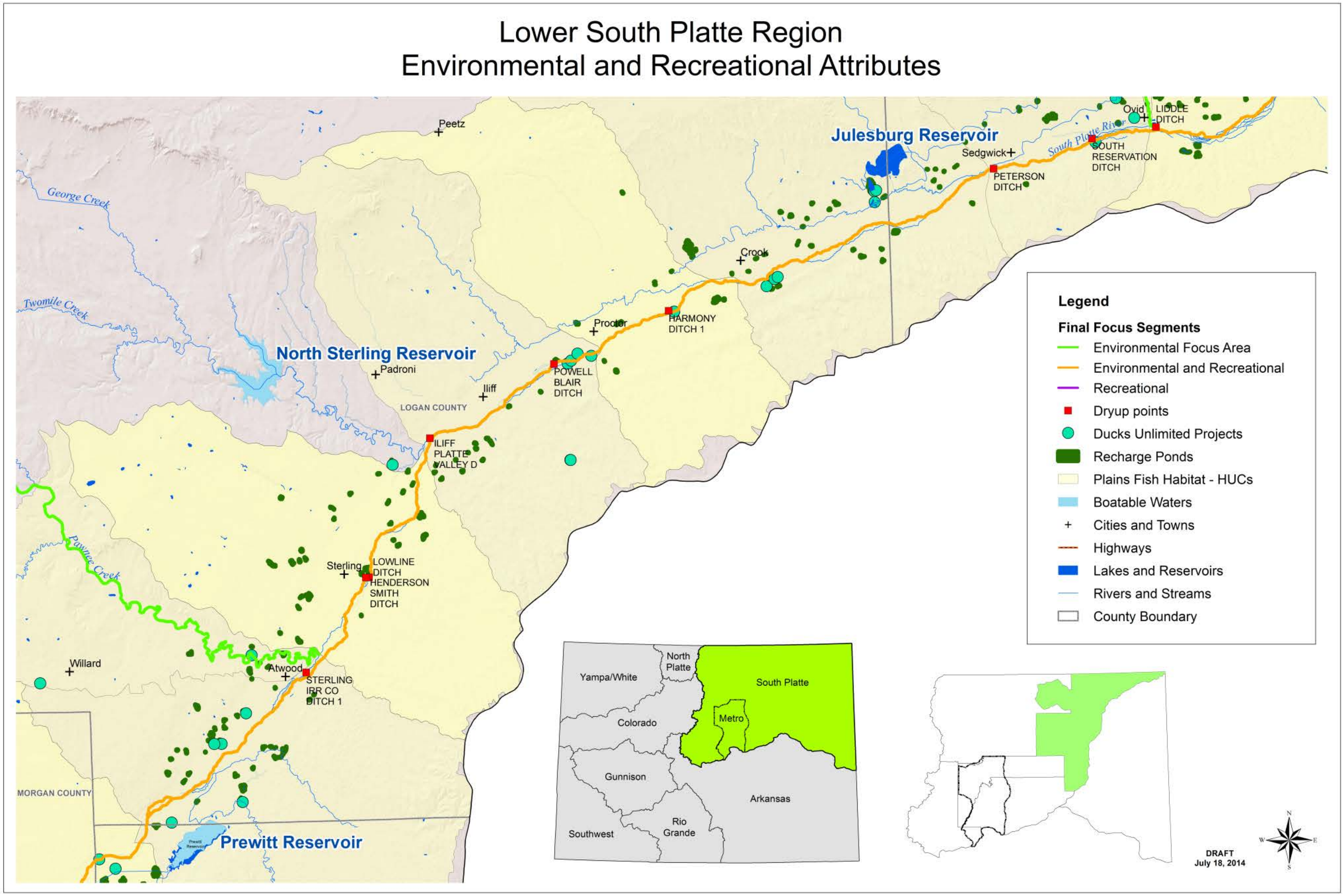
The reintroduction project alone may not fully protect the species. Additional protections could be provided by addressing the habitat fragmentation caused by diversion structures and dry-up points (Figure 9). These types of physical features can limit the amount of habitat available to plains fish species. These fish species require contiguous, year round habitat to complete their life cycle. Features that prevent fish movement disrupt their life cycle and can result in lower population sizes. Possible projects that could address the habitat fragmentation include cooperatively coordinated fish passageways and other structural solutions including storage and recharge to limit the number of days of dry-up on the river.

The recharge projects, including the Ducks Unlimited Projects, directly address the goal for enhancing water bird and waterfowl viewing and hunting. The various reservoirs throughout the area directly address flatwater boating goals and indirectly address wildlife habitat and waterfowl viewing and hunting goals. The plains fish reintroduction project directly addresses the environmental goal for state threatened and endangered species. Figure 9 shows the focus areas and locations of the DU projects, recharge sites, reservoirs, rare fish habitat, dry-up points and diversion structures in the Lower South Platte Basin. The data to specifically evaluate the hydrology and tradeoffs for environmental flows, recreational uses and wildlife habitat is not currently available within the existing databases. The evaluation of the hydrology is not currently in the scope of this BIP. Additional work could be undertaken in the future in priority focus

[3] The Ducks Unlimited Project data is indicated as being present in the entire HUC. This highlights the stream reach associated with that HUC. The actual project may affect fewer stream miles based on location of the project within the HUC and other hydrological operations in the area. The project may also affect more stream miles due to the increased streamflows downstream of the recharge project.

areas to determine the hydrology and potential possible impacts and benefits, if such data is available. Additional analyses may assist in future decisions regarding tradeoffs in managing this area which has historically been highly managed and modified from natural flows. Additional analysis may allow for consideration of tradeoffs including costs, engineering, feasibility, and water rights administration of such projects. The methodology described in this Appendix can be used to further assess where projects may benefit attributes in the future.

Figure 9 Lower South Platte Plains Fish Habitat



5 Environmental and Recreational Projects List

The existing projects in the South Platte Basin are included in Table 4. Some refinements to the projects list have been included, although more refinements to the list and specificity of the projects are needed. Additional projects have been included in Table 5 and include those recommended for inclusion by members of the environmental and recreational subcommittee of the Metro and South Platte Basin Roundtables.

Table 4 - Environmental and Recreational Projects (based on SWSI 2010)

SWSI NCNA Database Projects (no ISF or Stewardship)							
ProjectID	ProjectName	ProjectCategory	ProjectType	ProjectLocation	ProjectStatus	ProjectContact	ProjectNote
231	West Gold Remediation	NCNA Interviewed	Project	"Chicago Creek, upstream of confluence with Clear Creek"	Completed	Christine Crouse	Built water diversion to separate drainage from mine tailings to protect water quality in Chicago Creek
223	Lombard Mine Cleanup and Mill Site Removal	NCNA Interviewed	Project	"Cumberland Gulch, upstream of confluence with Fall River"	Completed	Christine Crouse	Reshaping two mine dumps and burying wood waste from mill building
232	Minnesota Mine Remediation	NCNA Interviewed	Project	"Lion Creek, above confluence with West Fork Clear Creek"	Planned	Christine Crouse	"Spring seeping contaminated water from underground collapsed mine, plan to use passive remediation using an alkaline barrier to neutralize iron, zinc, and aluminum flowing out of spring"
309	Land conservation	NCNA Interviewed	Project		Ongoing		DU holds many easements on the river
310	Land conservation	NCNA Interviewed	Project		Planned		"Plan to protect additional 27,000 acres, which would include the water rights"
311	Seasonal wetland habitat restoration	NCNA Interviewed	Project		Ongoing		"Needs programs to control noxious weeds, lower priority than main stem."
312	Riparian habitat improvement education and outreach	NCNA Interviewed	Project		Ongoing		
313	South Platte Protection Plan	NCNA Interviewed	Information		Completed	Becky Long, South Platte Enhancement Board, David*	Implemented in 1997 to protect values in lieu of USFS making a W&S determination.
335	Tarryall Reservoir Enlargement	CPW	Project		Planned	CDOW	Presented in concept
336	Montgomery Reservoir Enlargement	NCNA Interviewed	Project		Planned	CDOW	Presented in concept
337	Tamarack Project	CPW	Project		Completed	CDOW	
801	Riparian restoration project	NCNA Interviewed					
803	St. Vrain Creek Corridor Committe releases 1000 AF/yr to beneift minnows	NCNA Interviewed	flow protection				
176	Bard Creek Instream Habitat Structures	NCNA Interviewed	Project	Bard Creek	Completed	Carl Chambers	Instream Fish Habitat Structures
chrf_51	River Restoration - Riparian Re-vegetation	CWCB	Project	Bear Creek	Planned	"Wendy Hawthorne, Groundwork Denver"	

SWSI NCNA Database Projects (no ISF or Stewardship)							
ProjectID	ProjectName	ProjectCategory	ProjectType	ProjectLocation	ProjectStatus	ProjectContact	ProjectNote
cwrp_13	River Restoration Design	CWCB	Plan	below Chatfield	Planned	"Cecily Mui, South Suburban Parks and Recreation"	South Suburban Park
CDOW_5	Channel Restoration	CDOW	Stream and Riparian Restoration	Big T at Glade Park	completed	Ben Swigle - CDOW	
CDOW_6	Channel Restoration	CDOW	Stream and Riparian Restoration	Big Thompson at Narrows SWA	Planned	Ben Swigle - CDOW	
CDOW_39	Big Thompson Stream Restoration Phase 1	CDOW	Restoration	.1 segment upstream of the Mall Street Bridge below Olympus Dam	Completed	CDOW	Channel Restoration (0.1 miles) including vortex structures, pool excavation, boulder clusters
168	Big Thompson River Instream Fish Habitat Project	NCNA Interviewed	Project	Big Thompson River above Waltonia	Completed	Carl Chambers	ADA fishing access and Instream Fish Habitat Improvements
282	Minimum flow releases from Olympus Dam - BOR and NCWCD	NCNA Interviewed	Flow Protection	Big Thompson River from Estes Park to Dillon Tunnel	Ongoing	Larry Howard	Flows are specified by season and are defined as the lesser of the specified flow or the inflow into Lake Estes
263	Barrier Construction	NCNA Interviewed	Project	Black Hollow Creek	Completed	Kelly Larkin	Barrier construction for Greenbacks
CDOW_28	Fish Passage study	CDOW	Study	Boulder Creek	Ongoing	Ashley Ficke - CU Boulder	Study on ability of different fish species to pass through diversion structures under varying flows and temperatures.
162	Bull Pond Livestock Fencing Project	NCNA Interviewed	Project	Bull Pond	Completed	Carl Chambers	Livestock Fencing to promote wetland recovery
268	Investigating operations change	NCNA Interviewed	Flow Protection	Cache La Poudre	Planned	Amy Beatie	"Planning effort, looking at different operation efforts to leave more water in the river; next to new GOCO-funded path"
45	Cache la Poudre bank stabilization	NCNA Interviewed	Water Quality Protection	Cache la Poudre (near I-25)	Completed	Becky Pierce	Created wetlands and excavated sediment
166	Dutch George bank Stabilization	NCNA Interviewed	Project	Cache La Poudre River at Dutch George	Completed	Carl Chambers	Bank Stabilization
167	Kelly Flats Campground Bank Stabilization	NCNA Interviewed	Project	Cache La Poudre River at Kelly Flats Campground	Completed	Carl Chambers	Bank Stabilization
165	Mountain Park Campground Fish Habitat Project	NCNA Interviewed	Project	Cache La Poudre River at Mountain Park Campground	Completed	Carl Chambers	Instream Fish Habitat Structures

SWSI NCNA Database Projects (no ISF or Stewardship)							
ProjectID	ProjectName	ProjectCategory	ProjectType	ProjectLocation	ProjectStatus	ProjectContact	ProjectNote
203	Cherry Creek Basin Water Quality Authority	NCNA Interviewed	Water Quality Protection	Cherry Creek Reservoir	Completed	Aurora Water Resources	water quality management and projects within to promote water quality downstream of Cherry Creek Reservoir
234	Courtney-Ryley-Cooper	NCNA Interviewed	Project	Clear Creek	Completed	Christine Crouse	"Rafting and fishing spot, habitat improvement and disabled access"
287	Golden Mile habitat improvement for fisheries - focused on brown trout mainly	NCNA Interviewed	Project	Clear Creek - Golden - just above RICD	Completed	David Nickum	
CDOW_25	Alvarado Bridge Replacement	CDOW	Project	Clear Creek @ Lawson	Completed	Clear Creek County	Replaced 4-culvert bridge with span, allowing movement of fish
218	McClellan Mine Remediation	NCNA Interviewed	Project	Clear Creek at Dumont	Completed	Christine Crouse	"McClellen: remediation of orphan mine site on Clear Creek. Material removed, remainder capped. Raft launching site built."
169	Como Creek Fishery Habitat Structures	NCNA Interviewed	Project	Como Creek	Completed	Carl Chambers	Instream Fish Habitat Structures
221	General Herkimer Mill Site	NCNA Interviewed	Project	Confluence of Clear Creek and Spring Gulch	Completed	Christine Crouse	"Mine waste remediation, controlling run-off"
156	Corral Creek fish Structures	NCNA Interviewed	Project	Corral Creek	Completed	Carl Chambers	Instream Fish Habitat Structures
CDOW_8	Craig Creek (VanHall Property)	CDOW	Project	Craig Creek	Planned	Freestone Aquatics	Channel improvements, sediment transport, Planned
186	Creedmore Lakes Livestock Fencing Project	NCNA Interviewed	Project	Creedmore Lakes	Completed	Carl Chambers	Livestock Fencing to promote wetland recovery
47	"East Plum Creek wetlands restoration, channel restoration work."	NCNA Interviewed	Project	East Plum Creek	Completed	Becky Pierce	"Created wetlands, and installed in-stream structure to re-channel stream for Prebles Jumping Mouse"
164	Elkhorn Creek Instream Fish Habitat	NCNA Interviewed	Project	Elkhorn Creek	Completed	Carl Chambers	Instream Fish Habitat Structures and Bank Stabilization
36	Five-Mile Creek Channel Reconstruction	NCNA Interviewed	Project	Five-Mile Creek	Completed	Mark Beardsley	Stream Restoration
cwrp_9	"River Restoration - channel reconfiguration, riparian re-vegetation"	CWCB	Project	Fourmile Creek	Completed	"Dieter Erdmann, Colorado Open Lands"	
24	Pettee Ranch Riparian Restoration	NCNA Interviewed	Project	Four-Mile Creek	Completed	Mark Beardsley	Riparian restoration of grazing impacts
25	Four-Mile Creek / Denver Water Channel Reconstruction	NCNA Interviewed	Project	Four-Mile Creek	Completed	Mark Beardsley	Reconstruction of 3 mile channelized creek to 5 mile meandering stream. Part of larger wetlands restoration project.
35	Four-Mile Creek / Denver Water Channel Reconstruction #2	NCNA Interviewed	Project	Four-Mile Creek	Completed	Denver Water	90 acre Wetlands restoration. Part of a larger restoration project
224	Silver Age/Ship Ahoy	NCNA Interviewed	Project	Gilson Gulch	Ongoing	Christine Crouse	"Clean water diversion project to prevent contamination of the headwaters from 40,000

SWSI NCNA Database Projects (no ISF or Stewardship)							
ProjectID	ProjectName	ProjectCategory	ProjectType	ProjectLocation	ProjectStatus	ProjectContact	ProjectNote
							cubic yard Silver Age mine waste pile"
225	Gilson Gulch	NCNA Interviewed	Project	Gilson Gulch	Ongoing	Christine Crouse	An erosion and sediment control project designed to protect Clear Creek from metals and acidity associated with mine waste in the upper portions of the watershed
226	Silver Cycle	NCNA Interviewed	Project	Gilson Gulch	Ongoing	Christine Crouse	A mine waste consolidation and reclamation project designed to remove mine waste and stabilize the channel of Gilson Gulch
227	Mine Drainage Treatment Demonstration Project	NCNA Interviewed	Project	Gilson Gulch	Planned	Christine Crouse	A planned project to treat the base flow of Gilson Gulch using state-of-the-art passive mine drainage treatment techniques
175	Grizzly Gulch Riparian Restoration	NCNA Interviewed	Project	Grizzly Gulch	Completed	Carl Chambers	Stream Stabilization and Riparian Restoration
235	Grizzly Gulch Habitat Improvement	NCNA Interviewed	Project	Grizzly Gulch	Completed	Christine Crouse	"Habitat improvement for greenback, mine remediation, maintenance of chemical barrier protecting greenbacks from Brook Trout"
CDOW_27	Reintroduction of Native Trout	CDOW	Project	Grizzly Gulch	Planned	Paul Winkle - CDOW	Planned introduction of Native Trout
148	Gross Reservoir Minimum Release	NCNA Interviewed	Flow Protection	Gross Reservoir	Completed	Denver Water	Denver Water Minimum Instream Flows
285	Potential Environmental Pool	NCNA Interviewed	Flow Protection	Gross Reservoir	Planned	David Nickum - Colorado Trout Unlimited	
283	Minimum release from Idylwylde Dam of 7.0 cfs	NCNA Interviewed	Flow Protection	Idylwylde Dam - City of Loveland USFS easement	Ongoing	Larry Howard - Larimer County Municipalities	
chrf_4	"River Restoration - riparian Re-vegetation, sedimentation mitigation"	CWCB	Project	James Creek	Completed	"Colleen Williams, James Creek Watershed Initiative"	
288	Improve fish habitat and recreational opportunities	NCNA Interviewed	Project	Jefferson County - one mile of stream along Hghwy 6	Planned	David Nickum	
150	L.C. Pump Station to Chatfield Reservoir instream flows	NCNA Interviewed	Flow Protection	L.C. Pump Station to Chatfield Reservoir	Completed	Denver Water	Denver Water Minimum Instream Flows
CDOW_15	Greenback Cutthroat Recovery Project	CDOW	Habitat	La Poudre Pass, Corral, Neota, Willow, Hague, Chapin Creeks as well as Baker Gulch and the	Planned	USFS, CDOW	The USFS decision in the Long Draw EIS to protect and reclaim the headwaters of the Cache la Poudre for greenback cutthroat recovery. Planned

SWSI NCNA Database Projects (no ISF or Stewardship)							
ProjectID	ProjectName	ProjectCategory	ProjectType	ProjectLocation	ProjectStatus	ProjectContact	ProjectNote
				upper South Fork of the Cache la Poudre.			
222	Dibbins Mill and Sydney Tunnels Remediation	NCNA Interviewed	Project	Leavenworth Creek	Completed	Christine Crouse	"Mine waste remediation, controlling run-off"
CDOW_38	Left Hand Creek Restoration	CDOW	Restoration	Left Hand Creek	Completed	CDOW	Channel Restoration (0.9 miles)
sev_1	"River Restoration - riparian Re-vegetation, sedimentation mitigation"	CWCB	Project	Lefthand Creek	Completed	"Colleen Williams, James Creek Watershed Initiative"	
155	Little Beaver Creek Fish Structures	NCNA Interviewed	Project	Little Beaver Creek (Between Comanche Peak Wilderness and Confluence of the South Fork of the Cache La Poudre River)	Completed	Carl Chambers	Instream Fish Habitat Structures
177	Little James Creek Bank Stabilization	NCNA Interviewed	Project	Little James Creek	Completed	Carl Chambers	Bank Stabilization and Mine Tailings cleanup
CDOW_24	USACE flood control study	CDOW	Study	Lower Poudre River below Fort Collins	Ongoing	USACE	US Army Corps flood control study - Poudre River at Greeley.
CDOW_29	Tamarack Recharge Study	CDOW	Study	Lower South Platte at Tamarack SWA	Ongoing	John Stednick - CSU	Study on how recharge projects affect physical habitat during winter flow conditions.
14	Puma Hills River Ranch Channel Reconstruction	NCNA Interviewed	Project	Lower Tarryall Creek	Completed	Mark Beardsley	"Channel Reconstruction and Stabilization, and some riparian protection"
15	Allen Ranch Channel Reconstruction	NCNA Interviewed	Project	Lower Tarryall Creek	Completed	Mark Beardsley	"Channel Reconstruction and Stabilization, and some riparian protection"
16	Bennis Ranch Channel Reconstruction	NCNA Interviewed	Project	Lower Tarryall Creek	Completed	Mark Beardsley	"Channel Reconstruction and Stabilization, and some riparian protection"
17	Tarryall State Wildlife Area Channel Reconstruction	NCNA Interviewed	Project	Lower Tarryall Creek	Completed	Mark Beardsley	"Channel Reconstruction and Stabilization, and some riparian protection"
18	Tarryall Reservoir Outlet Channel Reconstruction	NCNA Interviewed	Project	Lower Tarryall Creek	Completed	Mark Beardsley	"Channel Reconstruction and Stabilization, and some riparian protection"
CDOW_9	Lower Allen Ranch	CDOW	Project	Lower Tarryall Creek	Planned	Flywater	Channel improvements, sediment transport, riparian improvements, Planned
228	Lower Trail Creek Remediation	NCNA Interviewed	Project	Lower Trail Creek near confluence with	Ongoing	Christine Crouse	Abandoned mine remediation to project watershed

SWSI NCNA Database Projects (no ISF or Stewardship)							
ProjectID	ProjectName	ProjectCategory	ProjectType	ProjectLocation	ProjectStatus	ProjectContact	ProjectNote
				Clear Creek			
CDOW_11	Middle Fork South Platte Restoration	CDOW	Project	M Fk. South Platte	ongoing	CDOW - Matt Kondratieff	Adult Salmonid Habitat, channel improvements, sediment transport, riparian improvements, Ongoing and completed. See Attached List
142	River North Greenway Master Plan	NCNA Interviewed	Information	Metro Denver Greenways	Completed	Jeff Shoemaker	master plan for recreation use on the Metro North South Platte
143	Westerly Creek Greenway Master Plan	NCNA Interviewed	Information	Metro Denver Greenways	Planned	Jeff Shoemaker	master plan for recreation use on Westerly Creek
144	Recreational and Riparian Improvements along the South Platte	NCNA Interviewed	Project	Metro Denver Greenways	Completed	Jeff Shoemaker	habitat enhancements and recreation enhancements along the Metro South Platte
145	Expansion / Enhancement to Confluence Park	NCNA Interviewed	Project	Metro Denver Greenways	Completed	Jeff Shoemaker	habitat enhancements and recreation enhancements to Confluence Park
146	Chatfield Reallocation Program	NCNA Interviewed	Flow Protection	Metro Denver Greenways	Planned	Jeff Shoemaker	storage water in chatfield for releases into South Platte for recreation use
147	River South Greenway Master Plan	NCNA Interviewed	Information	Metro Denver Greenways	Completed	Jeff Shoemaker	master plan for recreation use on the Metro South Platte
20	McDaniel Ranch Riparian Restoration	NCNA Interviewed	Project	Michigan Creek	Completed	Mark Beardsley	Riparian Restoration of Ranching impacts
cwrp_3	"River Restoration - Channel reconfiguration, Riparian re-vegetation"	CWCB	Project	Middle Boulder Creek	Completed	"Roger Svendsen, Boulder Flycasters TU"	
CDOW_3	Channel Restoration	CDOW	Stream and Riparian Restoration	Middle Boulder Creek @ Rogers Park	Completed	Ben Swigle - CDOW	
CDOW_7	Channel Restoration	CDOW	Stream and Riparian Restoration	Middle Boulder Creek above Barker Reservoir	Planned	Ben Swigle - CDOW	
CDOW_4	Greenback Cutthroat Waters	CDOW	Study	Middle Boulder Creek from confluence with Boulder Creek to headwaters	Planned	Ben Swigle - CDOW	
286	Buffalo Peak Ranch fishery restoration - channel modification to provide better habitat restoration for brown trout	NCNA Interviewed	Project	Middle Fork at Buffalo Peaks SWA	Completed	David Nickum and Ecological Resource Consultants	
22	Buffalo Peaks Ranch Fish Habitat	NCNA Interviewed	Project	Middle Fork of South Platte	Completed	Mark Beardsley	"Fish Habitat in channel work, bank stabilization, public access"
23	Santa Maria Ranch Riparian Restoration	NCNA Interviewed	Project	Middle Fork of South Platte	Completed	Mark Beardsley	Riparian restoration and Channel reconstruction
21	Fairplay Beach Stream Restoration	NCNA Interviewed	Project	Middle Fork of South Platte in	Completed	Mark Beardsley	Riparian Restoration of Placer mining impacts

SWSI NCNA Database Projects (no ISF or Stewardship)							
ProjectID	ProjectName	ProjectCategory	ProjectType	ProjectLocation	ProjectStatus	ProjectContact	ProjectNote
				Fairplay			
170	Middle St. Vrain River Fish Structures	NCNA Interviewed	Project	Middle St. Vrain River at Camp Dick	Completed	Carl Chambers	Instream Fish Habitat Structures
CDOW_36	Habitat improvements projects	CDOW	Structural	NF Republican	Planned	CDOW	Habitat Improvement projects for Stonecat within the NF republican watershed
CDOW_30	Dr. Falke Study	CDOW	Study	NF Republican and Arikaree River	Completed	Jeff Falke - University of Oregon	Study on native fish population and habitat in NF Republican River Basin.
233	Aorta Mine Remediation	NCNA Interviewed	Project	North Empire Creek	Planned	Christine Crouse	"Seeping mine was draining into North Empire Creek, now goes into pipe under a landfill. Project will make improvements to inlet of that pipe"
CDOW_26	Reallignment of State Highway 119	CDOW	Project	North Fork Clear Creek	Planned	Holly Huyck-CDOT	Treat mine wastes, cap tailings piles, improve fish habitat
1	Lazy River Stream Restoration	NCNA Interviewed	Project	North Fork of South Platte	Completed	David Bennet	Added vortex weirs
34	North Fork Fish Channel	NCNA Interviewed	Project	North Fork of South Platte (just below Antero)	Completed	Denver Water	Created alternate channel for fish movement
159	North Fork of the Cache La Poudre River Instream Fish Habitat	NCNA Interviewed	Project	North Fork of the Cache La Poudre River	Completed	Carl Chambers	Instream Fish Habitat Structures
289	Halligan-Seaman Shared Vision Planning	NCNA Interviewed	Project/Flow Protection	North Fork of the Poudre	Ongoing	City of Greeley, City of Ft. Collins	
163	North Lone Pine Creek Fencing Project	NCNA Interviewed	Project	North Lone Pine Creek	Completed	Carl Chambers	Livestock Fencing to promote wetland recovery
158	Pennock Creek Instream Fish Habitat	NCNA Interviewed	Project	Pennock Creek	Completed	Carl Chambers	Instream Fish Habitat Structures
CDOW_33	Boreal toad reintroduction	CDOW	Species reintroduction	Poudre River Basin from Big South Confluence to Headwaters	Ongoing	CDOW	Reintroduction of Boreal Toads in Cameron Pass Area
CDOW_19	Diversion structure modifications for bypass flows	CDOW	Structural	Poudre River - Watson hatchery to Fossil Creek	Planned	CDOW	Create ability to bypass low flows through diversion structures on Poudre river, including the CDOW Watson
CDOW_14	NISP EIS Impacts Study	CDOW	EIS Study	Poudre River below Canyon Mouth	Ongoing	NCWCD	An assessment of the Lower Poudre river corridor as the habitat changes relative to water levels for both riparian areas and fish habitat is currently underway associated with this project. Ongoing
CDOW_17	Anderson Engineering 2-D modeling	CDOW	Study	Poudre River below Canyon Mouth	Completed	NCWCD	Groundwater modeling in support of proposed NISP project

SWSI NCNA Database Projects (no ISF or Stewardship)							
ProjectID	ProjectName	ProjectCategory	ProjectType	ProjectLocation	ProjectStatus	ProjectContact	ProjectNote
CDOW_21	JOP Enhancement	CDOW	Flow Agreement	Poudre River below Joe Wright Reservoir	Planned	CDOW	Exchange of Greeley owned Laramie Tunnel water into Chambers Lake to enhance existing wintertime JOP flows.
CDOW_23	Poudre River stream restoration - below Watson Lake diversion structure	CDOW	Restoration	Poudre River below Watson Lake SWA	Planned	CDOW	Channel restoration and design of low flow channel to improve habitat and channel funtion at low flow
CDOW_20	Minimum instream flows - Poudre River	CDOW	Flow Agreement	Poudre River in Fort Collins	Planned	CDOW	Potential agreement to maintain 25 cfs at the Poudre River Lincoln St. gage from Nov. - April
CDOW_16	Joint Operating Plan (JOP)	CDOW	Flow Agreement	Poudre River Mainstem	Completed	CDOW	Operating agreement between CDOW, Fort Collins and Greeley to provide minimum wintertime flows in Poudre River.
CDOW_18	Physical habitat modeling	CDOW	Study	Poudre River, North Fork	Completed	City of Greeley	Technical report by Bill Miller in support of proposed Halligan Seaman project
sev_22	River Restoration - Riparian Re-vegetation	CWCB	Project	Rock Creek	Planned	"Ed Self, Wildlands Restoration Volunteers"	
802	Various bank stabilization and riparian restoration projects	NCNA Interviewed	Restoration	S Boulder Creek			
CDOW_12	South Fork South Platte Restoration	CDOW	Project	S Fk. South Platte	Planned	CDOW - Matt Kondratieff	Adult Salmonid Habitat, channel improvements, sediment transport, riparian improvements, Planned and completed
46	Saint Vrain stream realignment and wetland enhancement	NCNA Interviewed	Project	Saint Vrain (near Longmont)	Completed	Becky Pierce	"Realigned stream channel, wetland mitigation and enhancement"
CDOW_2	South Boulder Creek Channel Restoration	CDOW	Stream and Riparian Restoration	South Boulder Creeek between Pinecliff and Moffat Tunnel	Completed	Ben Swigle - CDOW	
172	Jumbo Mountain Picnic Ground Bank Stabilization	NCNA Interviewed	Project	South Boulder Creek at Jumbo Mountain Picnic Ground	Completed	Carl Chambers	Bank Stabilization and Instream Fish Habitat Structures
CDOW_1	Channel Restoration	CDOW	Restoration/Diversion Reconstruction	South Boulder Creek between South Boulder Road and 1 mile west of Hwy 36.	Completed	Ben Swigle - CDOW	
284	Fish passage on diversion structures	NCNA Interviewed	Project	South Boulder Creek from Gross Reservoir to Mouth	Completed	David Nickum - Colorado Trout Unlimited	
154	South Fork of Cache La Poudre River Fish Structures	NCNA Interviewed	Project	South Fork of Cache La Poudre	Completed	Carl Chambers	Instream Fish Habitat Structures

SWSI NCNA Database Projects (no ISF or Stewardship)							
ProjectID	ProjectName	ProjectCategory	ProjectType	ProjectLocation	ProjectStatus	ProjectContact	ProjectNote
				River			
CDOW_13	Upper South Platte Stream Restoration	CDOW	Project	South Platte	Planned	CDOW - Matt Kondratieff	Adult Salmonid Habitat, channel improvements, sediment transport, riparian improvements, Planned
CDOW_34	Identification and modification of barriers to fish passage on South platte	CDOW	Study	South Platte	Planned	CDOW	Indentfication of South Platte mainstem and tributary diversion structures that are barriers to fish passage. Propose collaboration with structure owers to investigate feasibility and funding of structure modification to allow for fish passage.
26	South Platte Protection Plan #3 - Eleven Mile Reservoir	NCNA Interviewed	Flow Protection	South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte) and North Platte (from Insmont to confluence with South Platte)	Completed	Denver Water	Release of minimum instream flows necessary for fishery habitat
27	South Platte Protection Plan #4 - Cheeseman Reservoir	NCNA Interviewed	Flow Protection	South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte) and North Platte (from Insmont to confluence with South Platte)	Completed	Denver Water	Release of minimum instream flows necessary for fishery habitat
28	South Platte Protection Plan #5 - Outflow Ramping from Eleven Mile / Cheeseman Reservoir / Roberts Tunnel	NCNA Interviewed	Flow Protection	South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte) and North Platte (from Insmont to confluence with South Platte)	Completed	Denver Water	Outflow Ramping Agreement (ie reservoir outflow fluctuation agreements by percent of change)
29	South Platte Protection Plan #6 - Channel work on North Fork	NCNA Interviewed	Information	South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte)	Completed	Denver Water	Commitment to consult Colorado Division of Wildlife in any channel work and to maintain or enhance structural habitat for trout.

SWSI NCNA Database Projects (no ISF or Stewardship)							
ProjectID	ProjectName	ProjectCategory	ProjectType	ProjectLocation	ProjectStatus	ProjectContact	ProjectNote
				and North Platte (from Insmont to confluence with South Platte)			
30	South Platte Protection Plan #7 - Planning meetings b/t Operators and fisheries and whitewater interests	NCNA Interviewed	Information	South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte) and North Platte (from Insmont to confluence with South Platte)	Completed	Denver Water	Commitment to consult fisheries and recreation interests regarding upcoming operations.
31	South Platte Protection Plan #8 - New operating and monitoring equipment	NCNA Interviewed	Information	South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte) and North Platte (from Insmont to confluence with South Platte)	Completed	Denver Water	"Install low flow valve at Eleven Mile Reservoir, install stream temp. monitors at Eleven Mile and Cheeseman Reservoirs, and SNOTEL gages in the basin"
32	South Platte Protection Plan #2 - Spinney Mountain Reservoir	NCNA Interviewed	Flow Protection	South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte) and North Platte (from Insmont to confluence with South Platte)	Completed	City of Aurora	Release of minimum instream flows necessary for fishery habitat
33	South Platte Protection Plan #9 - Stream Channel Maintenance	NCNA Interviewed	Water Quality Protection	South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte) and North Platte (from Insmont to confluence with South Platte)	Planned	Kevin Bayer	"Monitor Sediment levels, and where necessary develop in-channel projects to stabilize banks and erosion resulting from the 2002 Hayman fire."

SWSI NCNA Database Projects (no ISF or Stewardship)							
ProjectID	ProjectName	ProjectCategory	ProjectType	ProjectLocation	ProjectStatus	ProjectContact	ProjectNote
153	Happy Meadows/ Sportsman's Paradise River Restoration	NCNA Interviewed	Project	South Platte at Happy Meadows	Completed	Carol Ekarius	riparian and river restoration
131	Trumbull Trout Habitat Enhancement	NCNA Interviewed	Project	South Platte below Horse Creek	Completed	Steve Dougherty	Improve trout habitat in river and provide better public access
WSRA-SP-1	South Platte River Recreation and Habitat Feasibility Study	WSRA	Study	South Platte River	Ongoing	Eric	Restoration Study
chrf_22	Happy Meadows Campground River Restoration Design	CWCB	Plan	South Platte River near Lake George	Completed	"Carol Ekarius, Coalition fo the Upper South Platte"	
103	Hayman Fire Restoration	NCNA Interviewed	Information	South Platte River upstream of Michigan Creek	Planned	Steve Dougherty	Doing Hydro assessment in regards to sediment impacts from the Hayman Fire. Also removal of low-head dam.
290	Chatfield Reallocation	NCNA Interviewed	Project/Flow Protection	South Platte through Metro Area	Ongoing	CWCB	
291	Metro Area River Restoration Proposals	NCNA Interviewed	Project	South Platte through Metro Area	Planned	CWCB	
CDOW_31	Plains Fish Monitoring	CDOW	Monitoring	South Platte/ Republican	Ongoing	CDOW	Ongoing monitoring of native fish populations in North Fork and Republican River basins.
CDOW_35	Plains fish reintroduction	CDOW	Species reintroduction	South Platte/ Republican	Planned	CDOW	Reintroduction of native plains fish species including Brassy Minnow, Northern Redbelly Dace, Common Shiner, Plains Minnow, Suckermouth Minnow
CDOW_32	Special Status Plains Fish Species - State Conservation Plan	CDOW	Monitoring/Study/Conservation Plan	South Platte/ Republican (& Arkansas)	Completed	CDOW	Plan for all designated State Threatened and State Endangered native plains fish.
48	Mayer Ranch Park mitigation project	NCNA Interviewed	Project	South Turkey Creek	Completed	Becky Pierce	channel reconstruction to mitigate incised stream.
149	Strontia Springs Reservoir to L.C. Pump Station instream flows	NCNA Interviewed	Flow Protection	Strontia Springs Reservoir to L.C. Pump Station	Completed	Denver Water	Denver Water Minimum Instream Flows
12	Lazy River Stream Stabilization	NCNA Interviewed	Project	Tarryall Creek	Completed	Mark Beardsley	Stream Stabilization with Rock
13	Eagle Rock Ranch Stream Stabilization	NCNA Interviewed	Project	Tarryall Creek	Completed	Mark Beardsley	Stream Stabilization with Rock
CDOW_37	Tarryall Project	CDOW	Restoration	Tarryall Creek	Completed	CDOW	Channel and Riparian restoration (0.6 miles)
cwrp_1	River Restoration - Riparian Re-vegetation	CWCB	Project	Tarryall Creek near Jefferson	Completed	"Dieter Erdmann, Colorado Open	

SWSI NCNA Database Projects (no ISF or Stewardship)							
ProjectID	ProjectName	ProjectCategory	ProjectType	ProjectLocation	ProjectStatus	ProjectContact	ProjectNote
						Lands"	
CDOW_10	Trail Creek Restoration	CDOW	Project	Trail Creek	Planned	CUSP - Carol Ekarius	Channel improvements, sediment transport, riparian improvements, Planned
173	Tributary of West Fork of Clear Creek Bank Stabilization	NCNA Interviewed	Project	Tributary of West Fork of Clear Creek	Completed	Carl Chambers	Bank Stabilization and Instream Fish Habitat Structures
174	Reintroduction of Native Cutthroat Trout	NCNA Interviewed	Project	Tributary of West Fork of Clear Creek	Planned	Carl Chambers	Planned Reintroduction of Native Cutthroat Trout
chrf_42	River Restoration - Riparian Re-vegetation	CWCB	Project	Upper Rock Creek	Completed	"Ed Self, Wildlands Restoration Volunteers"	
19	Cline Ranch Riparian Restoration	NCNA Interviewed	Project	Upper Tarryall Creek	Completed	Mark Beardsley	Riparian Restoration of Ranching and Placer mining impacts
229	Upper Trail Creek Remediation	NCNA Interviewed	Project	Upper Trail Creek	Completed	Christine Crouse	Mine remediation to prevent acid mine drainage
CDOW_105	Knight-Imler Project, South Fork of South Platte River	CDOW	Restoration	Upstream: 415892E, 4324356N, Downstream: 416521E, 4322089N	Completed	CDOW	2002, 1.2mi
CDOW_102	Antero Project, South Fork of South Platte River	CDOW	Restoration	Upstream: 423008E, 4316108N, Downstream: 423513E, 4316072N	Completed	CDOW	1999, 0.7mi
CDOW_106	Hartsel Project, South Fork of South Platte River	CDOW	Restoration	Upstream: 429621E, 4319613N, Downstream: 430562E, 4319239N	Completed	CDOW	2002, 1mi
CDOW_111	Middle Fork of South Platte River (Phase 1)	CDOW	Restoration	Upstream: 435539E, 4318654N, Downstream: 435811E, 4318497N	Completed	CDOW	2007, 0.5mi
CDOW_110	Middle Fork side-channel Project, Middle Fork of South Platte River	CDOW	Restoration	Upstream: 435539E, 4318654N, Downstream:	Completed	CDOW	2006, 0.6mi

SWSI NCNA Database Projects (no ISF or Stewardship)							
ProjectID	ProjectName	ProjectCategory	ProjectType	ProjectLocation	ProjectStatus	ProjectContact	ProjectNote
				435904E, 4318299N			
CDOW_112	Middle Fork of South Platte River (Phase 1 continued)	CDOW	Restoration	Upstream: 435811E, 4318497N, Downstream: 435918E, 4318290N	Completed	CDOW	2008, 0.2mi
CDOW_113	Dream Stream (Phase 1), South Platte River	CDOW	Restoration	Upstream: 436205E, 4317880N, Downstream: 436644E, 4317668N	Completed	CDOW	1991, 0.4mi
CDOW_107	Aurora Project, South Platte River	CDOW	Restoration	Upstream: 440995E, 4316473N, Downstream: 441837E, 4316347N	Completed	CDOW	2003, 1mi
CDOW_114	Buckley Ranch Project, South Platte River	CDOW	Restoration	Upstream: 446523E, 4313949N, Downstream: 446817E, 4313806N	Completed	CDOW	1993, 0.4mi
CDOW_101	Dream Stream (Phase 2), South Platte River	CDOW	Restoration	Upstream: 446817E, 4313806N, Downstream: 446897E, 4313763N	Completed	CDOW	1998, 0.2mi
CDOW_109	South Fork Project, South Fork of South Platte River	CDOW	Restoration	Upstream: 446897E, 4313763N, Downstream: 435955E, 4318057N	Completed	CDOW	2005, 1.7mi
CDOW_104	Dream Stream (Phase 3), South Platte River	CDOW	Restoration	Upstream: 446897E, 4313763N, Downstream: 447885E, 4313638N	Completed	CDOW	2001, 0.9mi

SWSI NCNA Database Projects (no ISF or Stewardship)							
ProjectID	ProjectName	ProjectCategory	ProjectType	ProjectLocation	ProjectStatus	ProjectContact	ProjectNote
CDOW_103	Threemile Creek Creek Project, Tributary to South Platte River	CDOW	Restoration	Upstream: 447474E, 4313277N, Downstream: 447592E, 4313211N	Completed	CDOW	2000, 0.5mi
CDOW_108	Dream Stream (Phase 4), South Platte River	CDOW	Restoration	Upstream: 447885E, 4313638N, Downstream: 448492E, 4313429N	Completed	CDOW	2004, 0.3mi
219	Little 6 #1	NCNA Interviewed	Project	Virginia Canyon upstream from confluence with Clear Creek	Completed	Christine Crouse	Offsite removal of mine waste and erosion control
220	Little 6 #2	NCNA Interviewed	Project	Virginia Canyon upstream from confluence with Clear Creek	Completed	Christine Crouse	"Mine waste remediation, controlling run-off"
230	Doctor Mine Remediation	NCNA Interviewed	Project	West Fork Clear Creek	Completed	Christine Crouse	"Habitat improvement for greenback, mine remediation, maintenance of chemical barrier protecting greenbacks from Brook Trout"
cwrp_7	Greenway Master Plan	CWCB	Plan	Westerly Creek	Ongoing	"Brian Hyde, Westerly Creek Connection"	

Table 5 - Additional Identified Environmental and Recreational Projects

Additional Identified Projects							
ProjectID	***ProjectName***	***ProjectCategory***	***ProjectType***	***ProjectLocation***	***ProjectStatus***	***ProjectContact***	***ProjectNote***
	Whitney & Eaton Ditches Fish Passage Project	CPW	Fish Passage	Poudre River: Whitney & Eaton ditches near Frank SWA	Proposed	CPW	Stakeholders include Whitney Ditch Co., Eaton Ditch Co., CPW, Larimer County, Windsor, and Greeley
	Boxelder Ditch Fish Passage Project	CPW	Fish Passage	Poudre River: Boxelder Ditch / Fossil Creek Reservoir Diversion near ELC	Planned	CPW	Stakeholders include Fort Collins and CPW

Additional Identified Projects							
ProjectID	***ProjectName***	***ProjectCategory***	***ProjectType***	***ProjectLocation***	***ProjectStatus***	***ProjectContact***	***ProjectNote***
	Big Valley Reach Fish Passage Project	USFWS	Fish Passage	Big Thompson River: Southside Ditch, Louden Ditch, and George Rist Ditch	Proposed	CPW	Stakeholders include USFWS, Big Thompson River Restoration Coalition, CPW, private land owners, South Side Ditch Conmpany
	Meadows & South Ledge Fish Passage Project	USFWS	Fish Passage	St. Vrain Creek: Meadows Ditch and S. Ledge Ditch	Proposed	CPW	Stakeholders include USFWS, Boulder County, ditch companies, Crane & Associates, and CPW
	Green Ditch Fish Passage Project	USFWS	Fish Passage	Boulder Creek: Green Ditch	Planned	CPW	Stakeholders include USFWS, Boulder Open Space and Mountain Parks, and CPW
	Greenback Cutthroat Recovery Project	CPW	Species reintroduction	Upper/Lower Square Tops Lake and Duck Creek	Proposed	CPW	Introduction of Native Trout
	Greenback Cutthroat Recovery Project	CPW	Species reintroduction	Rock Creek	Proposed	CPW	Introduction of Native Trout
	Middle Fork of South Platte River (Phase 2)	CPW	Restoration	Upstream: 435415E, 4318627N, Downstream: 436015E, 4318251N	Completed	CPW	2009, 0.2mi
	Middle Fork of South Platte River (Phase 3)	CPW	Restoration	Upstream: 435246E, 4318865N, Downstream: 435415E, 4318627N	Completed	CPW	2010, 0.3mi
	Middle Fork of South Platte River (Phase 4)	CPW	Restoration	Upstream: 435154E, 4318861N, Downstream: 435246E, 4318865N	Completed	CPW	2011, 0.3mi
	Clear Creek/Twin Tunnels Project, Clear Creek	CPW/CDOT	Restoration	Clear Creek	Ongoing	CPW	Stakeholders include CPW and CDOT
	Dream Stream (Phase 5), South Platte River	CPW	Restoration	Upstream: 448492E 4313429N, Downstream: 449579E 4313398N	Ongoing	CPW	Stakeholders inlcude CPW and Park County, began Fall 2013, 1.5mi
	Greenback Cutthroat Recovery Project	CPW	Species reintroduction	Dry Gulch - trib to upper Clear Creek, Clear Cr. County	Planned	CPW	Introduction of Native Trout

Additional Identified Projects							
ProjectID	***ProjectName***	***ProjectCategory***	***ProjectType***	***ProjectLocation***	***ProjectStatus***	***ProjectContact***	***ProjectNote***
	Greenback Cutthroat Recovery Project	CPW	Species reintroduction	Herman Gulch - trib to upper Clear Creek, Clear Cr. Co	Planned	CPW	Introduction of Native Trout
	Big Thompson Stream Restoration Phase 2	CDOW	Restoration	0.2 mile segment downstream of stream gage below Olympus dam	Completed	CDOW	Channel Restoration (0.2 miles) including vortex structures, pool excavation, boulder clusters, root wads, log spurs, spawning channel, riparian plantings, reduction of channel witdth with fill material
	Greeley Poudre Greenway		Project	Poudre	Planned	Becky Safraik , Greeley	Channel improvements, gravel pit storage, greenway
	Fort Colllins Poudre River restoration and enhancement project		Stream and Riparian Restoration	Poudre	Planned	John Stokes, Fort Collins Natural Areas Director	Complete master plan and segments are being completed
	Josh Ames Dam Removal Project		Stream and Riparian Restoration	Poudre	Completed 2013	Fort Collins	Completed partially with WSRA grant
	North Fork Poudre Eagles Nest Restoration Project		Habitat Restoration	Poudre	Planned	CO Trout Unlimited, Larimer County Open Lands	Ongoing, long-term Rocky Mountain Flycasters (Colo Trout Unlimited) project in cooperation with Larimer county Open Lands (now part of Larimer Co. Dept Nat. Resources).
	Park County Prioritization Process		Flow/Lake Level	Park County	Planning	Park County Advisory Board on the Environment	prioritization process of streams and natural lakes that could benefit from in-stream flow and natural lake level water rights.
	Sugar Creek Sediment Mitigation Project		Species Habitat	Sugar Creek Watershed in Douglas County			5-Year Plan Sugar Creek Watershed in Douglas County – confluence with SP River about 10 miles upstream from Strontia Springs - center of the project area is near coordinates 105°10’00” and 39°18’00” (NAD83). Preble’s Meadow Jumping Mouse Habitat
	CUSP Projects			Upper South Platte			various projects, list being refined
	South Park Groundwater and Surface Water Water Quality Baseline Study		Study	Upper South Platte	Completed	Park County Land & Water Trust Fund	Develop a multi-year baseline of water quality in South Park before energy exploration & development.

Additional Identified Projects							
ProjectID	***ProjectName***	***ProjectCategory***	***ProjectType***	***ProjectLocation***	***ProjectStatus***	***ProjectContact***	***ProjectNote***
	Mine Assessment Project in Headwaters of South Platte		Study	Upper South Platte	Completed	CWCB Healthy Rivers Fund grant, LWTF, & CUSP	Identified the water-quality impacts of historical mining and impacts from the acid rock drainage throughout the watershed. North Fork of the Upper South Platte – mines plus iron fens in Hall Valley & Geneva Creek areas Middle Fork of the Upper South Platte – mines, mills, settling ponds and surface water bodies in Montgomery, Buckskin and Mosquito Gulches South Fork of the Upper South Platte – Weston Pass Mining District and mines around Fourmile Creek headwaters
	Park County Land & Water Trust Fund Projects			Upper South Platte			various projects, list being refined
	Park County Trout Population Monitoring: Habitat Use and Migration Patterns in South Park Streams		Monitoring	Upper South Platte	In Progress	CPW, CO Trout Unlimited, EcoMetrics, South Park National Heritage Area, & LWTF	Provide a scientific basis for planning and designing stream restoration and habitat improvement projects that support quality trout stream fisheries in the Middle and South Forks from Fairplay to Antero & Spinney Reservoirs.
	Park County Water Resources Inventory and Strategic Plan: Assessment of Functional Condition and Identification of Priorities for Restoration and Protection		Study	North and Middle Forks of the South Platte and Tarryall Creek	In Progress	CWCB Healthy Rivers grant, CPW Wetlands Program, LWTF, SPNHA, CUSP	This is a basin-wide assessment that will rate the functional condition and restoration potential of stream and wetland habitats on the North and Middle Forks of the South Platte and Tarryall Creek. It will produce an organized set of priority preservation and restoration projects on properties where the causes of degradation or impairment can be resolved and where protection from future impacts is possible. The study team will include local, state and federal agencies. This project is an on-the-ground match for an EPA grant project by Colorado Natural Heritage Area to develop a web-based wetlands planning toolbox using Park County as an example area in the toolbox.

6 Additional Analyses Needed

The examples given above and the IPPS discussed above indicate some projects that may provide protections to environmental and recreational attributes. In addition to the presence or absence of protections in focus areas, various other items can impact the shortage or gap for environmental and recreational needs. Changes in river conditions due to climate change or increased uses in the basin could result in reduced streamflows and further impair wildlife habitat. The trend of irrigated agricultural lands being dried up can impact the amount and location of environmental and recreational needs in the Basin. These trends and conditions can be further analyzed with the framework discussed in this section. Additional analyses to determine these impacts may be performed in the next phase of the BIP.

7 Challenges to Assessment

A number of challenges exist to evaluating the impacts of M&I projects on environmental and recreational attributes, including:

- The project is in permitting process that limits ability to evaluate project independent of process.
- The project sponsor/proponent is concerned about serving its customers and not necessarily concerned about impacts of project on other system components (environment, recreation, agriculture) and therefore is not interested in a multi-purpose project.
- The project sponsor or proponents may not have previously worked with other organizations and/or do not know of such organizations that may be available to work cooperatively to benefit multiple purposes.
- The funding needed to consider impacts and ways to improve a project is not available.
- The data or analysis does not exist to sufficiently evaluate impacts or potential multi-purpose benefits of the project.

8 Data Gaps

Data gaps exist in the data sources needed to fully implement the methodology described in this appendix. These data gaps include discrepancies between the GIS shapefiles and Microsoft Access databases. There is also additional data not included in these data sets such as detailed project descriptions, project objectives by attribute, implementation schedules, and expected outcomes. There are also areas where more information or studies are needed. Additional studies could be performed under future projects to determine the sufficiency of projects to protect attributes.

8.1 Data Limitations

1. The current data for assessing projects and protections exists in the SWSI 2010 GIS data, the CWCB MS Access database and new focus areas approved by the BRTs, and provided by various sources. The main limitation for the analysis of attributes, Focus Areas, projects and protections is the lack of a common, consistent and comprehensive database. The discrepancies found between the SWSI 2010 GIS data and the MS Access database demonstrates the need for a thorough, systematic and comprehensive review and correction of the data. While some limited

database improvements have been made, a full database reconstruction is beyond the scope for the BIP and should be completed at the State level since it appears to the present in all basins. It is recommended that the discrepancies in the multiple data source be reconciled in the near term .

2. The determination of measurable outcomes requires very specific data for the presence of attributes, any factors that currently limit the attribute, a quantification of what would be needed to remove the limitations and projects that specifically target the attribute or attributes. An example of such data is:

   Attribute “A” exists in 20 miles out of Focus Area “XYZ”. Focus Area “XYZ” is 60 miles long. Attribute “A” requires 30 miles of contiguous, connected habitat to maintain a viable population. The objective of specific projects is to increase the presence of Attribute “A” by 10 miles to provide habitat to sustain the population. Project “ABC” is would remove a barrier to passage that would reconnect 5 miles of habitat to the existing 20 miles of habitat. An additional future project to connect another 5 miles of stream is needed to meet the goal of 30 miles of habitat.

   The data needed for the above example would include:

   - Population estimates for the species by stream reach
   - Identification of specific barriers that fragment habitat
   - A determination of the amount of continuous habitat associated with each fragmentation point.
   - Determination of the flow requirements for the species throughout the reach.
   - Measurement of flows within the reach.
   - Identification of projects that could modify the barriers so passage is possible.
   - An implementation plan and schedule for each project.

3. The above types of data are not provided in the current database at the level of detail needed to determine whether a project provides sufficient protection to meet a measureable objective. In general, a protection can be inferred, however, sufficiency cannot. It is recommended that the background information from the NCNA interviews and project descriptions be acquired, documented and assimilated into a meta data set to support the database. It is assumed that this information exists or did exist at one time when the SWSI 2010 report was completed.

4. New data is being complied as part of the BIP process. The new data should be subject to the same scrutiny and review as the existing database. Any new data should include as much detail as possible on the attributes, project objectives, project description and metadata to trace the data to the originating entity. If possible, any hardcopy information should be converted to digital format (either searchable PDF, spreadsheet or database file format). A master list of all new data should be maintained with the existing database files to reduce the effort needed by contractors or BRTs to implement future versions of the BIP.

8.2 Recommendations

There are several recommendations to address the data limitations discussed above. These recommendations are discussed below for both short-term and long-term recommendations.

Short term (one month to six month time frame)

- Document to the degree possible the discrepancies between the GIS database from SWSI 2010 and the MS Access database.
- Document the current status of mapped focus areas and associated attributes
- Document limitations of using the current database for determination of sustainability.
- Document the limitations of using the existing project data for determining the level of protection provided for the attributes by project.

Long Term (1 to 2 year timeframe)

- Comprehensive, systematic, review and update of the multiple databases to provide a complete data set for future evaluations.
- Develop and implement a quality assurance protocol for data entry, data analysis, and data documentation for all data in the database.

Appendix E – Water Quality

Prepared by:

TDS Consulting Inc.

Contents

South Platte River Basin Implementation Plan Water-Quality and Watershed-Health Aspects

Executive Summary

A bibliographic review was conducted provide information on water quality and watershed "health", based upon past and recent investigations completed in various watersheds of the South Platte River Basin or for the Basin in its entirety. A brief water-quality overview is included for the Republican River Basin. This report summarizes study results and information available from a number of sources, including numerous websites and makes specific recommendations regarding information gaps and future water-quality and water-related environmental issues facing the Basin's stakeholders in the future.

Watershed resources management includes stormwater and flood control. Innovative projects are being developed in the Basin that provide water quality and flood control benefits. In addition, numerous studies have dealt with water-quality characterization and/or management for large parts of the South Platte River Basin or for the entire Basin. One primary example is the U.S. Geological Survey's study of the Basin's water resources under the auspices of its National Water-Quality Assessment (NAWQA) Program. The Basin has been delineated into a total of 18 eight-digit hydrologic unit codes (so-called HUCs). Only subareas approximately covering the first 12 HUCs are included this review, with descriptions of available information and data provided generally in an upstream-to-downstream order.

This review identifies the range of water-quality monitoring data and related information available for the various subareas. A number of the subareas surrounding the Denver metropolitan area, including prairie and mountain tributaries, have watershed plans, monitoring reports, source-water protection plans, and other investigation reports describing specific issues of concern in water quality or watershed health. The intent of this review was to highlight, subarea by subarea (watershed by watershed) conditions of concern for these attributes and, in some cases, remedial projects or mitigation measures for maintaining or improving these conditions. The concept of sustainable watershed water-resources management underlies many of the watershed/subarea-based studies cited in this review.

Sustainable management for these attributes is interrelated with the water-supply complexities and land-use changes affecting water quality and land cover, the latter factor being especially critical in the forested, mountain tributary streams flowing into the South Platte River. In this respect, institutional consideration (e.g., Federal vs. private land ownership) plays a role. The role of land-management Federal and State agencies, as well as the water-resources and environmental-protection agencies requiring compliance with NEPA and CERCLA regulations is critical to the goal of sustainable water-resources management.

From a water-quality perspective in the South Platte Basin, the following examples indicate the diversity of concerns relative to current and future Statewide planning:

1. Water-quality changes, generally beneficial, due to West Slope transfers of water into the Basin.
2. The occurrence and areal extent of agricultural-related chemicals (nitrogen or phosphorus compounds, herbicides and insecticides) affecting shallow ground-water resources and eventually downstream streamflow quality.

3. Mountain communities relying upon bedrock wells, providing limited supplies and impacting in some areas by cross-contamination from individual wastewater-treatment systems.
4. The threat of emerging contaminants (including pharmaceuticals and personal care projects, so-called PPCPs) being only partially removed by current state-of-the-art wastewater technologies and potentially being introduced into water bodies downstream of wastewater-treatment facility discharges. To date, these types of contaminants remain unregulated. However, water-supply utilities in the Basin are beginning to gather baseline information on these substances.
5. Forested areas of mountain tributaries of the South Platte Basin are being impacted by diseases affecting trees. This degradation of forested lands is resulting in increased wildfire potential, contribution of organic decomposition and nonpoint-source nutrients, and challenges in tree-kill diseases and control of wildfires and increased nutrients.
6. A few of the mountain tributaries have been impacted by historical mining and mine-related activities. These cases (primarily involving the North Fork of the South Platte River, Clear Creek, Boulder Creek, and St. Vrain Creek watersheds), along with the presence of a mineralized zone transecting these watersheds, result with concerns of trace-metals concentrations and controls to reduce these through various forms of remedial actions.
7. Water supplies provided by municipal water-utility entities are regulated by the U.S. Environmental Protection Agency (USEPA) and in recent years document the water-quality of these supplies in annual reports. These reports are important, in that, from year to year, supply sources may well vary, depending on both surface-water and groundwater sources.
8. Water-resources management includes groundwater resources in the Basin – either alluvial systems interactive with streams or deeper groundwater systems. Bedrock aquifers of the Denver Basin are a key part of overall supplies in the Denver metropolitan area. Fractured bedrock aquifers in mountainous areas of the Basin provide sufficient supplies for individual wells.
9. Wastewater treatment and re-use are important facets of the Basin's water supplies. Innovative systems are being developed in the Basin to increase water availability for various beneficial uses.

This report review attempts to cover many, but not all, of the examples provided above. It is hoped that the information contained herein is sufficient to promote deliberations involving these topics, to help to prioritize future investments in maintaining or improving the Basin attributes of water quality and watershed health, and finally to contribute to the overall Statewide water-planning process.

1 Introduction

1.1 Background and Purpose

This report, to be appended to the South Platte BIP, is intended to provide information on water quality and watershed "health", based upon past and recent investigations completed in various watersheds of the South Platte River Basin or for the Basin in its entirety. This report summarizes study results and information available from a number of sources, including several websites. The report's last section summarizes the general present conditions involving water quality and watershed health and makes specific recommendations regarding information gaps and future water-quality and water-related environmental issues facing the Basin's stakeholders in the future.

1.2 General Physical Setting

The South Platte River Basin (Basin) comprises approximately 24,000 square miles (mi^2) and is located principally in the northeastern quadrant of the State of Colorado. Relative small parts of the Basin are located in states of Nebraska and Wyoming. These minor areas impact the lower stream reaches of the South Platte River and are not included within the scope of this assessment. Also, the western part of the Republican River Basin is included in the areal extent of water-quality/watershed-health characterization effort documented herein.

2 Approaches

Through his professional experience and personal contacts, the principal investigator (PI) of this study is generally familiar with water-quality conditions as well as watershed-health issues facing many parts of the Basin. Information regarding these attributes has been supplemented through fairly intensive web-based searches for watershed- or subarea-based entities, data, and information dealing with the issues addressed in this study. The intent is to provide some indication of the range of water-quality data, information, and studies providing a comprehensive water-quality/watershed-health depiction of the Basin's areal extent.

Numerous studies have dealt with water-quality characterization and/or management for large parts of the South Platte River Basin or for the entire Basin. One primary example is the U.S. Geological Survey's study of the Basin's water resources under the auspices of its National Water-Quality Assessment (NAWQA) Program. Example highlights of several investigations are given later.

Also, the Basin has been delineated into a total of 18 eight-digit hydrologic unit codes (so-called HUCs); this delineation is used by the U.S. Geological Survey and other organizations for dealing with the various subareas of the major river basins of the U.S. Of these 18 HUCs, only subareas associated with the first 14 HUCs are considered within the scope of this study. In particular, relatively more interest and information is available for the first seven HUCs (for this Basin, identified as 10190001 through 10190014), located in the upstream (southern) and western (mountain tributaries) areas of the Basin. The descriptions of available information and data for 12 of these HUCs are provided generally in an upstream-to-downstream order. No information was found for the downstream-most tributary HUCs 10190013 (Beaver Creek) and 10190014 (Pawnee Creek). The HUC-delineated methodology is a logical way to discuss water-quality/watershed-health conditions or issues; however, various water-quality-oriented stakeholder entities do not follow these delineations exactly. Accordingly, the details provided in this assessment generally follow the upstream-to-downstream sequence offered by the 12 HUCs of the Basin but are modified to include information for the various watershed or subarea-based organizations dealing with conditions and issues for smaller subareas of the Basin.

3 Discussion

3.1 Basinwide Characterization

An overview of historical water-quality conditions was provided in a broader South Platte River Basin assessment study for the Colorado Water Conservation Board by Woodward-Clyde Consultants (1982, pp. 35-40). A USGS bibliography (Dennehy and Ortiz-Zayas, 1993) provides a more extensive list of study reports. As noted above, a primary, more-recent source for the topic of this study is provided by the USGS' NAWQA Program. Many of the USGS studies under this program were completed in the 1990s; therefore, some of the topics addressed in several technical reports are proposed for updating. Nonetheless, water-quality issues identified during these investigations are judged largely relevant today and in the future. Four examples of water-quality issues were identified and warrant some consideration herein:

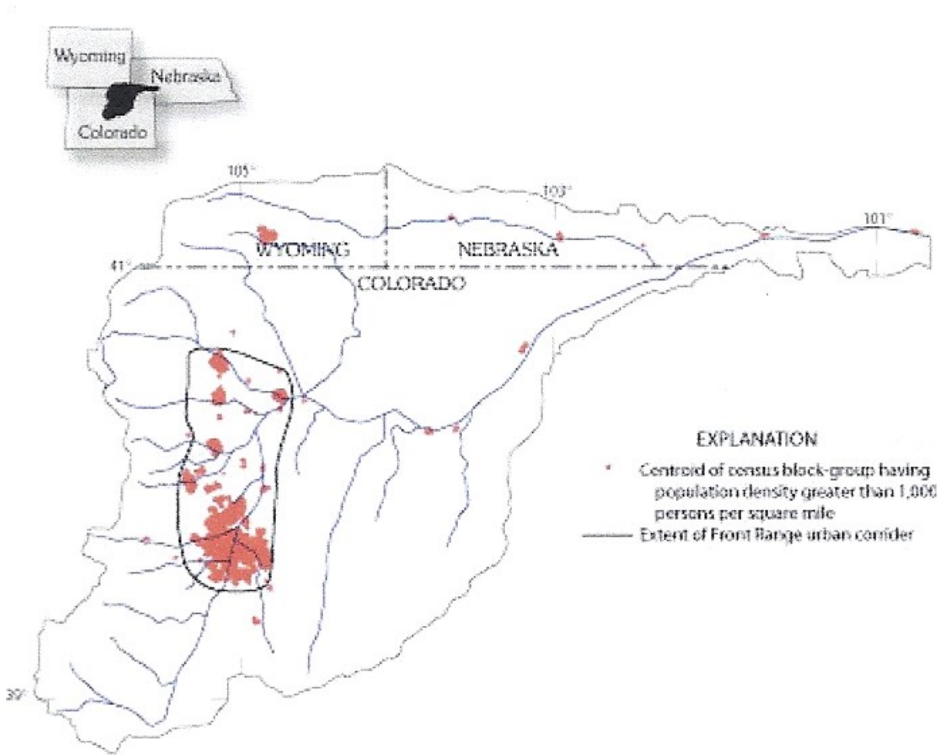
1. Water development and water quality.—Water development began in 1870 in the Basin (Dennehy and others, 1998, p. 8), when the first irrigation ditches were constructed. Over the past 140+ years, irrigated agriculture in the Basin and trans-basin water conveyance into the Basin has significantly altered the "natural" (historical) hydrologic system. These alterations, in addition to increased population growth with needs for water supply and wastewater treatment, have affected the quantity and quality of water in the South Platte River. Besides direct water-quality impacts, changes have resulted in a substantial decrease in channel width of the South Platte River, to a greater degree prior to 1938. Considering ground-water/surface-water interactions is critical to effective water management, especially in the upper and lower stream reaches of the South Platte River.

2. Because agriculture accounts for about 37 percent of the land use in the Basin, impacts of agricultural chemicals (herbicides and pesticides) are of increasing concern. In the NAWQA study, it was estimated that 2 million pounds of active pesticide ingredients have been applied annual in the Basin (Dennehy and others, 1998, p. 16). This trend is due to greater water demands in populated zones (primarily the Denver metropolitan area), requiring innovative water-exchange systems in alluvial recharge/withdrawal areas downgradient of these zones in which water is pumped, conveyed by pipeline, and treated for municipal water supplies. Addressing levels of agricultural chemicals, as well as other chemicals of concern, will be of increasing importance to assure good water quality for potable water supplies.

3. Municipal wastewater treatment plants (WWTPs) are permitted to discharge limited amounts of nutrients. Over the recent two decades, largely due to the total maximum daily load (TMDL) assessment process by the CDPHE, nutrient-discharge limits are becoming more stringent. In the basin in the 1990s, 25 WWTPs along the Front Range urban corridor discharged approximately 275 million gallons per day (gpd) of effluent, constituting about 95 percent of the total daily effluent discharge in the Basin (Dennehy and others, 1998, p. 18). About 7,000 tons of nitrogen and 1,200 tons of phosphorus were discharged by WWTPs into the Basin (Litke, 1996). These estimates have decreased in recent years, due to increased WWTP treatment through

denitrification and phosphorus-removal technologies (www.lewwtp.org/our-process/denitrification).

Figure 1 - Distribution of Population Centers, South Platte River Basin (Dennehy and others, 1998)



4. A NAWQA study examined the effects of different land uses (agriculture, forested, urban, and mixed urban/agriculture) on water quality, using a combination of physical, chemical, and biological information on streams and aquifers (Dennehy and others, 1998, p. 20). Customized ranking schemes and indices were used with each land-use classification for assessing land-use/water-quality interactions impacting different categories of chemical constituents or physical/biological characteristics.

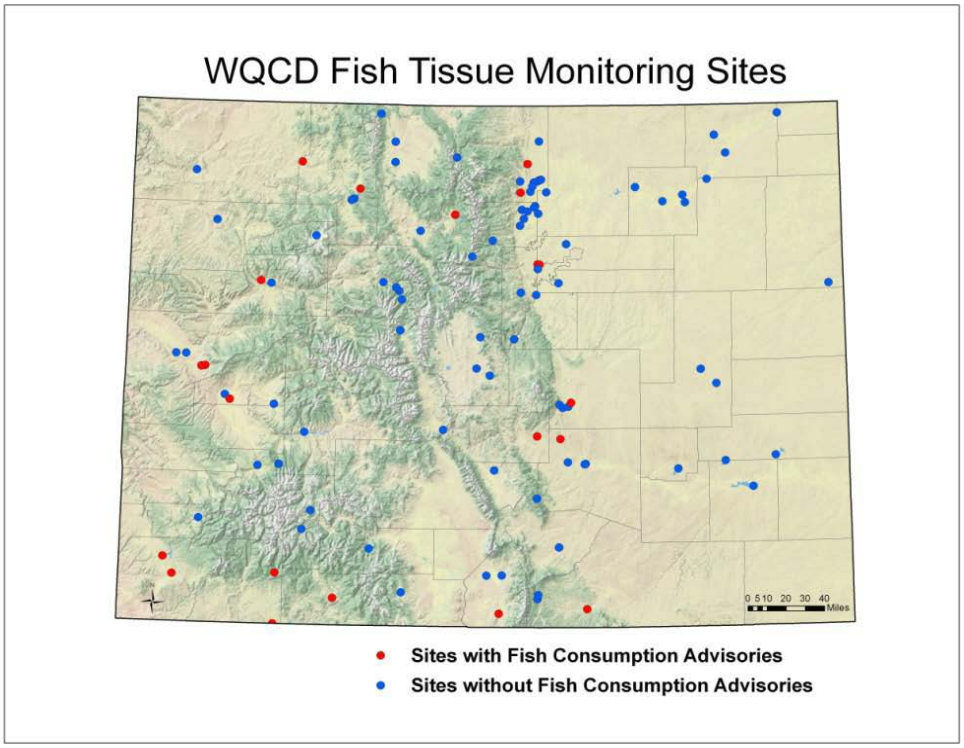
A recent Ph.D. dissertation completed at CSU (Haby, 2011) included an extensive use of available streamflow and water-quality (dissolved solids) to assess areal variability and time trends in concentrations and loads of this indicator variable. Another, quite innovative CSU study evaluated the use of fauna species as indicators of groundwater quality (Ward and others, 1989), as applied to the South Platte River system.

A statewide water-quality management plan (SWQMP) was developed (CDPHE, 2011) to provide a forum for water-quality planning using a watershed-based framework. This “living” document (presuming periodic updates are forthcoming as proposed by CDPHE-WQCD) is to assist water policymakers, managers, and others (stakeholders) in setting priorities, developing strategies, and evaluating progress in water-quality protection and restoration efforts. Chapter 11 of this initial SWQMP document deals with the Platte River Basin (including the part of the North Platte River in Colorado). This is a useful compendium of information on water-quality information as well as ecology, stream standards, and completed total maximum daily loads (TMDLs) assessment studies and plans for implementation. *[Note: These are separate phases in the TMDL process; few implementation plans are known to have been developed to date.]*

Many municipalities and water districts conduct their own water quality assessments. Some of those entities include Denver Water, Aurora Water, Northern Water, and Greelwy.

One means of tracking progress of the goal of the SWQMP is through the Integrated Water-Quality Monitoring & Assessment Report – the most recent of a series of State of CO (305(b) reports in fulfillment of this section of the Clear Water Act (CDPHE, 2012). This document provides a broad range of water-quality related information, including key topics such as impacts on wetlands, funded 319 grants for nonpoint-source projects, approved TMDLs, and aquatic species. CDPHE fish-tissue monitoring sites are indicated in the following map of Colorado:

Figure 2 - CDPHE Fish-Tissue Monitoring Sites



Finally, a section of this report summarizes assessment results for the South Platte River Basin (CDPHE, 2012, Appendix D, pp. 134-135), in terms of use support according to USEPA's system of five integrated-report (IR) categories (CDPHE, 2012, pp. 5-8) for fully-supporting water bodies in the state by basin:

Table 1 - EPA Integrated Report Categories

Table 25: Individual Use Summary for the South Platte River Basin.

EPA IR Category	River Miles	Lake Acres
1 - Fully Supporting	7,042	19,248
2 - Some Uses Supporting	1,582	13,375
3 - Insufficient Data, including waters on the M&E list	10,214	68,410
4a – TMDL Completed and Approved	123	0
4b – Impaired no TMDL Necessary	0	0
4c - Impaired Naturally, Placed on the M&E list	0	0
5 - Impaired and TMDL Necessary	3,139	13,047

For example, category (IR) 1 means a stream reach is attaining water-quality standards; for category 2, only some classified uses are attained, etc. Category 5 triggers the need for a TMDL.

A statewide strategic plan for the protection of wetlands and riparian areas has been developed by the Colorado Parks and Wildlife (CPW, 2011). An early South Platte conference (Woodring, 1993) focused on the theme of defining ecological and sociological integrity of the Basin. Institutional aspects of water-quality management (Nichols and others, 1972) focused on the South Platte River Basin.

This information-overview document now will describe a range of examples of water-quality and watershed-health study results on a watershed- or subarea-delineated basis, in a general upstream-to-downstream order. In the summary and conclusions section of this report, a tabulation of watershed/subarea-based organizations and contact information is provided.

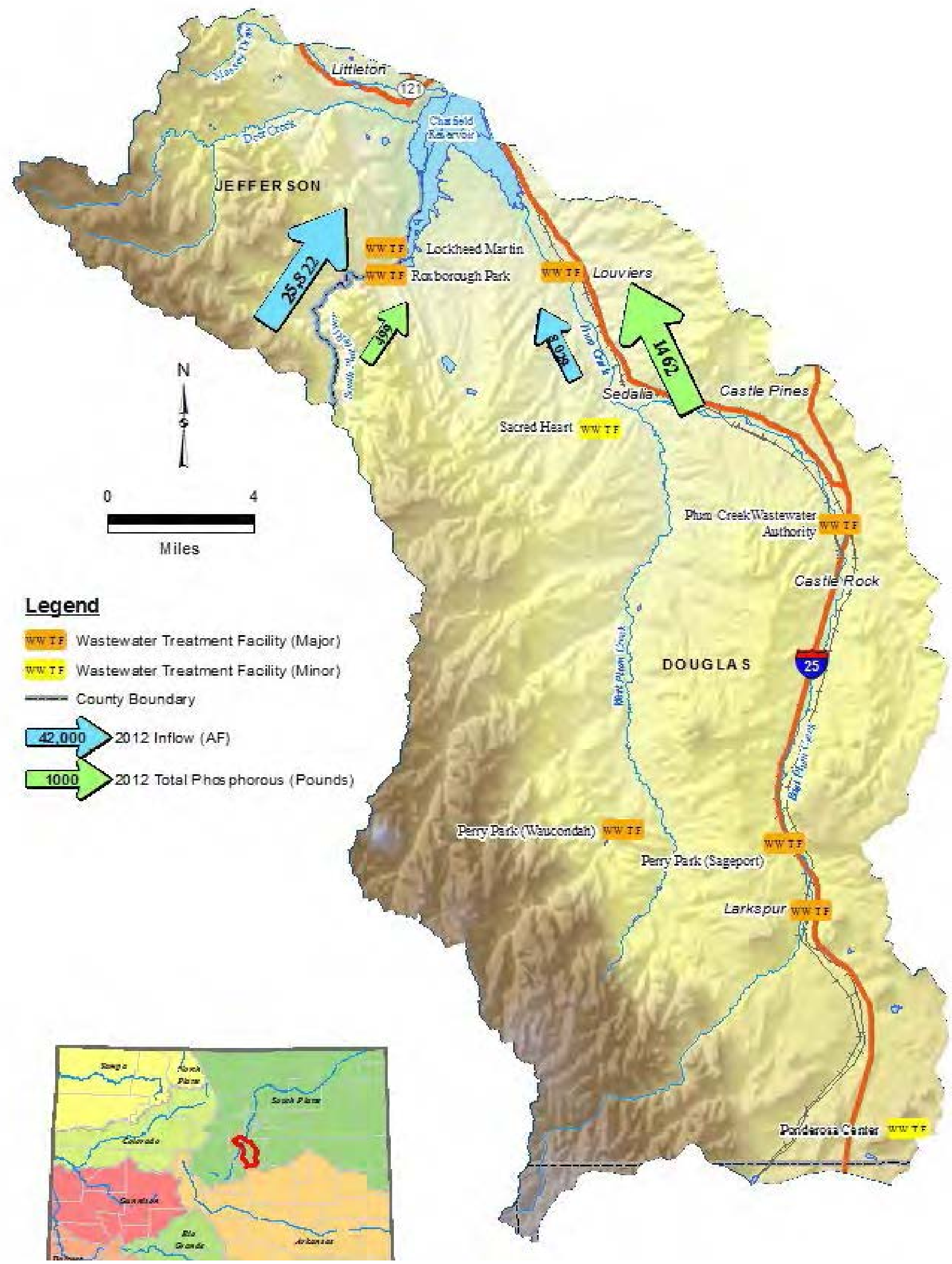
3.2 Upper South Platte River Basin

For water-quality and watershed-health purposes, the Coalition for the Upper South Platte (CUSP) was organized in 1998. Its areal extent covers a land area of 2,600 square miles (mi^2) from the Continental Divide to Strontia Springs Reservoir southwest of the Denver metropolitan area. This area encompasses all of HUC 10190001 and part of HUC 10190002 *(water-usgs.gov/GIS/huc-name.html#Region10)*. This upper-Basin watershed is heavily used for recreation (fishing, camping, hiking, etc.) and supplies municipal water for about 3/4th of the State's residents *(www.uppersouthplatte.org/watershed.html)*, including the Centennial Water & Sanitation District serving the Highlands Ranch (TDS Consulting Inc., 2001). The South Park area within this sub-basin has recently been the focus of oil-and-gas development (Johnson, 2012). A source-water protection plan study is being developed for water supplies for downstream municipalities (Beth Nielsen, CUSP, *written communication*, March 24, 2014). A Water Quality Assessment of the Upper South Platte was conducted by consultants for Denver Water in September 2013. The study identified potential impacts to water quality from mine discharges, fires, and recreation (Denver Water, September 2013).

3.3 Chatfield (Reservoir) Basin

The Chatfield Watershed Authority (CWA) was created in 1984. A draft watershed plan for this area encompassing Chatfield Reservoir, the Plum Creek tributary subwatershed, and the reservoir South Platte inflow/outflow points has been prepared for the Chatfield Watershed Authority (CWA) (Tetra Tech, Inc., 2013). A related watershed-planning process brochure outlines priority projects for this watershed. Historically, a long-term monitoring program (since 1983) has collected data on surface-water quality (in-Reservoir, inflows/outflow), as well as groundwater quality for some Plum Creek alluvial wells) (ASI, 1994). Annual water-quality reports (CWA, 2013a) and a "roadmap" for attaining water-quality goals (CWA, 2013b) are examples of watershed management. Also, a nonpoint source investigation has been completed for the Plum Creek subwatershed, and a water-quality model application was done for Chatfield Reservoir. A more-recently completed environmental impact statement (EIS) involving evaluating impacts of designating a part of the Reservoir's volume for water supply (so-called storage reallocation for its primary designation for flood control) was completed by the U.S. Army Corps of Engineers (2013); ambient water-quality conditions as well as changes due to Reservoir operations by this reallocation were included in this NEPA impacts assessment. Two example of an upstream Plum Creek phosphorus study is given by Kunkel and Steele (1993) and TDS Consulting Inc. (2000). A summary of historical data is given in DRCOG (1997). Comparisons of total phosphorus-chlorophyll-*a* relationships for several Denver Metropolitan area reservoirs (Chatfield, Bear Creek, Cherry Creek, and Standley Lake) are reported in Steele and others (1991) and updated in Lorenz and others (1995). As part of the RCRA Part B regulations, groundwater-quality conditions were evaluated at the Martin-Lockheed facility located southwest of Chatfield Reservoir (WCC, 1983).

Figure 3 - Chatfield (Reservoir) Basin (Source: Tetra Tech, Inc., 2013)

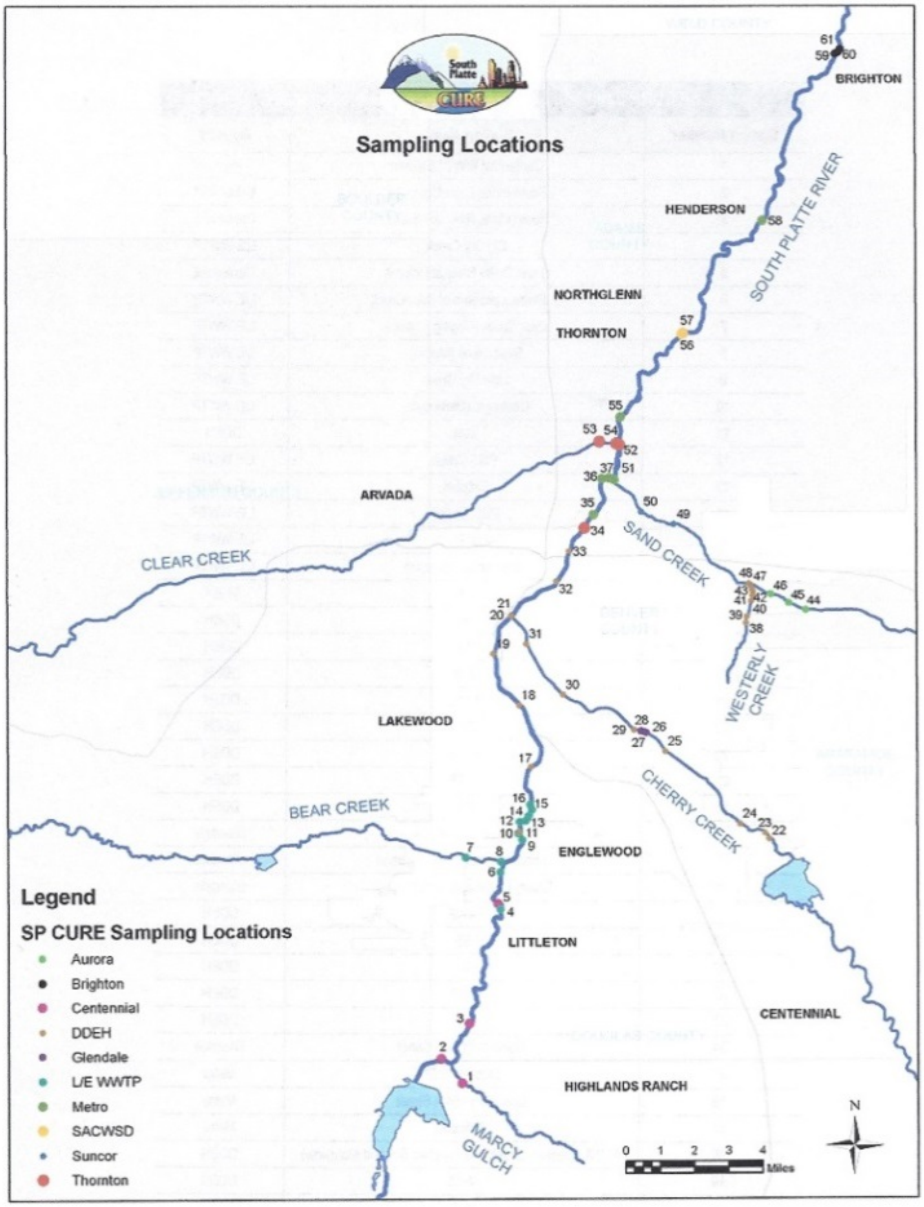


3.4 South Platte in the Denver Metropolitan Area

The primary water-quality planning agency for this region/subarea is the South Platte Coalition for Urban River Education (SPCURE). Technical issues overseen by SPCURE include water-quality monitoring, modeling, TMDLs, load allocations (LAs), and wasteload allocations (WLAs). It works through coordination with other local-governmental entities.

Figure 4 - Sampling along the South Platte River in the Denver Metropolitan Area (Source: SPCURE website)

Figure 5 - SPCURE Water-Quality Monitoring Sites (www.spcur.org)



Beginning in this subarea and downstream along the South Platte River, nitrates in both streamflow and groundwater have been investigated by the USGS (Litke, 1996; McMahon and others, 1996). Pesticides also have been of concern (Kimbrough and Litke, 1996; 1998). Focus included assessing conditions in the South Platte River alluvial aquifer between Denver and Greeley, covering an area of about 75 mi^2. This critical resource is impacted by both WWTF discharges upstream and use of fertilizers on adjacent agricultural lands. The USGS study objective was to assess the extent to which naturally occurring processes in the aquifer might reduce nitrate concentrations, thereby decreasing the effects of irrigated agriculture on water quality of the South Platte River. Water-sediment chemistry along the South Platte River in the Denver Metropolitan Area has been characterized (Steele and Doerfer, 1983). Farther downstream along the South Platte River, municipal water-supply pumpback schemes (Aurora Water, *undated;* CO District Court, 2011) have been developed or are being expanded).

Figure 6 - South Platte River, Northern Denver Metropolitan Area (Source: CDPHE-WQCD, 2012, p. D-13)

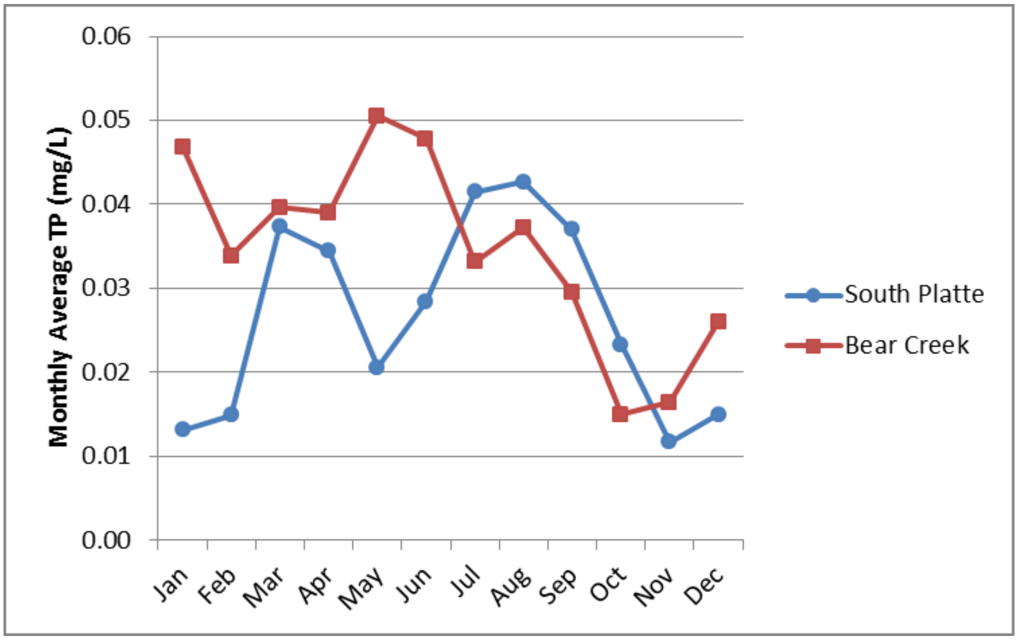
The USGS has conducted a recent, extensive evaluation of the Denver Basin aquifer system (Paschke, 2011), which includes a large middle part of the South Platte River Basin. This aquifer system is a key component of water-management and water-use activities in the Basin. Although the focus of this document is on water availability and management, the USGS NAWQA program for the South Platte Basin listed two studies for assessing groundwater quality in Denver Basin domestic and public-supply wells *(http//co.water.usgs.gov/projects/CO255/ index.html)*. A series of USGS hydrologic atlases (Robson and Romero, 1981a; 1981b; Robson and others, 1981a; 1981b; Robson and Banta, 1995) include water-quality data assessment of the four aquifer units comprising the Denver Basin bedrock system. Management of groundwater use from these units continues to be a challenge to water-resources decision-makers. More recently, conjunctive surface-water/groundwater uses through recharge and subsequent withdrawals are being considered by several water providers.

3.5 Bear Creek Watershed

The Bear Creek Watershed Authority (BCWA), established in 1981, "protects and restores water and environmental quality within the Bear Creek watershed …" Its primary focus is on dealing with water quality upstream from Bear Creek Reservoir. The BCWA has conducted a long-term monitoring program of inflow streams as well as in-Reservoir water-quality conditions for areal characterization and evaluation of time trends. CDPHE-WQCD Control Regulation #74 designates the BWCA as the "water quality management" agency" and specified phosphorus targets (both concentration limits and loads) for WWTF dischargers in the watershed. In addition, the BWCA submits annual reports to describe the watershed's water-quality status.

Evergreen Lake was dredged in the 1980s (WCC, 1980). Hydros Consulting, Inc. (2011) conducted a water-quality assessment and water-treatment alternatives cost analysis of the Bear Creek/Turkey Creek watershed of behalf of the Denver Water Department (DWD). Two technical memoranda document their study findings. An example of seasonal (monthly) variations in total-phosphorus (TP) concentrations from the second report is given as follows:

Figure 7 - Seasonal variations of Total-Phosphorus Concentrations, South Platte River (Strontia Springs) vs. Bear Creek (above Harriman Ditch), Averages of 2000-2010 Data (Source: Hydros Consulting, Inc., 2011, p. 9)



Seasonal variations of Total-Phosphorus Concentrations, South Platte River (Strontia Springs) vs. Bear Creek (above Harriman Ditch), Averages of 2000-2010 Data *(Source: Hydros Consulting, Inc., 2011, p. 9)*

A watershed plan is in progress for the lower reach of Bear Creek, downstream from Bear Creek Reservoir to the confluence with the South Platte River *(groundworkcolorado.org website).*

The Turkey/Bear Creek watershed, as well as several other mountain-stream watersheds flowing into the South Platte River, has critical groundwater resources used primarily by mountain homes and small communities. A multiyear water-quality monitoring program was conducted for CDOT for assessing during-construction impacts of U.S. Highway 285 improvements along Turkey Creek (TDS Consulting Inc., 2003). An assessment was for the Turkey Creek watershed was completed for Jefferson County by its zoning department and the U.S. Geological Survey, comparing historical versus current (2001) water-quality conditions (USGS and JeffCo, 2001, Table 1). Earlier studies investigated interactions between domestic wells and septic fields, indicating cases of *e-Coli* and nutrient contamination. An example of one study done in the Kinney Park area is given by In-Situ (1986). These studies have resulted in recommended spacing between wells and septic systems to minimize the possibility of well contamination in fractured bedrock. A mountain-area aquifer-sustainability study (CDM, 2010) was conducted for the CWCB.

3.6 Cherry Creek Basin

The Cherry Creek Basin Water Quality Authority (CCBWQA) goals include achieving and maintaining a chlorophyll-a standard (18 ug/L) for Cherry Creek Reservoir, reducing sediment loads from the watershed, and maintaining and enhancing the overall diversity of habitat in the watershed (www.cherrycreekbasin.org/cc_goals.aspx). Its 2012 watershed plan (Leonard Rice Engineers, Inc., 2012) is in the process of being updated. Its monitoring program, begun in the early 1980s (Steele and others, 1989), has evolved over time, and data results and interpretation, along with other watershed-protection and -restoration activities, are incorporated in a series of annual reports (Advanced Sciences, Inc., 1994; Leonard Rice Engineers, Inc. and others, 2012). Examples of stormwater-runoff projects and effectiveness are given by Mulhern and Steele, 1988; Kunkel and others, 1992; and Kunkel and Steele, 1992). Later reports on effectiveness of sediment-detention basins are available.

3.7 Upper Clear Creek Watershed/Standley Lake

The Upper Clear Creek Watershed Association (UCCWA) was created in 1993; a primary function of this organization is to represent the watershed's "upper basin" stakeholders as well as to provide a forum for addressing water-quality issues and concerns for downstream ("tributary basin" and "Standley Lake") entities. The framework for this coordination is through the Clear Creek/Standley Lake Watershed Agreement (Hydros Consulting, Inc., 2012, Appendix A). A watershed-wide monitoring program began in February 1994; a monitoring plan was developed for describing monitoring sites, sample scheduling, and variables to be measured in the field or analyzed in the laboratory. The monitoring plan has been dynamic, with the most recent status comprising two components: one focusing on nutrients/sediment-related/physical variables (Hydros Consulting, Inc., 2012, Appendix B); the second involving trace metals and supported by the USEPA. This separation into two monitoring components began in 2005. As with most watersheds, other water-quality data are being collected in this watershed by other entities (Steele, 2012). Watershed-agreement annual reports to the CDPHE's Water Quality Control Commission have included basic-data appendices for both monitoring-program components; however, recent reports have not included the trace-metals data.

A useful "state-of-the-watershed" report on the upper Clear Creek watershed was prepared by Norbeck and Flineau (1997). Funded by the USEPA, a watershed advisory group (WAG) dealing with mine-impacts existing in the late-1990s; the group's findings are given in a final report (Board of Upper Clear Creek Watershed Advisory Group, 2001). The original upper Clear Creek watershed plan (TDS Consulting Inc., 2006), which focused upon trace metals and associated stream standards and prioritization of mining-related remediation projects, has been updated and enhanced by Clear Creek Consultants and Matrix Design Group (2014).

The Clear Creek Watershed Foundation (CCWF) was created to develop and implement projects in the watershed for the protection and restoration of water quality and watershed health. A watershed-sustainability report outlined various management techniques applicable to the watershed (CCWF, 2007). Over the past two decades, a number of USEPA and 319 grants have been managed by the CCWF for improving conditions, primarily involving historical mine-impacted areas.

Numerous study reports completed over the past two decades document a wide range of the watershed's water-quality and watershed-health conditions. Examples include the following:

- Advanced Sciences, Inc. (1993)–watershed/Standley Lake water-quality data assessment
- Steele and Clayschulte (1997) – water-quality assessment summary for the watershed
- Huyck and others (1999) – metals and fauna studies for mine-site remediation
- Bell (1999) – collation of physical, chemical, and biological watershed data

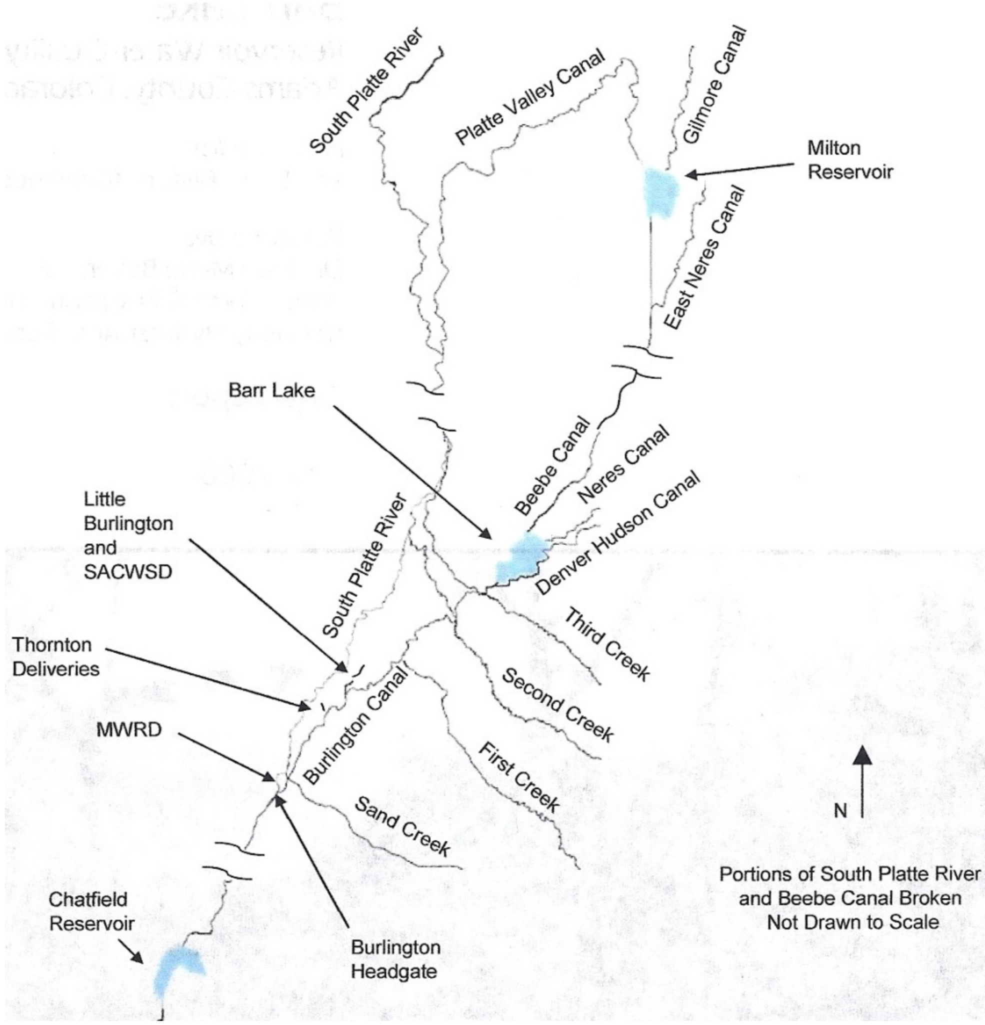
- Herron and others (2001) – reclamation feasibility, Virginia Canyon
- Abel and Steele (2002) – seasonal variability in trace-metals concentrations
- Woodling and Ketterlin (2002) – CDOW biological monitoring program update
- TDS Consulting Inc. (2002) – trace-metals data assessment for CDPHE-HMWMD
- Szewczyk and Emerick (2002) – CSM study of stream habitat quality
- Wildeman and others (2003) – CSM mine waste-pile/sediment characterization study
- Medine (2004) – USEPA-funded model development and application, WASP4-Meta4
- Butler (2005) – CSM trace-metals study of the North Fork Clear Creek
- Matrix Design Group (2013) – CDOT-funded sediment control action plan (SCAP)
- JW Associates, Inc. (2013) – watershed/wildfire assessment and prioritization study
- TDS Consulting Inc. (2013) – latest addendum, trace-metals data/loads assessment

The remedial-investigation/feasibility-study project managed by CDPHE-HMWMD (Tetra Tech-RMC, 2004a; 2004b) addressed the final remediation work to be completed for Operable Unit 4 for the watershed as a Superfund site. There have been several iterations of QUAL2E model applications for the watershed. Other reports focus on issues associated with water-quality and ecology of Standley Lake (Tetra Tech, Inc., 1994; Horn and others, 1996; Hydros Consulting, Inc., 2012). A source-water protection plan for water users of Standley Lake was conducted by Buirgy (2010). Historical impacts of Rocky Flats on Woman Creek, which previously flowed into Standley Lake, are of interest (Advanced Sciences, Inc., 1992; Steele and others, 1993a; 1993b). A watershed-restoration environmental assessment was conducted by the USDA (2013) for selected sites in the upper Clear Creek watershed. The mountain-tributary aquifer sustainability study (CDM, 2010) was noted previously and applies to this watershed as well. Other recent, relevant water-quality presentations include Pierce and others (2010) and Steele and others (2012).

3.8 Barr Lake/Milton Reservoir

The Barr Lake-Milton Reservoir Watershed Association (BMWA) is a “consensus-driven group dedicated to improving water quality through collaborative efforts” (Patten, 2009). A water-quality assessment for Barr Lake was completed by AMEC Earth and Environmental (2008). A watershed plan for the entire Barr-Milton subarea has been completed (BMWA, 2008). This subarea is undergoing change, due to increased interest in a recharge/pumping project in the Beebe Draw area downgradient from Barr Lake by the United Water & Sanitation District on behalf of southeast Denver metropolitan area water providers. For water-quality protection with an earlier water-rights application involving this subarea, the settlement document is of interest (CO District Court, 2011). An amendment to this for a follow-on water-rights case is pending.

Figure 8 - Barr Lake/Milton Reservoir Subarea (AMEC Earth & Environmental, 2008)

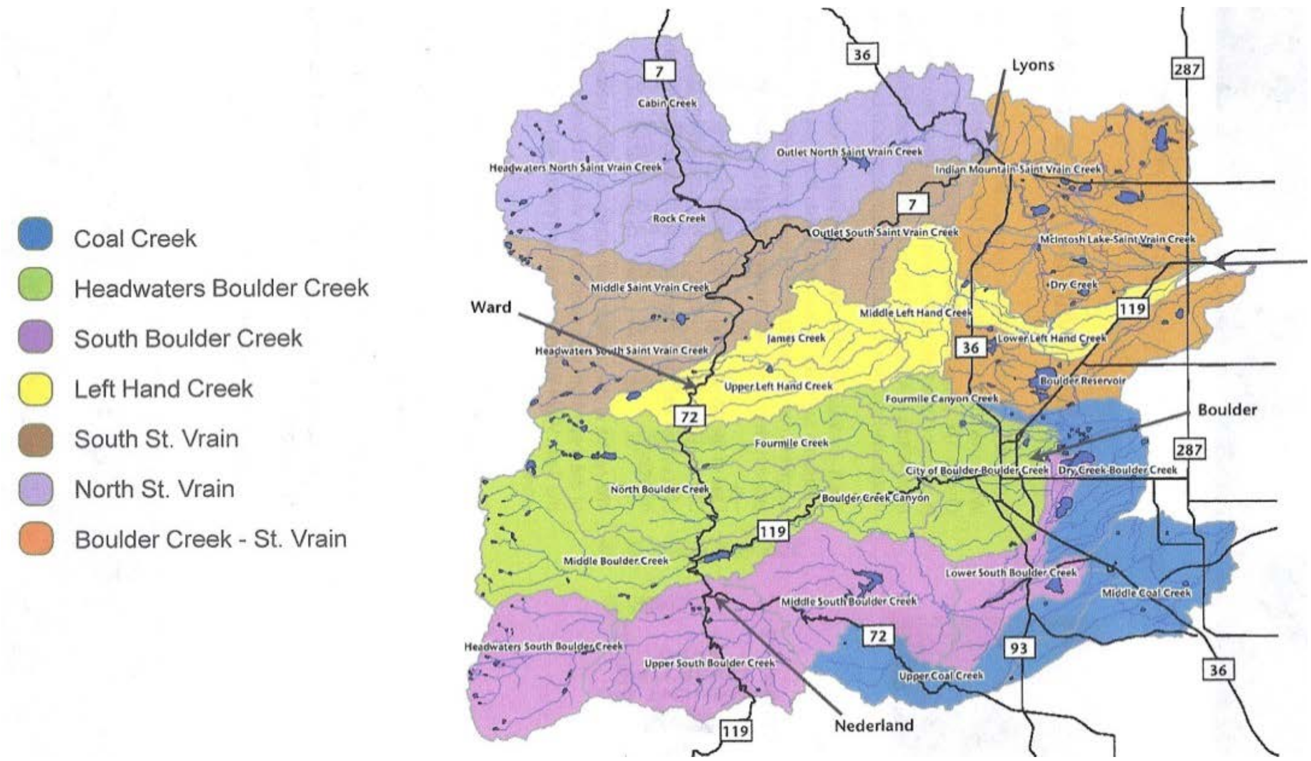


Water development in this subarea demonstrates the challenge of integrated management of surface-water/groundwater resources for various beneficial uses and users. The benefits of the water-quality monitoring efforts through SPCURE transfer to current and possible future impacts on water development in this subarea. Maintaining recreational and wildlife aspects of these impoundments also is a critical factor, benefitting the entire mid-South Platte River basin area.

3.9 St. Vrain Creek Watershed

The St. Vrain Creek watershed also encompasses several smaller mountain streams (north-to-south): Left Hand Creek, Boulder Creek, and Coal Creek. St. Vrain Creek then flows northeast into the Big Thompson River. An USEPA website provides a water-quality assessment on a stream-segment basis (www.iaspub.epa.gov/tmdl_waters10/...). One of the more critical subwatersheds is for Boulder Creek; a water-quality assessment was made by the USGS in a state-of-the-watershed report (Murphy, 2006). JW Associates also include the St. Vrain Creek watershed in his series of watershed/wildfire assessments (www.jw-associates.org/ saintvrain.html). The Colorado State Forest Service (CSFS, 2013) forest-health status report included this as well as other mountain watersheds in the eastern part of the South Platte Basin. Mountain Pine Beetle and Spruce Beetle progression maps are provided and can be compared with previous years' (1996-2013) areal depictions of affected forest areas.

Figure 9 - Saint Vrain Watershed Catchments (Source: JW Associates)



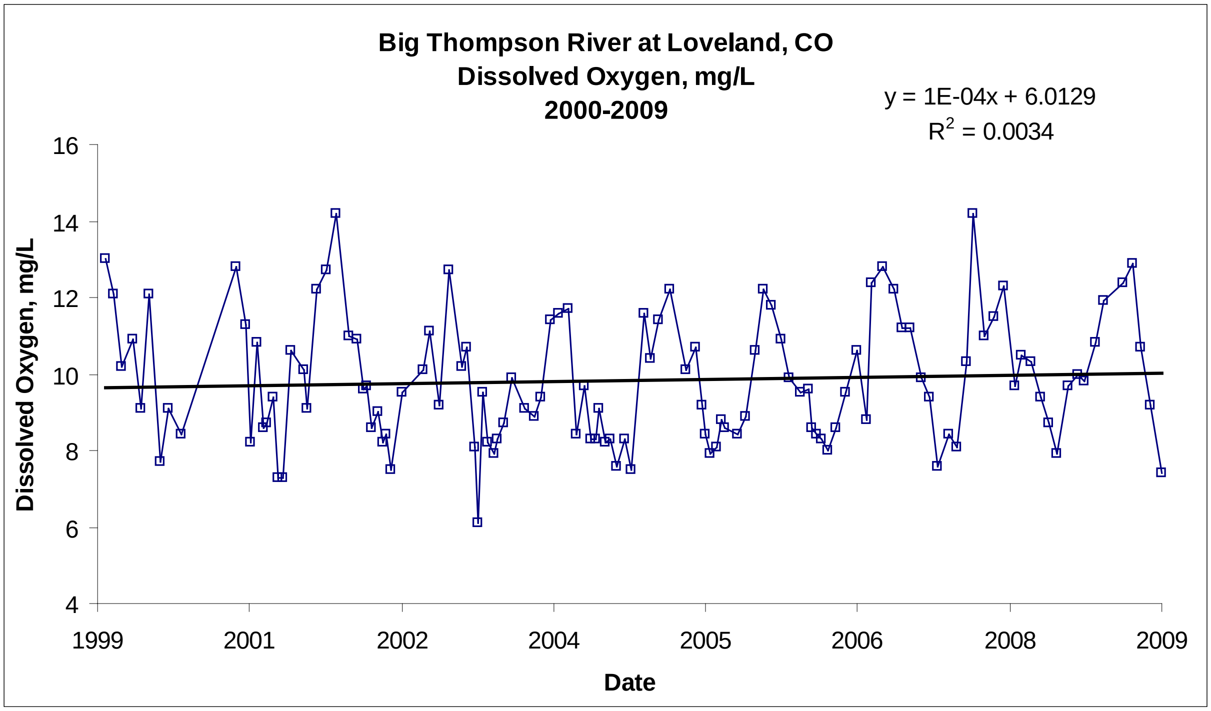
3.10 Big Thompson River Watershed

The Big Thompson Watershed Forum (BTWF) is the organization overseeing water-quality and watershed-health investigations for this watershed. A watershed management plan was completed by Buirgy (2007). JW Associates and JG Management System Inc. (2010) conducted a watershed assessment, focusing upon prioritization of watershed-based hazards to water supplies. In 2013, the BTWF sponsored a nutrient pilot project involving the Sylvan Dale Guest Ranch (www.btwatershed.org).

Walsh and others (1978) assessed water-quality recreational benefits, using Rocky Mountain National Park as a case study and based upon interviews with Park visitors. This study indicated a statistical relationship between benefits from water quality and patterns of participation in outdoor recreation activities, attitudes, and other socioeconomic variables.

CSU has collaborated with the BTWF on compiling and analyzing water-quality data for this watershed (Haby and Loftis, 2007).

Figure 10 - Seasonal Variations in Dissolved-Oxygen Concentrations, Big Thompson River at Loveland, CO (Source: J.D. Stednick, Colorado State University, written communication, July 30, 2010)



3.11 Cache la Poudre River Watershed

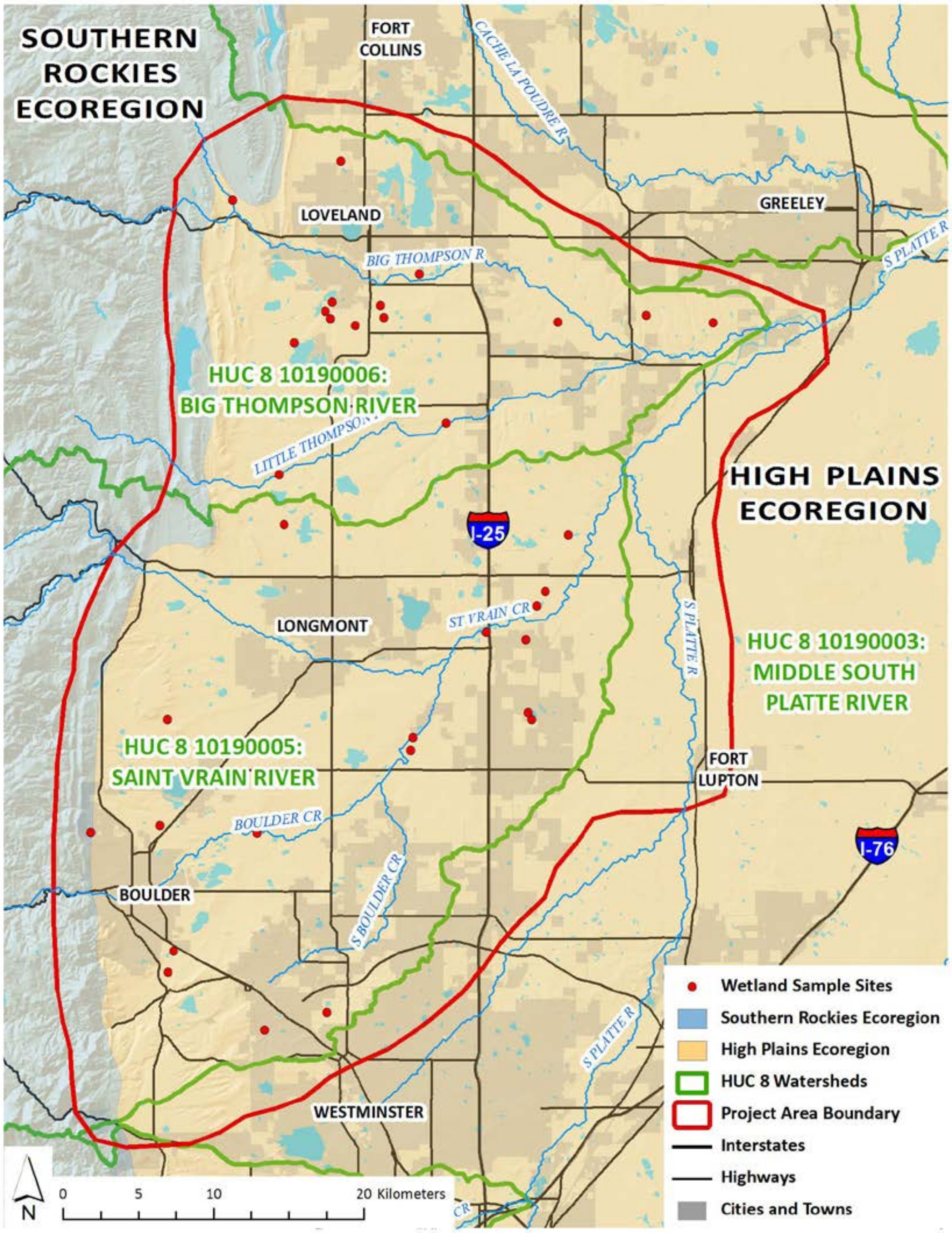
The NRCS (2009) completed a so-called "rapid assessment" of this watershed, focusing upon irrigated agriculture. Conservation-system improvements included issues of nutrient and pest management. Impaired water-quality stream segments were identified for E. coli and selenium, as well as low dissolved-oxygen concentrations in Horsetooth Reservoir (NRCS, 2009, p. 12). Additional water-quality descriptions are included in CDPHE (2012) and WQCD (2013).

This watershed plays a major role in the Colorado-Big Thompson trans-basin diversion project and the more recent proposed Windy Gap Firming project (USBOR, 2011). Another proposed project currently undergoing review is the Northern Integrated Supply Project (NIPS) (USEPA, undated). All of these water-development projects have water-quality and watershed-health implications. A baseline water-quality monitoring program started in 1991 under the auspices of the Northern Colorado Water Conservancy District. The program component, as an example, for "flowing sites" (streams, rivers, and canals) is described in a summary fact sheet by NCWCD (2010). Basic data and numerous water-quality data-analysis reports are available from NCWCD. With the domestic/municipal water use of NCWCD's system, emerging contaminants also are being analyzed (NCWCD, 2013). A so-called "rapid assessment" was made by the NRCS (2009). The Cache la Poudre watershed has also been doing water quality mitigation after the fire.

A couple of CSU studies are relevant to this watershed relative to nutrient characterization:

- Goodwin (2011) – phosphorus transport/eutrophication in the Cache la Poudre watershed
- Son (2013) – nutrient-load inputs to the Cache la Poudre watershed

Figure 11 – Big Thompson – St. Vrain Watersheds Showing Wetland Sample Sites (Source: CDPHE-WQCD, 2012, p. 122)



3.12 Northern Plains Basin Tributaries (Lone Tree Creek & Crow Creek)

Wylie and others (1993) studied nitrate conditions in the alluvial aquifer of Lone Tree Creek. Lone Tree Creek is susceptible to flooding. This subarea is part of the Pawnee National Grasslands (USDA, 2014;

ARNF, 2009), protected as part of the Arapaho-Roosevelt National Forest. No other water-quality data sources or related issues were found in this cursory assessment effort.

3.13 Southern Plains Basin Tributaries (Box Elder Creek, Kiowa Creek, and Bijou Creek)

The Boxelder Stormwater Authority was created in August 2008. Although its 2006 Master Plan dealt primarily with flooding issues, it included components addressing water-pollution control and watershed protection (PBSJ, 2006). Recent concerns of hydraulic-fracking in Box Elder Creek (Jaffe, 2014) are indicative of the increasing public awareness of this energy-development alternative in many parts of the South Platte Basin.

3.14 Lower South Platte River Basin

The Lower South Platte Water Conservancy District (LSPWC) was founded in 1964 and deals primarily with water-resources management of the Basin's interactive surface-water/groundwater system within the State of Colorado. A number of CSU-based studies have been conducted for evaluating ambient quantity/quality characteristics as well as model-predicted changes for improved water-resources management.

Figure 12 - Irrigation-Diversion Ditch, Lower South Platte River (Source: LSPWCD website)

3.15 Republican River Basin

The part of the Republican River Basin in Colorado is bordered on the east by the State of Kansas. The Republican River Water Conservation District was created in 2004 to promote compliance with the tri-state Republican River Compact, principally involving farmers and ranchers in the Basin. Water use in Colorado involves surface waters of the Republican River system as well as the west-central part of the critical Ogallala Aquifer (American Ground Water Trust, 2002). No surface-water investigations were found through the internet web research. However, the Ogallala Aquifer was studied intensively by the U.S. Geological Survey. Water-quality baseline studies were conducted in earlier USGS reports. A recent New York Times article (Bair, 2011) summarized several water-quality issues impacting the Ogallala Aquifer:

- 14 percent of all Ogallala irrigation wells tested contained on or more pesticides
- The most common detected herbicide was Atrazine
- Five percent of testes Ogallala irrigation wells indicated nitrate concentrations equal to or in excess of the safe drinking-water standard (<10 mg/L NO^3-N) set by the USEPA.

4 Impaired and Threatened Waters

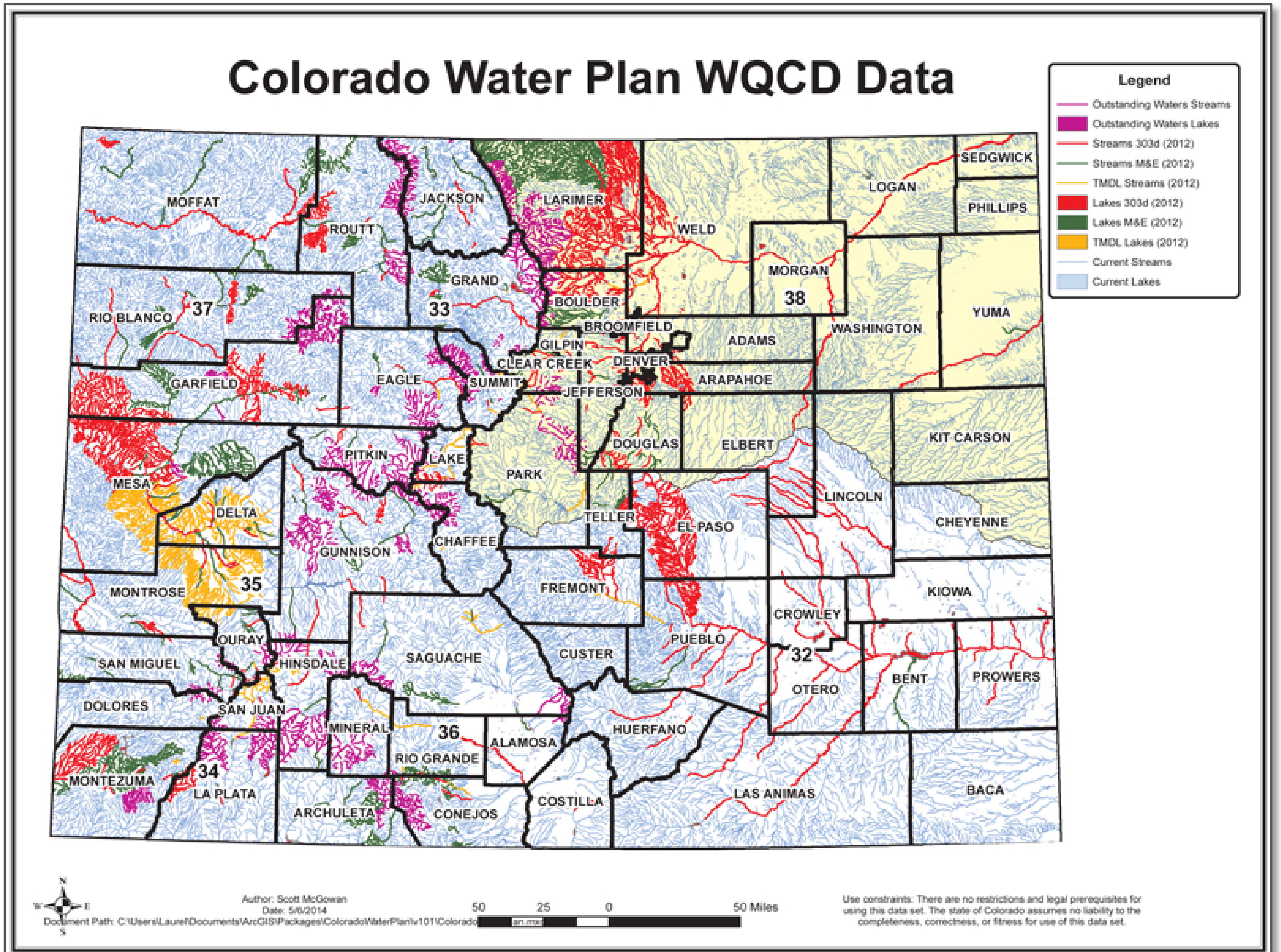
The term "303(d)" indicates those waters on the list of impaired and threatened waters (stream/river segments, lakes) that the Clean Water Act requires all states to submit for EPA approval. States are required to assess the condition of surface waters and submit lists of those that are too polluted to meet water quality standards (called impaired waters). The Act requires that states establish priorities to address these impaired waters by developing water restoration plans (also known as Total Maximum Daily Loads or TMDLs). TMDLs identify pollutant load limits necessary to clean up the water to meet water quality standards and then quantify a pollutant "budget" for different sources of pollutants. The water restoration plans are then implemented via permit requirements and through a variety of other local, state or federal water protection programs.

The Colorado Department of Health and Environment maintains an ongoing monitoring plan to assess the water quality of the State's streams and lakes. The objective of the monitoring plan is to gather, assess and report data regarding the chemical, physical and biological integrity and quality of state surface waters for the Federal Clean Water Act (CWA) 303d list of impaired waters and the 305b report of status of water quality in Colorado as the EPA Integrated Report.[1]

The 303d listed lakes and streams found throughout the Basin are shown in Figure 4-1, highlighting waterways where water quality may be of concern in the South Platte Basin.

[1] Sources: Colorado Department of Health and Environment (CDPHE), Environmental Protection Agency (EPA)

Figure 4-1. South Platte 303d Listed Waterways



Source: CDPHE

5 Summary and Conclusions

A tabulation of various watershed-based water-quality management entities (a few water conservancy districts are included) was judged to be useful for the users of this document, where only selective references can be given to indicate the diversity and magnitude of useful investigations and reports available for addressing water quality and watershed health:

Table 2 - Summary of Watershed/Regional/Subbasin Organizations, South Platte River Basin

SP Organization	***Website***	***Contact***	***Description/Notes***
Coalition for the Upper South Platte (CUSP)	www.uppersouthplatte.org	Beth Nielsen, Program Assistant	Water quality, forest health, wildlife mitigation, and education; South Park (oil & gas development)
Chatfield (Reservoir) Watershed Authority	www.chatfieldwatershed authority.org	Larry Moore & Kevin Urie, Co-Chairs	Water-quality protection for drinking-water supplies, recreation, fisheries, and other beneficial uses, small WWTPs
South Platte Coalition for Urban River Evaluation (SPCURE)	www.spcure.org	Sarah Reeves, Coordinator	Water-quality monitoring, USGS data/model studies, TMDLs, sediment impacts; WWTP discharges
Bear Creek Watershed Authority (BCWA)	www.bearcreekwatershed authority.org	Russ Clayschulte, Executive Director	Established 1981, monitoring program, includes Turkey Creek, GW-WQ studies, TMDLs, small WWTPs
(Lower) Bear Creek Watershed Planning and Assessment	groundworkscolorado.org	Rachael Hansen, Program Manager	319 Grant (awarded in 2011); website information; watershed plan in process
Cherry Creek Basin Water Quality Authority (CCBWQA)	www.cherrycreekbasin.org	Chuck Reid, Manager	Watershed plan (2012); long-term water-quality monitoring (annual reports); reservoir controls (TP/chlorophyll-a); WWTPs
Upper Clear Creek Watershed Association (UCCWA); Clear Creek Watershed Foundation (CCWF)	www.clearcreekwatershed.com	Katie Fendel, UCCWA Chair; J. David Holm, CCWF Executive Director	Water-quality monitoring, USGS data/model studies, TMDLs, I-70 sediment-control impacts; WWTP discharges; watershed plan update (2013); management agreement (Standley Lake Cities)
St. Vrain River Watershed Stakeholders	www.svlhwcd.org	Sean Cronin, Executive Director	Organized in 1971; levy taxes; providing augmentation water to members; water education

SP Organization	Website	Contact	Description/Notes
Big Thompson Watershed Forum (BTWF); also NCWCD, see below	www.btwatershed.org	Zach Shelley, Program Director	WQ monitoring and assessments; watershed management plan (2007); watershed-protection volunteers; CO-BT Project
Big Thompson River Restoration Coalition			Restore river corridor, fisheries and natural areas, and make watershed resilient to future flooding.
Cache la Poudre River Basin - Northern Colorado Water Conservancy District(NCWCD)	www.northernwater.org (also see STP below)	Eric Wilkinson, General Manager	Providing water to northeastern CO via the trans-basin CO-BT P and the Windy Gap projects (above) and the proposed NIPS/Glade Project
Lone Tree Creek/Crow Creek tributaries (Pawnee Natl. Grasslands)	www.fs.fed.us/r2/arnf/	T.J. Williams, USFS	Arapaho-Roosevelt National Forest/Pawnee National Grasslands
Box Elder Creek/Kiowa Creek/Bijou Creek	www.hoaonlineresource.com/ boxelder/news.php?category=4		Boxelder Stormwater Authority; stormwater master plan (2006)
Lower South Platte Conservancy District	www.lspwcd.org	Jo Frank, General Manager	Created in 1964; 406,000 acres of agricultural lands; water management and technical services
South Platte River Urban Waters Partnership	www.urbanwaters.gov	Devon Buckels, AICP, Coordinator	Non-regulatory partnership of over 40 organizations focusing on water quality, water protection, and water awareness in the South Platte River watershed.
South Platte Forum	www.southplatteforum.org	Jennifer Brown	Annual conferences since 1989
Republican River Water Conservation District (RRWCD)	www.rrwcd.org	Deb Daniel, General Manager	Created in 2004, self-governed, promotes local involvement in Republican River Compact; Ogallala Aquifer conservation
Colorado Department of Parks and Wildlife (CDPW) - RiverWatch	www.coloradowater.org	Michaela Taylor, Program Manager	Started in 1989; primarily volunteers with training; lab in Ft. Collins (CDPW)
Save the Poudre (STP)–Poudre Waterkeeper	www.savethepoudre.org	Gina Janett	Advocacy group, against proposed NIPS/Glade Project
Centennial Water & Sanitation District	www.centennialwater.org	John Hendrick, General Manager	Water/wastewater provides in Highlands Ranch
Evergreen Metro District	www.evergreenmetrodistrict.com	David Lighthart, General Manager	Supplies water and wastewater treatment for the Evergreen community area

SP Organization	*Website*	*Contact*	*Description/Notes*
Aurora Water	aurorawater.org		Supplies water to its service area
Golden Utilities	www.cityofgolden.net/departments-divisions/water/		Water & wastewater treatment for the Golden service area
Littleton Water & Light	www.littletonwaterandlight.org		
Lakewood Utilities	www.lakewood.org/Utilities/		
Englewood Utilities	www.englewoodgov.org		
Denver Water Department	www.denverwater.org		Supplies water to its service area
Standley Lake Cities	Cities of Westminster, Northglenn, Thornton, and Arvada		Stakeholders in the upper Clear Creek watershed
Greeley	www.greeleygov.com/water		
Longmont	www.ci.longmont.co.us/pwwu/water/		
Fort Collins	www.fcgov.com/utilities/		
Fort Collins-Loveland Water District	www.fclwd.com/		
Boulder	https://bouldercolorado.gov/water		
United Water and Sanitation District	www.unitedwaterdistrict.com	Bob Lembke, President	Client districts: ACWWA and ECCV (SE Denver metro area)
Northern Colorado Water and Sanitation District	www.northernwater.org/		

Municipal water supply utilities and providers require development and submittal of annual water-quality reports to be available to the public. Examples are those by Centennial (2013), Aurora Water (2012) and the Denver Water Department (2013).

Long-term human-health epidemiological studies are recommended to assess the potential long-term adverse impacts of the presence of minute concentrations of chemicals introduced into water supplies – namely, herbicides and insecticides, and pharmaceuticals and personal care products (PPCPs, or emerging contaminants) (Battaglin and others, 2013; Daughton and Ternes, 1999; Sprague and Battaglin, 2005; NCWCD, 2013; Stephenson, 2013). These substances currently are unregulated by the USEPA and CDPHE; however, low-detection analytical methods have been developed, and this regulatory situation may change in the near future.

Finally, review of water-management strategies proposed in the past (Nichols and others, 1972; CCRI South Platte Team, 1980) might be beneficial with regard to future planning in the South Platte River Basin as well as Statewide planning from the standpoints of water quality and watershed health. The benefits of dealing with these issues on a watershed/subarea scale are demonstrated by the bibliographic overview provided by this document. Also, we may learn from *post-audit* analysis of water-development projects that were not authorized (USEPA, 1996). The review of reasons why these past efforts did not move forward can assist in future planning, particularly as similar projects will likely be needed in the future.

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Appendix F – South Metro Water Supply Authority Concept for Discussion

Below is a collaborative conjunctive use multi-purpose project concept based on a potential Flaming Gorge Pipeline project and conjunctive use with the Denver Basin Aquifer. This is an example that provides something for others to react to, and should be evaluated and built upon through the Basin Roundtables and planning process. Although this "straw-man" is conceptualized around a Flaming Gorge Pipeline project, many of the concepts could extend to other new water supply projects. Section 1 describes the concept and Section 2 provides additional summary information on the Denver Basin Aquifer and the opportunity to use it as a drought reserve.

Section 1: Conjunctive Use Multi-Purpose Project Concept

This description outlines potential elements of a conjunctive use multi-purpose new supply project.[1] This conceptual "straw-man" project is prepared to test and demonstrate the ability of a project to meet stakeholders' concerns including environmental, recreational, and water users concerns. It could be centered around a number of potential projects such as the Green Mountain/Blue River Pumpback, Yampa Pumpback, Blue Mesa Pumpback, or Flaming Gorge Pipeline with conjunctive use of the Denver Basin Aquifer and interruptible supply agreements in the South Platte Basin.

This description is intended to focus discussions related to new supply development and provide a framework for analysis and feedback. It is anticipated that the substance of a specific concept will change and additional details will be developed over time. This description can help inform recent IBCC and roundtable discussions and ultimately be included as part of a roundtable-to-roundtable engagement within Section 4.8 Interbasin Projects and Methods of the South Platte and Metro's Basin Implementation Plan (BIP).

As a starting point, the following the elements of a multi-purpose project are described:

- Project Description
    - Water Source
    - Risk Management and Variability
    - Headwater Enhancement
- Overall Benefits of the Project
- Challenges/Issues/Costs of the Project
- Potential Area of Origin Compensation
- Statewide Policy Objectives
- Financing and Governance

[1] Several sources were used to compile this memo including: Prior "Basin of Origin" bills (between 1988 and 2000 the Colorado General Assembly looked at 16 out of basin transfer proposals of which some were compensation/mitigation approaches, some focused on additional requirements before diversion, and two required voter authorization); Reports from the Colorado Water Resources Research Institute on area-of-origin compensation; The South Metro Water Supply Study (February, 2004); SWSI Phase II Section 5 (Addressing the Water Supply Gap); Discussions between the Yampa/White Roundtable and South Platte Roundtable on the proposed Yampa Pumpback Project; SWSI 2010 and the December 15, 2010 IBCC Report; and Basin Roundtable Project Exploration Committee (a.k.a Flaming Gorge Task Force) Phase 1 Report.

These elements are outlined in general terms below. Additional details such as yield (average, firm, and dry), water rights, infrastructure, cost estimates, mitigation, funding, etc. will need to be further developed with additional stakeholder input. In addition, a section at the end further describes the Denver Basin Aquifers as an opportunity for a risk and drought reserve. Including the Denver Basin aquifers as an asset to provide supplies when no project yield is available can be an important element in risk management of Colorado's Compact Entitlement.

The specific elements of projects, mutual commitments, and milestones of progress would be the subject of an exploratory investigation and ultimately negotiation among multiple parties. It is anticipated that should a package of projects emerge as feasible and desirable, commitments would be made in tandem. As potential end users made certain commitments, potential opposers would also make commitments helping to ensure that a new west slope supply project will, in fact, be a fundamental part of "filling the gap" package. This approach needs to provide confidence that Colorado River water supply development will be available for the east slope, thereby providing an alternative to agricultural to urban water transfers.

<u>Elements of a Conjunctive Use Multi-Purpose Project</u>

Project Description:
For discussion purposes, this concept is centered around the Flaming Gorge Pipeline Project. It has been initially screened through a sub-committee, and also been investigated by a variety of agencies over several decades. Much information is already available, reducing the need to gather new data. A group has also begun to coordinate with the US Bureau of Reclamation to review hydrologic analyses and model projections of potential yields and operations. This Conjunctive Use Flaming Gorge Pipeline Multi-Purpose Project contains several major components. The components include:

1) **Flaming Gorge Pipeline**: The source of water for the project would be a contract with the Bureau of Reclamation (BOR) for an annual average yield from Flaming Gorge Reservoir of 150,000 + acre feet. The water would be diverted from the Green River through a pumpstation at Flaming Gorge Reservoir. A 400-mile 7-8 foot diameter pipeline would convey this water to the Front Range. The most likely pipeline route would travel along Interstate 80 through Wyoming to Laramie, and then south along the Colorado Front-Range. The pipeline would convey supplies to municipalities in Wyoming and on the Colorado Front-Range in the South Platte and Arkansas Basin.

   The overall capacity of the pipeline should include consideration of several opportunities beyond that required to convey 150,000 acre feet for several reasons:
   a. Cost/benefit review of moving additional water under certain hydrologic conditions;
   b. Potential as a water management tool, capable of bringing water to the Front Range as an alternative diversion method to depletion in the headwaters of the Colorado River. That might position the project as a riparian restoration project as well as a new supply project, and;
   c. In a fashion similar to the transaction between the Southern Nevada Water Authority

and the Arizona Water Banking Authority[2], Colorado could perhaps develop underground storage of other Upper Basin state's compact entitlement as a component of risk management and oversize the conveyance system for that type of possibility.

2) **Risk Management and Project Variability Strategies:** In 2010, the IBCC agreed that the development of new water supplies from the Colorado River "should be accompanied by a risk management program that ... is integrated with 'triggers' and utilizes other dry cycle sources to fill the gaps when the new supply water is unavailable." Because populations and economies would be dependent upon this new water supply from Flaming Gorge, mechanisms would need to be in place to deal with periodic supply shortages. The IBCC recommended a two-pronged approach: 1) "to put in place an 'early warning' system that shuts down, curtails, or offsets [the new supply project] in advance of a Compact curtailment. The early warning system would be based on hydrologic triggers;" and 2) "the water supply triggers would be coupled with an emergency water bank or other operational scenario that would meet the critical needs of all of Colorado's post-1922 users if a curtailment cannot be avoided."
   a) **Triggers and Dry-Period Sources**
      i) Triggers: Hydrologic triggers could include Lake Powell levels, overall storage in the CRSP system, the 10-year rolling average of upper basin deliveries, or some combination. The IBCC notes, "additional work is needed to define which triggers would be used ... and how they would work."
      ii) Sources to meet shortages: Regardless of the triggers, the end users of the project would need supplies that can be used conjunctively with the Flaming Gorge supplies. This is not a new concept for many front-range utilities. For example, the South Metro region recently secured a permanent, but variable, renewable water supply through the WISE Project. In years when no delivery occurs, they will continue to rely on Denver Basin well pumping. Similar strategies could be used to deal with the variability of a Flaming Gorge project and associated triggers.
         (1) Denver Basin Aquifer Conjunctive Use and ASR: Diversion of water from Flaming Gorge could be tied to levels in Lake Powell or other triggers to avoid compact curtailment. This strategy involves diverting a larger amount of water in wet years for front range groundwater users to store water in Denver Basin aquifers through an ASR (aquifer storage and recovery) program to assure sustained productivity. In dry periods when supplies are not available from Flaming Gorge, municipalities with access to the Denver Basin Aquifer would meet their water needs from local groundwater supplies. Through ASR and changing the use of the Denver Basin Aquifer from a base supply to a drought supply, the aquifers can be managed to assure long-term reliability. Additional information on this concept is included in the section below "Denver Basin Aquifers - Our Best Opportunity for a Risk and Drought Reserve."
         (2) East Slope Temporary Ag. Transfers: Interruptible supply agreements with east slope agricultural water rights could also provide a back up water supply during dry-cycles. An alternative agricultural transfer project could build on the FLEX

[2] http://www.snwa.com/ws/future_banking_arizona.html

Market concept and include the temporary transfer of agricultural water rights similar to substitute water supply plans (CRS 37-92-308) and interruptible supply contracts (CRS 37-92-309). It could also include supporting the development of additional storage and infrastructure in the Arkansas and South Platte river basins to facilitate the temporary transfer of agricultural water rights to Front Range municipalities.

b) **Emergency West Slope Water Bank for pre-1922 Water Rights**: The triggers and dry-sources above would be coupled with an emergency west slope water bank to help ensure the critical needs of all of Colorado's post-1922 users would be met if a curtailment cannot be avoided. As described by the IBCC, "this water bank would utilize the consumptive uses of Colorado's pre-1922 water rights on a willing buyer/lessee–willing seller/lessor basis. The bank could be combined with or include the use of the capacity of existing reservoirs such as Blue Mesa. The concept of such a bank is the effort of a current study by West Slope and Front Range water users."

3) **Headwater Enhancements**: This multi-purpose project could include non-consumptive environmental and recreational benefits to the headwaters of the Colorado River system. This could involve exchanges with current transbasin diverters for additional flows in Colorado headwaters and could utilize specifics from the Grand County Streamflow Management Plan and the Colorado Roundtable's Nonconsumptive Needs Assessment. This concept would need to be explored with current transbasin diverters.

Potential Area of Origin Compensation

Through the IBCC and Basin Roundtable process, west slope representatives have said that they would need several commitments before being supportive of this type of multi-purpose project. These included:

- Continued viability of the west slope's regional economy
- Certainty – ensure an increment of water is available for development in each west slope basin
- Front-Range commitment to conservation and reuse
- Environmental mitigation and enhancement

These elements could be met through a combination of water related benefits for the west slope sub-basins and/or socio-economic compensation.

Water related benefits for west slope sub-basins

Even though the diversion may not occur directly in each basin, different elements could be included to distribute statewide benefits, ensure continued viability of the west slope's economy, and provide certainty.

- Yampa/White
  - Infrastructure for irrigation of additional acres in Moffat County (20,000-30,000 acres of land could be irrigated)
  - Water for future municipal development particularly in Steamboat and Craig. Upper basin interests have previously secured 60,000 a.f. subordinations to protect future uses and they have indicated they would want a similar subordination or component of the project.

- Colorado
  - Exchanges with current transbasin diverters for additional flows in Colorado headwaters (Grand County Streamflow Management Plan; Blue River Flow enhancement)
  - Maintain Dillon Reservoir Levels
  - Wolcott Reservoir for future west slope water demands and additional yield to the Grand Valley
- Gunnison
  - Agricultural firming projects in the upper basin (Tomichi Creek, etc.) to help with current agricultural shortages
  - Water quality improvements in the Uncompahgre River and Lower Gunnison (selenium)
- Southwest
  - Financial assistance and support developing their identified projects and processes

Socio-Economic Compensation (Development Fund)
Generally, the most useful form of compensation would be unrestricted monetary compensation to be used by the west slope to compensate unprotected parties and for whatever other purposes its citizenry prefers. Rather than committing to specific projects, a development fund could be established. The money from this fund would be available to provide assistance for future water needs (see above) or other economic development on the west slope.

The fund could be financed in a number of ways as further described below. These financing mechanisms could also be accompanied by a charge placed on users of the multi-purpose project water (perhaps indexed to the current price of water in the South Platte Basin). The fund could be held by the state (CWCB) or potentially by west slope conservation districts or counties. Expenditures would be made against the fund for projects proposed by municipalities, conservancy districts, and other public entities on the west slope. Appropriate expenditures could be solely water related[3], or appropriate expenditures could include other economic development projects.

An alternative, predicated on the pipeline becoming a riparian restoration management tool, would be application of funds in two ways: First, for compensatory projects in the Colorado River basin, and; Secondly, to fund the increased cost associated with alternative diversions of transbasin sources. The first compensation is an early milestone in the process, bringing environmental benefits to the headwaters on the way to project permitting. The second form of compensation, where water providers with low cost, gravity delivery systems accept alternative deliveries, may also be necessary to have the required support for the project.

The major Front Range water providers have invested enormous capital in transbasin diversion structures. That investment yields lower cost water supply for their customers. The offset to the increased cost of alternative delivery might take the form of cash or delivery of more water than

[3]New storage projects, repair and rehabilitation of existing water storage and delivery facilities, municipal water systems, improvement of irrigation systems, on-farm improvements resulting in greater efficiency, water based recreation facilities, securing in-stream flows, and other water-related projects.

could have been historically diverted. The combination of a hold harmless economic approach, coupled with compensatory water stored underground, might be sufficient to garner enthusiastic support for the project.

Financing
In addition to the configuration of the project, the other major outstanding questions relate to how the project would be financed, managed and implemented. Four models could be further explored:

1. Federal/State partnership similar to the Central Arizona Project
2. State water project such as the California State Water Project
3. State/Local partnership where the state facilitates the project, but end users finance and manage it
4. Local/Local partnership similar to WISE and Chatfield as water examples and E-470 as a transportation example
5. Public/Private partnership similar to transportation projects (Hwy 36) [4]

Under any funding model it is most appropriate for use rates and tap fees to be the primary base of funding. This connects the customers with what they are paying for. However, the conceptual package of projects described above will likely also include broader public benefits that are more dispersed than those that accrue to the specific end users of the transmountain diversion project. Therefore broader public funding mechanisms should also be explored. Two funding mechanisms, a "water" mill levy and a Container Fee, are briefly described as examples of how some of the broader public components of this multi-purpose concept could be funded. These funding mechanisms are described in order to demonstrate that broader funding mechanisms could be available if a package of projects is generally agreed to. SMWSA is not advocating for nor necessarily supportive of either method; rather, they are described as possibilities in order to spark further discussion.

Finance - "Water" Mill Levy

- A two (2) mill property tax on the nine largest front-range counties will generate about $107 million/year. (Adams $9m; Arapahoe $15.2m; Boulder $11m; Denver $20.2m; Douglas $8.6; El Paso $11.6; Jefferson $14.4; Larimer $7.6m; Weld $9m). As a point of comparison most fire districts collect an 8+ mill. An additional two mills might incentivize linking land-use planning and water supply planning in the “Big 9.”
- One (1) mill, or about $54 million/year could help provide water and economic development for the west slope. This could be done through a “Development Fund” as described above or it could be divided between the west slope counties.
- The other (1) mill or about $54 million/year could help fund construction and operation and maintenance of the multi-purpose project, including headwaters exchanges.
- As a point of comparison, the 2009 General Fund Revenue for the following counties - Gunnison $10.388M; Montrose $10.1M; Logan $4.5M; Garfield $28M; Otero $1M (estimate) - approximate what this fund could generate.

[4] Western Resource Advocates published a report, “Economic and Financial Impacts of the Proposed Flaming Gorge Pipeline” by Honey Creek Resources, Inc. September 6, 2011. The report compares public and private finance approaches. The report does not consider a public-private partnership.

Finance – The Container Fee Ballot Initiative of 2010
In 2010, two citizens filed a Ballot Initiative seeking a fee on beverage 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 at its hearing April 21, 2010. The minutes of that hearing document that the legislative staff determined such a fee would generate approximately $100 Million per year in revenue.

The Title Board's opinion setting the initiative title for the ballot was appealed to the Colorado Supreme Court. The basis of the appeal was that by naming the Basin Roundtables specifically (the funds were to be allocated in part based on roundtable approval of grants), the initiative was not a single subject. The Supreme Court granted the appeal. Given the timeline of the Colorado Water Plan, consideration could be given to a similar ballot initiative in November, 2015. The funds generated could go immediately to riparian restoration projects with future use for compensatory offsets. In the long run, the funding stream would support project development, permitting and eventually debt service.

Overall Benefits of the Project

- Front-range municipalities get an increment of high quality reusable water.
- New water supply development minimizes loss of irrigate acres in South Platte and Arkansas Basins. Transfers of east slope agricultural would no longer be the dominant strategy for meeting front-range water needs. East slope agriculture could participate in the project and receive additional yields (either directly or through "second use" of fully consumable return flows).
- Acceptable water quality that does not require advanced water treatment and may be used to blend with lower quality South Platte supplies.
- Allows development of new water supplies and utilization of Colorado's compact entitlements while protecting recreation, environmental flows, and future economic development on the west slope.
- Depending upon the location of the diversion it could diversify the state's M&I water supplies. The CRWAS indicates that climate change impacts are less severe in northern basins such as the Green River. Adding a more northerly water supply, and a basin other than the Colorado mainstem, would diversify the state's M&I water supply and could mitigate potential risks from climate change.

Challenge/Issues/Costs of the Project

- Potential endangered fish and depletion issues downstream of the diversion would need to be analyzed.
- May require enlargement or construction of additional storage in the South Platte or Arkansas basins. This storage could be surface water storage or underground storage.
- Additional cost analysis of the various component of the package of projects will be needed. This will include, but not be limited to, the cost of equipping existing wells for ASR, implementing a regional ASR program, and comparing the costs of ASR with above ground storage.
- Complexities of water right administration in the event of a compact call.
- Although the Colorado Compact recognizes the right of one state to move water through

another state, there will likely be a need for an agreement with Wyoming, perhaps Utah and perhaps between all four Upper Basin States.

Statewide Policy Objectives

- Safe reliable drinking water supply for all Colorado citizens
- Conservation – the project can include elements to require or encourage different conservation measures
- Reuse – the project can be configured for maximum utilization of fully consumable water either through M&I reuse or “second use” by east slope agriculture
- Maximum utilization of the state’s Colorado River Compact entitlements
- Environmental and recreational preservation and enhancements

Section 2: Denver Basin Aquifers
Our best opportunity for a risk and drought reserve

Existing Groundwater Conditions

Denver Basin Aquifers (Laramie-Fox-Hills, Arapahoe, Denver, and Dawson) comprise a huge groundwater storage reserve immediately beneath much of the central Front Range. The aquifers extend from roughly Greeley on the north to Colorado Springs on the south, the Foothills on the west, and the eastern boundaries of Adams, Arapahoe and Douglas counties on the east, comprising around 6700 square miles. The combined aquifers hold over 450 million acre-feet of water, and over 250 million of that may be economically pumped. Wells have been drilled and can produce up to as much as 1000 gallons per minute (gpm).

Historically, the South Metro area has relied almost exclusively on this non-tributary, nonrenewable groundwater supply. Estimates are that approximately 38MAF of recoverable water exists under the South Metro area. However, recent work reinforces previous observation regarding steady rates of aquifer declines. The 2013 Douglas County Rural Water Supply System Feasibility Study included a comparison of USGS groundwater modeling, measurements in active wells, and CDWR investigation of Denver Basin aquifer levels. The USGS modeling predicts a -1 to -5 feet per year average annual groundwater level decline and the CDWR investigation predicts a -5 to -13 feet per year decline. South Metro water providers continue to experience declines in aquifer levels and the cascading reduction in well yields.

Given the historic, current, and predicted declines in aquifer levels, the volume of Denver Basin Aquifer production will have a future economic limit which is likely to fall short of urban demands. Numerous studies between 2004 and 2013 all suggest that costs associated with continued reliance on non-tributary, nonrenewable groundwater are expected to be comparable or higher than costs for developing a regional renewable water supply system, thereby providing appropriate incentive to import renewable supplies that can be used conjunctively with the Denver Basin Aquifer.

Future Scenarios for Denver Basin Aquifer Groundwater Use

There are two likely scenarios for South Metro entities involving future use of Denver Basin groundwater: the first scenario is the status quo use of non-renewable groundwater supplies at increasing cost due to declining well production capacities. For the reasons discussed above, this scenario is generally unacceptable as it is an expensive and non-sustainable model.

A second – preferable - scenario is a large-scale conjunctive use plan involving development of renewable supplies and implementation of a robust wet-year aquifer recharge program in which reliance on Denver Basin Aquifer groundwater is primarily as a drought supply. While efforts to increase renewable supplies are currently underway, formalization of a significant conjunctive use plan involving a new transbasin diversion is urgently needed.

Such a conjunctive use plan can operate largely through existing and planned infrastructure. Water providers in the southern metro region rely on multiple wells for their water supply, and have constructed infrastructure connecting them with community water distribution systems. There are around 150 municipal supply wells in Douglas County alone. Recently, the WISE project included plans to link these service areas over the majority of the region. This will provide a water link both internally and to sources of renewable water from outside the region. The opportunity to recharge the Denver Basin Aquifers and a large-scale conjunctive use project is here.

Current annual well production in the area exceeds 40,000 afy (acre feet per year), which corresponds to an average rate of 35 mgd. Assuming the majority of wellfields are sized to meet summer demands and typically triple the average rate, there may be over 100 mgd of peaking capacity available in off-peak periods. With proper equipping and treatment capacity, a significant volume of renewable water could be supplied to the Denver Basin in wet periods for use during droughts.

A rough approximation of rates of flow into the aquifers can begin with the assumption that typical provider demands in the summer are sized for triple that year round rate, or 105 mgd in the aggregate. This leaves an average of up to 70 mgd in off-peak months. If off-peak demands are met with imported water making wells available for recharge, this rate could be returned to the aquifers for a total ranging between 25,000 and 45,000 af per year. Specific rates and durations of flows would be examined in detail during the feasibility review process. Generally, the initial projections affirm the potential viability of this concept.

The potential of a conjunctive use approach to integrating local non-tributary groundwater supplies and storage with interruptible surface water supplies from the South Platte and West Slope drainage basins was outlined in the State of Colorado’s Metro Water Supply Investigation, Final Report (Colorado Water Conservation Board, 1998). Subsequently, the South Metro Water Supply Study (prepared for the South Metro Water Supply Study Board in February, 2004) carried the concept further through a joint effort between the Douglas County Water Resources Authority, Denver Water, and the Colorado River Conservation District.
Conjunctive Use is characterized as “The coordinated use of surface and groundwater resources and facilities to produce a larger, more reliable and cost effective combined water supply that could be generated from either source alone.” (SMWSSB, page 1-12)

Centennial Water and Sanitation District in Douglas County has operated a conjunctive use plan since the early 1980’s and an aquifer storage and recovery project with Denver Basin deep wells since 1992. The technology and recharge operation have met no significant impediments after over 20 years of and over 14,000 acre-feet of treated potable water back into the aquifers. South Metro WISE participants are currently evaluating the feasibility of expanding this operation with future WISE deliveries.

To date, many water suppliers along the Front Range who rely on deep bedrock aquifers have not been able to capture wet year supplies. With the addition of WISE Project infrastructure and Parker’s Rueter-Hess Reservoir, the South Metro Area will soon have necessary infrastructure for a large-scale conjunctive use program. A large-scale conjunctive use plan could bring renewable surface water into the South Metro Region by utilizing:

- Interruptible raw water deliveries from existing transbasin diversion systems, Flaming

Gorge, or another new transbasin project.
- Deliveries only in wet periods of low-risk hydrologic and administrative conditions.
- Distribution to existing deep aquifer wells equipped for recharge.
- Dry period use of reliable, drought-proof deep aquifer production to provide water when surface yields are not available.
- No increase of risk to yields controlled by partner entities.
- Protecting the integrity of the Colorado River Compact under a working cooperative operation.

This concept has been investigated and described for over 15 years (if not longer) by key parties who would potentially be involved and is now worthy of serious consideration by the IBCC and the CWCB through Colorado's Water Plan. This concept is recommended for further investigation and a role as a practical and viable means to manage Colorado's statewide water resources. It should be vigorously pursued in subsequent stages of the Colorado Water Plan.