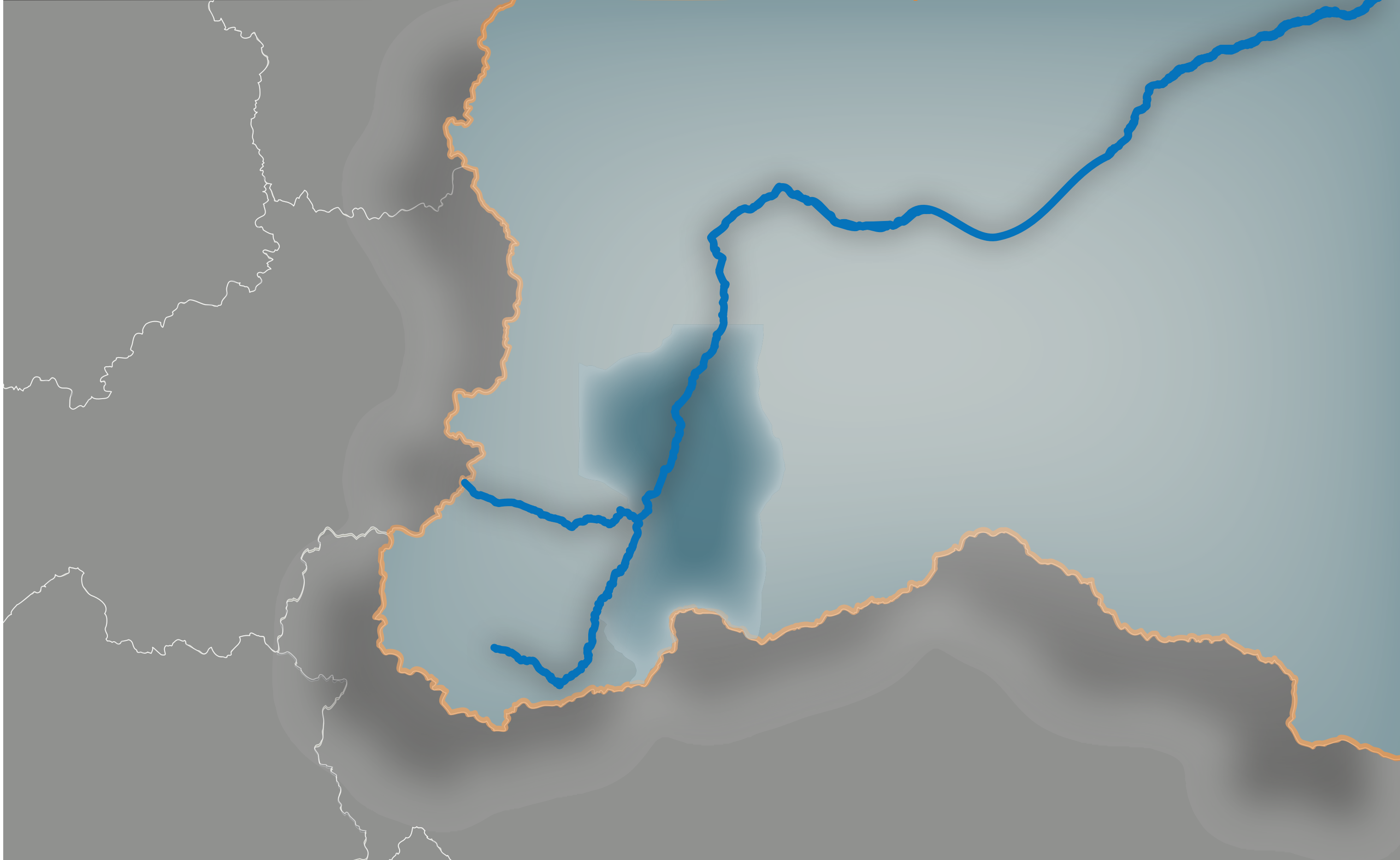

# South Platte Basin Implementation Plan

Metro Basin Roundtable

South Platte Basin Roundtable

April 17,
**2015**

HDR

West Sage
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# Acknowledgements

The South Platte Basin Implementation Plan (SP-BIP) could not have been developed over the past eighteen 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 BIP 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 the SP-BIP. The dedication and support of the people comprising this joint committee brought many important and diverse viewpoints to the 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 the 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 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 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, Craig Godbout and Brent Newman and to the State's consulting team on the Statewide Water Supply Investigation, led by CDM-Smith.

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# 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 SP-BIP, as a piece of this larger project, has been developed in a collaborative effort by the South Platte and Metro Basin Roundtables (BRTs). 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 Engineering and West Sage has been integrated in this document to form the 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 utilized multi-faceted communications and outreach tools to reach diverse stakeholders.

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# 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 |

| | |
|---|---|
| DBAS | Denver Basin Aquifer System |
| 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 |

# Executive Summary

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# S Executive Summary

## S.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 water needs including agriculture, oil and gas, tourism, environmental, recreational, industrial, and municipal uses, to differing regional outlooks about water management 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. 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
- A strong environment that includes healthy watersheds, rivers and streams, and wildlife.

Colorado's Water Plan tackles many water challenges faced by the state including:

- Addressing the projected municipal and industrial water supply gap that previous state reports indicate 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 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 long-standing interbasin and intrabasin challenges through cooperative dialogue and 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 Colorado's Water Plan should work to align state water projects, studies, funding opportunities, and other efforts. The Governor further directed that the Plan 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 working groups and ad-hoc panels to address specific issues that come to light in the process.

The first draft of Colorado's Water Plan was developed and submitted to the Governor in December 2014. The work of the Basin Roundtables and the Colorado Water Conservation Board continues to form the foundation of the Plan as it is finalized for submission to the Governor in December 2015.

## S.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 population.


**Figure S-1. Colorado River Basins**

The nine basin roundtables, as shown in Figure S-1, 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 factors affecting water in the South Platte River Basin, 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 river 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. Given the integrated water needs of the two designated "basins," however, the South Platte Roundtable and Metro Roundtable decided to develop a single Basin Implementation Plan for the South Platte River Basin.

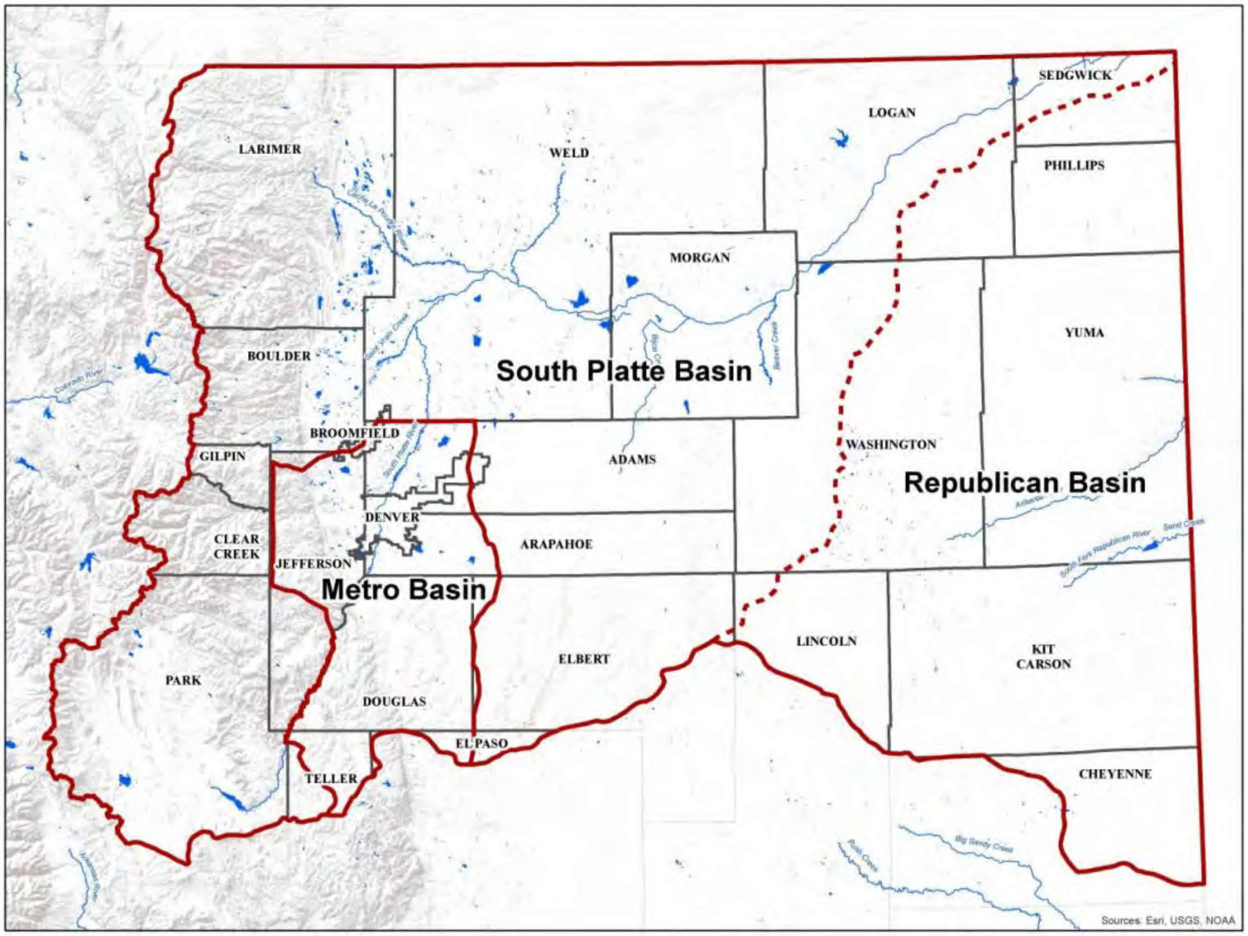


**Figure S-2. The South Platte Basin**

The South Platte Basin, as shown in Figure S-2, covers a large portion of Northern Colorado including 7 of the state's top 10 agricultural counties as well as major urban centers and diverse environmental and recreational attributes.

# S.3 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 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 basin's 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 regulatory agencies, elected officials, the business community, and the general public will bolster Colorado's ability to maintain 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.

## S.3.1 Limited Native Water Supply in the South Platte

The basin, in a typical year, has little unappropriated water available for new uses. Unappropriated flows in the basin often come in sporadic high peaks during wetter years, making the economics of building a reservoir to capture these supplies questionable because of the large carryover storage requirements. In the lower portion of the basin, where unappropriated flows exist in some years, efforts are underway to develop and use the water through conditional rights and existing projects. Unfortunately, unappropriated flows often occur in such infrequent and high magnitude peaks that they can not be captured and converted to reliable yield. 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 process known as “buy and dry” where agricultural water rights are willingly sold to municipalities to supplement their supply, resulting in the loss of irrigated agricultural lands. Although this method can help to address the projected water supply gap, there are negative economic and environmental impacts associated with “buy and dry”.

## S.3.2 Successive Use, Conservation, and Reuse

To address the basin’s water needs, water use efficiencies have been improved substantially along the South Platte, including successive use of water. The South Platte River is used and reused many times over to meet multiple needs. On average, South Platte Basin water is used seven times successively before it leaves the state at the Nebraska border. While this amount of successive use by downstream users is commendable, it can constrain the ability of water agencies to exchange water or to convey it back upstream, and can reduce the amount of water for downstream water users.

To establish water rights in Colorado, an emphasis is placed on the way that water is used. A key premise in Colorado water law is the concept of “beneficial use”, and specific water uses must be identified in order to receive a decree. These decrees also indicate whether a water right is limited to a single use or can specify the degree of reuse available. The limits placed on reuse of a water right frequently constrain or prevent water from being reused.

Additionally, because the South Platte relies heavily on return flows, expanded reuse is often simply a reallocation of water from agriculture to municipal uses, thus reducing the water available for agriculture, as well as environmental, and recreational purposes. Though only a limited amount of water is fully reusable under Colorado law, South Platte and Metro water providers are implementing innovative ways to reuse these supplies and are incorporating these projects as key components to meeting their long term needs.

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. In addition, indoor conservation measures can reduce the amount of available water for agriculture and environmental and recreational purposes by diminishing return flows the basin relies on. 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.

## S.3.3 Groundwater and Aquifer Storage and Recovery

Four types of groundwater are recognized in Colorado water administration: 1) tributary, 2) designated groundwater, 3) nontributary water outside of designated groundwater basins and 4) nontributary and not- nontributary Denver Basin bedrock water of the Dawson, Denver, Arapahoe, and Laramie - Fox Hills aquifers. Aquifer storage in the Denver Basin Aquifer System and conjunctive use of the alluvial aquifer and surface water present opportunities and challenges in addressing the future water needs of the South Platte River Basin.

The Denver Basin Aquifer System is an important, non-tributary, regional asset which is threatened by continuation or expansion of current withdrawal rates. The result is declining water levels and well productivity in large areas of the Aquifer. Conjunctive use of renewable supplies and the Denver Basin Aquifer System could provide promising opportunities for Metro municipalities to better manage water supplies through drought conditions and hydrologic variability. Additionally, new technologies for Aquifer Storage and Recovery (ASR) offer opportunities to use the Denver Basin Aquifer system for future water storage; however they require a reliable renewable resource to supply the recharge and provide strategies to meet EPA water quality requirements for injection water.

Alluvial aquifers (tributary groundwater) along the South Platte have been used historically by water users and continue to present opportunities for increased conjunctive use of surface and ground water supplies. However, numerous wells remain shut down or curtailed since 2006 due to a limited supply of affordable augmentation water in the central South Platte Basin to replace out-of-priority depletions from well pumping on other vested water rights.

In 2012, the Colorado Legislature passed HB-1278, entitled *Concerning the Authorization of a Study of The South Platte River Alluvial Aquifer*, directing the Colorado Water Institute (CWI) at Colorado State University to conduct a study of the South Platte alluvial aquifer. The HB1278 Study was completed in December 2013 and contained

**Types of Groundwater in Colorado Administration**

**Tributary groundwater** is underground water that is hydraulically connected to a stream system that influences the rate and/or direction of flow on that stream system.

**Designated groundwater** (1) is within the geographic boundaries of a designated ground water basin as created by the Ground Water Commission (2) natural course would not be available to or required for the fulfillment of decreed surface water rights. (3) Is in an area that is not adjacent to a continuously flowing natural stream where ground water withdrawals have been the principal source of water for at least 15 years prior to the first hearing on designating that basin.

**Nontributary groundwater** is “ground water, located outside the boundaries of any designated ground water basin in existence on January 1, 1985, the withdrawal of which will not, within 100 years, deplete the flow of a natural stream, at a rate greater than one tenth of one percent of the annual rate of withdrawal”.

**Nontributary and not nontributary of DBA** is ground water located within those portions of the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers that are outside the boundaries of any designated ground water basin in existence on January 1, 1985, the withdrawal of which will (not nontributary) and will not (nontributary), within one hundred years, deplete the flow a natural stream...at an annual rate of greater than one-tenth of one percent of the annual rate of withdrawal.

several recommendations. The South Platte Basin Roundtable formed a "Technical Committee" to investigate these recommendations and develop specific direction to resolve issues where appropriate. The Technical Committee's current focus is the development of a basin-wide groundwater monitoring network and the mitigation of localized high groundwater conditions in the La Salle/Gilcrest and Sterling areas.

### S.3.4 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 curtail water rights in Water District 64 that are junior to June 14$^{th}$, 1897 if flows at the Colorado-Nebraska state line drop below 120 cubic feet per second. 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 below.

The Republican River Compact between Colorado, Nebraska and Kansas places severe constraints on Colorado residents living and working in this basin. The Republican River Basin is physically distinct from the South Platte Basin such that the Rocky Mountain snowmelt feeding the South Platte River does not benefit the Republican River Basin. Rather, the Ogallala Aquifer, which spans eight Great Plains states, supplies the basin's agricultural economy. According to the 2012 USDA agricultural census, Yuma, Kit Carson, Phillips, and Washington counties are among the top ten agricultural producing counties in the state. In these areas, 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.

### S.3.5 Environmental Permitting Processes and Threatened and Endangered Species Recovery

Important species protection plans, namely the Platte River Recovery Implementation Plan (PRRIP), place restrictions on developing additional water supplies for the South Platte Basin. This three-state program protects 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 significantly constrain water planning in the South Platte. 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, some water supply agencies have been pursuing permits for new water supply projects for ten years or longer without clear resolution. The resulting delays and the extended timelines for permitting water projects, cause a significant financial burden for Colorado residents and result in costly risks for water providers due to the uncertainty of being able to meet their customers' future needs. Given the immense need for water in the basin, permitting processes for major water projects in the state must improve their turnaround times and the predictability of the process, while maintaining the needed environmental protections and mitigations.

### S.3.6 Environmental and Recreational Uses

Preservation and enhancement of the environmental and recreational aspects of the South Platte River is important to Colorado's economy and quality of life. Water is needed 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, skiing, flatwater and whitewater 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 attributes 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.

### S.3.7 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 approaching full development 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 while striving to maintain or enhance environmental and recreational values throughout the basin.

# S.4 Solutions for the South Platte

## S.4.1 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 tradeoffs 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 maintaining their right to use or sell vested property rights in the form of water rights, and concurrently offering potential new transactional methods to help lessen the associated impacts on others.

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.

### S.4.2 Strategic Overview

Although the two roundtables representing the South Platte Basin 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 Roundtables have utilized in determining solutions to meeting the projected municipal and industrial water supply shortfall are:

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 the state’s recent water planning program, a common phrase for an integrative approach is known as the “Four Legs of the Stool.” This approach recognizes that successful water planning in Colorado needs to utilize four specific tools; Conservation and Reuse, Identified Projects and Processes (IPPs), Agricultural Transfers, and new Colorado River supplies along with a strong supporting component of storage. The South Platte Basin Implementation Plan employs this approach.

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, and even enhancing these resources when possible. 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 be used to coordinate and manage highly variable yields expected from New Colorado River supplies. Additional Colorado River Basin supply would also augment existing municipal and industrial supply while providing environmental and recreational benefits. Front Range agricultural transfers coordinated with use of the Denver Basin Aquifer system 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 and reuse, and environmental and recreational programs. Implementing these solutions in a coordinated way can help 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 diverse sources of supply – from new Colorado River supplies and agricultural transfers – instead of risking Colorado's future on a single source, from either new Colorado River supplies or agricultural transfers.

# S.5 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. This process 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 eleven areas of focus, whose successful completion will be integral to meeting the basin's 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 hydrologic 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.

## S.5.1 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 decrease the M&I gap while unsuccessful IPPs will widen the gap even further, resulting in larger quantities of water being transferred from agricultural uses or new Colorado River supplies. Figure S-3 shows the IPP yield per county (with a 65 percent IPP success rate for the South Platte Basin and an 88 percent IPP success rate for the Metro Basin) as well as the remaining gap in each county after IPPs are implemented.

***Recommendations*: *Facilitate the implementation of IPPs both within and outside of the basin. Continue to support efforts to develop a basin-wide groundwater monitoring network, and to mitigate localized high groundwater.***

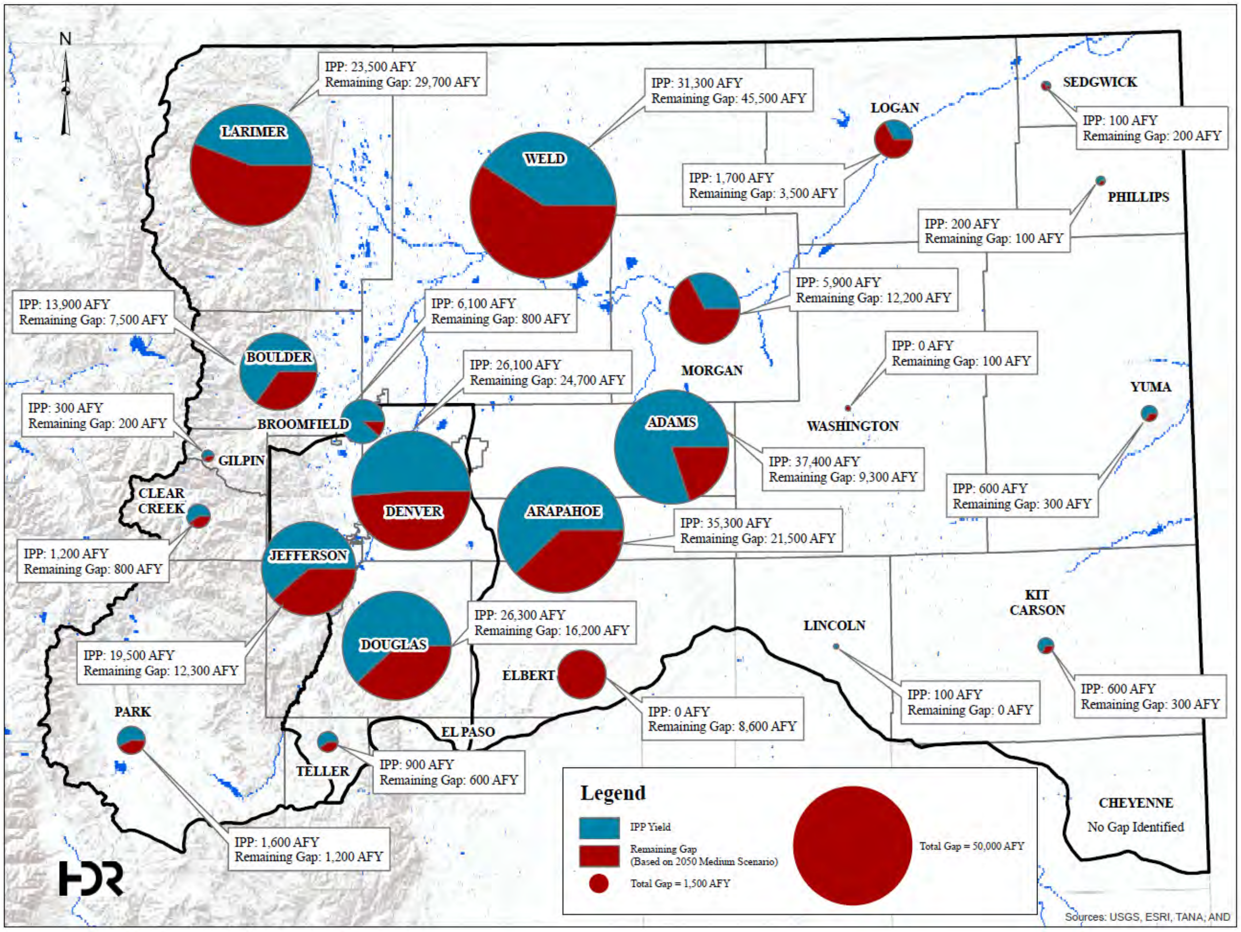


**Figure S-3. Remaining Gap by county (65% IPP Success Rate in the South Platte Basin and 88% IPP Success Rate in the Metro Basin)**

## S.5.2 Maintain leadership in conservation and reuse and implement additional measures to reduce water consumption rates

Already, the basin has reduced 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.

***Recommendations: Better coordinate water and land use planning to improve water use efficiency. Implement rate design improvements to require more efficient plumbing fixtures, appliances, and landscaping. Implement additional reuse where practicable.***

## S.5.3 Maximize use and effectiveness of native South Platte supplies

To more effectively utilize native South Platte supplies, the Roundtables suggest the development of multipurpose water storage and conveyance infrastructure, as well as new methods to more effectively utilize tributary and nontributary groundwater. Another critical aspect of utilizing existing supplies will be the exploration of integration of existing South Platte Water Supply Systems on a willing agency basis.

***Recommendations: Develop new, in-basin, multipurpose water storage and conveyance mechanisms, explore further integration of South Platte water supply systems to enhance yield and reliability, and develop methods to more effectively use groundwater. Encourage surface water and groundwater availability/hydrologic modeling to provide more detailed and reliable estimates of water availability.***

## S.5.4 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 delays 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 land in order to transfer its historical consumptive use (CU). The solutions described in the South Platte Basin Plan are not aimed at further complicating or restricting this process, but rather developing other alternatives. 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 producer's fields as "reservoirs" holding water supplies for times of shortage. Much is still to be evaluated 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.

***Recommendations: Continue to study water sharing practices and adjust the water court process to encourage water sharing practices while protecting the vested rights of water rights holders. Continue to support measures to maintain***

***the economy and agricultural production of the Republican River Basin and long-term compliance with the Interstate Water Compact. Finally, continue compliance with the South Platte Compact and the PRRIP.***

## S.5.5 Protect and enhance environmental and recreation attributes

There are important environmental and recreational attributes within the South Platte Basin that must be proactively considered when addressing water supply needs. Some environmental and recreational attributes in the basin are impaired by the current strategies used to meet water demands, and in these areas habitat and streamflows must be enhanced or maintained to support these attributes. The efforts being undertaken to meet the supply gap may potentially impact these attributes by affecting flows in streams, plant and animal habitat, as well as water quality. Reduced stream flow in focus areas has the potential to expand those areas requiring protection. Additional storage in the basin has the potential to impact streamflows and to disturb wildlife habitat. Opportunities to align environmental and recreational uses with the projects needed to meet the supply gap do exist, however. If cooperative operational agreements can be put into place, there is 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 benefits and impacts on 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.

***Recommendations: Fill existing data gaps regarding protection of environmental and recreational attributes in order to better understand the adequacy of existing and future protections. This should be done for all South Platte focus Areas where opportunities arise for new projects. Additionally, provide sustainable and reliable funding for data recording and reporting equipment to assist with environmental and recreational projects.***

## S.5.6 Simultaneously advance the consideration and preservation of new Colorado River Basin supply options

The Metro and South Platte Roundtables encourage strong consideration and preservation of the ability to use Colorado's entitlement under the Colorado River Compact as we pursue other strategies to meet our water demands. Investigating, preserving, and developing Colorado's entitlement to Colorado River supplies is beneficial to the state's economic, social, political and environmental future. This may involve large state-level water projects, or small level projects, each with comprehensive West Slope water supply and environmental and recreational components. The Roundtables support the Conceptual Framework developed by the IBCC (and as outlined in Colorado's Water Plan) as the means whereby new Colorado River Basin supply options could be investigated and potentially developed.

***Recommendations: Promote additional conceptualization analysis of shared development of additional Colorado River Basin supplies. Consider potential criteria for "State Water Projects" including benefits and challenges.***

## S.5.7 Promote Multi-Purpose Storage Projects that Enhance other South Platte Basin Solutions

Stream flows vary widely in the South Platte Basin, both year-to-year and seasonally. Storing water when it is abundant for use in times of shortage is a vital weather management strategy for a basin with diverse water needs. Storage has historically been important for managing water in the South Platte, and today's water managers understand that storage in the South Platte Basin is a vital means to provide water security for the vast agricultural, municipal and industrial, recreational and environmental needs of the basin. Further, additional storage is essential to implement the six previously described elements of the Basin Implementation Plan.

***Recommendations: The Metro and South Platte Basin Roundtables strongly advocate for the development of additional surface and groundwater storage, further research of aquifer storage and recovery (ASR), and investigation into additional off-channel storage and reservoir sites in the basin. Additionally, they encourage the consideration of alternatives to "State Water Projects" such as regional collaboration on and financing of water projects.***

## S.5.8 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 impact 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.

***Recommendations: The South Platte and Metro Roundtables recommend continued analysis of the potential for back-up supply, such as for east slope interruptible supply agreements. They also encourage additional research to disaggregate the basin's M&I supply gap to gather more specific data on the quantity, time, and geography of the gaps within each county.***

## S.5.9 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.

***Recommendations: Design and implement an intensive education, participation and outreach program designed to generate a lasting baseline of public awareness and support.***

### S.5.10 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.

***Recommendations: Continue research and development of new strategies to address both the technical and regulatory constraints associated with treating low quality water and disposing of waste including direct potable reuse (DPR) and indirect potable reuse (IPR), developing an appropriate regulatory framework for these technologies, and promoting and monitoring research on relevant technologies to advance these objectives.***

### S.5.11 Advocate for improvements to federal and state permitting processes

Cities throughout the South Platte Basin struggle 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 near and long term supply gaps while still maintaining regulatory compliance and environmental protections will require improvements to the permitting processes for supply projects. This begins with approvals for planned supply projects including IPPs to meet the nearer term supply gaps as well as other supply projects expected over 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.

***Recommendations: Identify methods to improve the approval process by increasing efficiencies in agency coordination, making changes to applicable statutes and regulations, and supporting the formation of a task force to study and implement ways to improve the permitting process for water supply projects.***

## S.6 Summary

The South Platte Basin faces a cadre of unique challenges in planning for its future water needs. It hosts some of the largest population centers in the state as well as several of the leading economic sectors. As such, the South Platte Basin faces the largest projected regional water shortfall for municipal, industrial and agricultural uses in the future. It also has wide-ranging environmental and recreational attributes important to the basin, the state, and the country. From Rocky Mountain National Park and the most heavily visited state parks, to the important endangered species recovery goals of the Platte River Recovery Implementation Program, the protection of non-consumptive water needs and enhancement of water-based ecosystems must also be fully considered in planning our future.

The South Platte Basin Implementation Plan offers a strategy to combat our water supply shortfalls by utilizing diverse, integrated supply solutions to chart a course that meets the projected water needs of the South Platte Basin as it continues to develop. This plan acknowledges the unique challenges, opportunities, and tradeoffs in the South Platte Basin, and then leverages these challenges into eleven 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 its many regions and 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 have 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.

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# 1

# Basin Goals and Measureable Outcomes

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# 1 Basin Goals and Measurable Outcomes

## Key Points

1. 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.
    - The South Platte Basin is home to diverse ecological and recreational attributes that are extremely important to residents' quality of life
2. 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 Basin Options
3. 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 Basin Supplies
    - Environmental and Recreational

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 measurable outcomes.

## 1.1 Basin Overview

The combined South Platte and Republican River Basins (Figure 1-1) 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**

### 1.1.1 South Platte River Basin

The South Platte River Basin incorporates the areas of both the South Platte Basin Roundtable and Metro Roundtable (Figure 1-2). 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 South Platte Basin's Front Range 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 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 northeast across Colorado's High Plains. The western portions of the basin contains montane and subalpine areas that are mostly forested in contrast to the High

Plains of the eastern basin which consists of 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.

**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 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 nontributary groundwater aquifers to supplement supplies. The South Platte Basin's surface water diversions average approximately 4.0 million acre-feet annually, with an additional annual average of 450,000 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 efficient use and reuse of water supplies across the basin. On average, only 400,000 acre-feet leave the Basin.

The South Platte River Compact of 1923 (South Platte Compact) established 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 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 businesses and industries within the South Platte Basin drive the majority of the state's overall economy. Additionally, agricultural production is the highest among basins across the State of Colorado. The Basin supports a wide range of ecological systems and important water-dependent recreational and ecological attributes. Coloradoans and tourists regularly enjoy the recreational opportunities provided by the basin's many environmental features. Willing water transfers from the agricultural sector to the municipal/industrial (M&I) sector have proven reliable, but may be unsustainable if Colorado and the South Platte value maintaining a diverse economy as populations grow. The challenge of preserving the M&I, agricultural, and recreational economies, and upholding 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 an important 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 linked to irrigated lands. Loss of irrigated agricultural lands will negatively impact local economies and the State 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 for the benefit of all Coloradans.
- **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" mechanism to supply water to the South Platte will include additional Agricultural Transfers, greatly increasing the negative impacts as described above.
- **Reliance on Nontributary Groundwater**—The dearth 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. Major economic and population growth in these counties coupled with the lack of surface water supplies, has led to 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 is critical to meeting future water supply needs. These projects will supply much-needed water to project participants. Failure to complete these projects will result in water shortages, additional Agricultural Transfers, or additional water diversions from the Colorado River Basin.
- **Aquifer Storage and Recovery in the Denver Basin Aquifer**—Use of surface water and nontributary aquifers for storage offers opportunities to expand sustainable water use. Aquifer storage is generally considered to have fewer environmental impacts and water stored in nontributary aquifers avoids evaporative losses. Aquifer storage poses control and administrative issues that will need to be addressed. ASR can be an effective management tool to supplement existing supplies of entities depending on the Denver basin.

- **Conjunctive Use of Alluvial Groundwater –** Conjunctive use of surface water and alluvial groundwater also offers opportunities to maximize use of native South Platte supplies. It has many benefits including drought protection, water use efficiency, and the control of shallow groundwater levels and consequent soil salinity. Currently, South Platte alluvial conjunctive users have made significant progress in developing augmentation plans that increase conjunctive use, and opportunities exist for implementing additional measures that increase conjunctive use. The challenge lies in sustainably utilizing alluvial groundwater at a higher level without injuring senior rights.
- **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 important to the quality of life for many South Platte Basin residents. The desire for irrigated urban landscape can 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, whitewater boating, etc.), city green ways, skiing, flatwater boating reservoirs, wetlands and open space. These opportunities are extremely important to Colorado's tourism economy and residents' quality of life. 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, which indicates the importance of environmental and recreational based tourism to the basin.

### 1.1.2 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 over 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 eight Designated Ground Water Basins - Northern High Plains, Kiowa Bijou, Southern High Plains, Upper Black Squirrel Creek, Lost Creek, Camo Creek, North Kiowa Bijou, and Upper Crow Creek – 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 Designated Ground Water Basin and eight Ground Water Management Districts as shown in Figure 1-3.

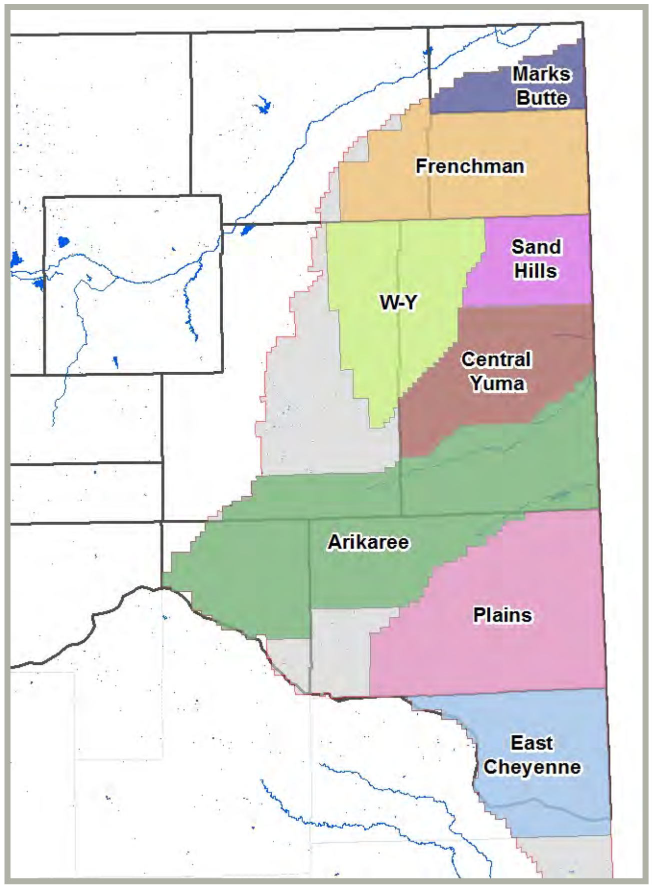



**Figure 1-3. Republican Basin Ground Water Management Districts**

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 achieve this, the two South Platte Basin Roundtables (Metro Basin Roundtable and South Platte Basin Roundtable Figure 1-4), 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).

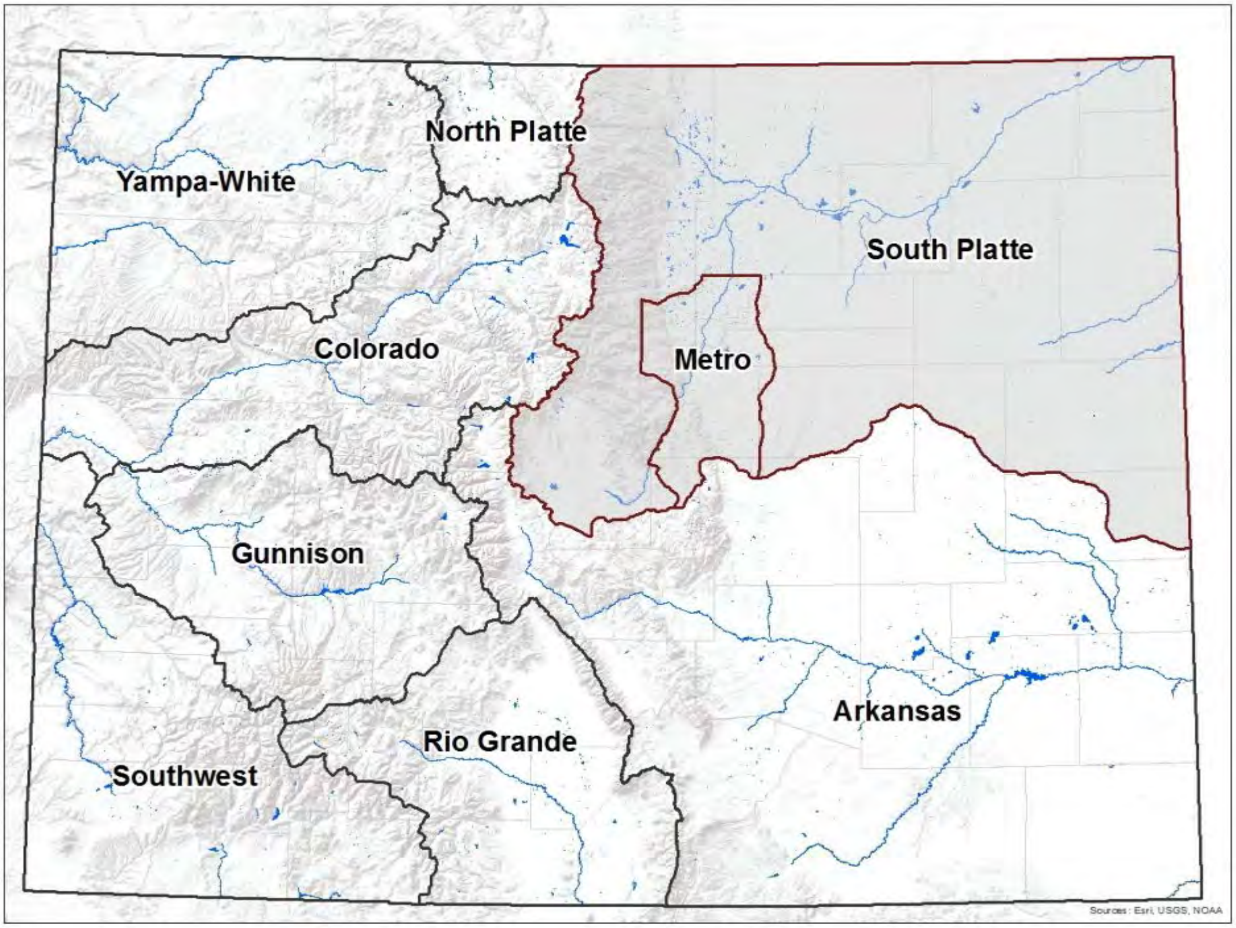



**Figure 1-4. Colorado Map of Basin Roundtables**

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 have collaborated closely with each other, the Roundtables and the CWCB. The two consulting teams also coordinated public outreach programs to encourage broad input and to simplify the ways in which diverse interests participated in the development of the SP-BIP.

Governor Hickenlooper’s May 14, 2013 Executive Order (Figure 1-5) 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***

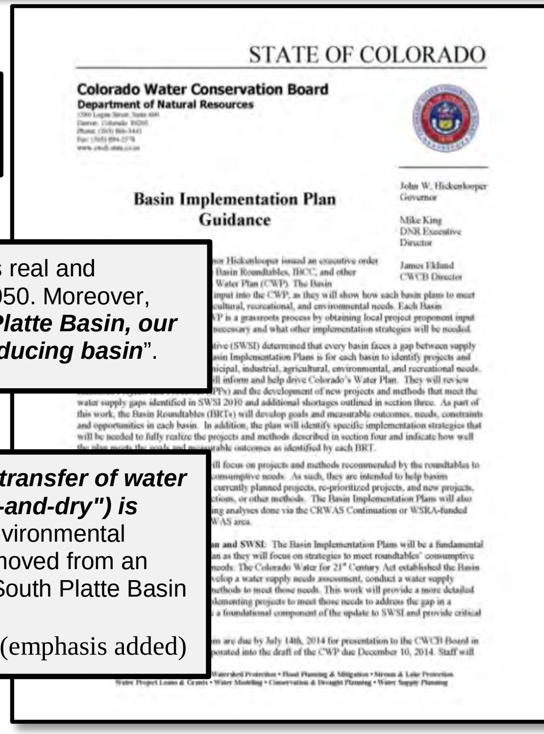
***The Executive Order calls for collaboration and specifically cites the water needs of the South Platte Basin***

"… 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

Colorado Water Conservation Board
Department of Natural Resources

Basin Implementation Plan
Guidance

John W. Hickenlooper
Governor

Mike King
DNR Executive
Director

James Eklund
CWCB Director

**Figure 1-5. Governor Hickenlooper's Executive Order**

As the Roundtable's mobilized throughout the State to develop their Basin Implementation Plans they were 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 submitted on April 17, 2015 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, as shown in Figure 1-6, was adopted by the CWCB in response to the dates in the Executive Order requires that the Final SP-BIP be submitted by April 17,

2015. Since the submission of the Draft SP-BIP in July 2014, the South Platte and Metro Roundtables have focused on additional efforts with respect to public outreach, technical analysis of surface water availability in the South Platte Basin, and the development of conceptual projects and methods for meeting the future water supply gap within the Basin. The results of these efforts have been incorporated into this Final SP-BIP. Another 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.

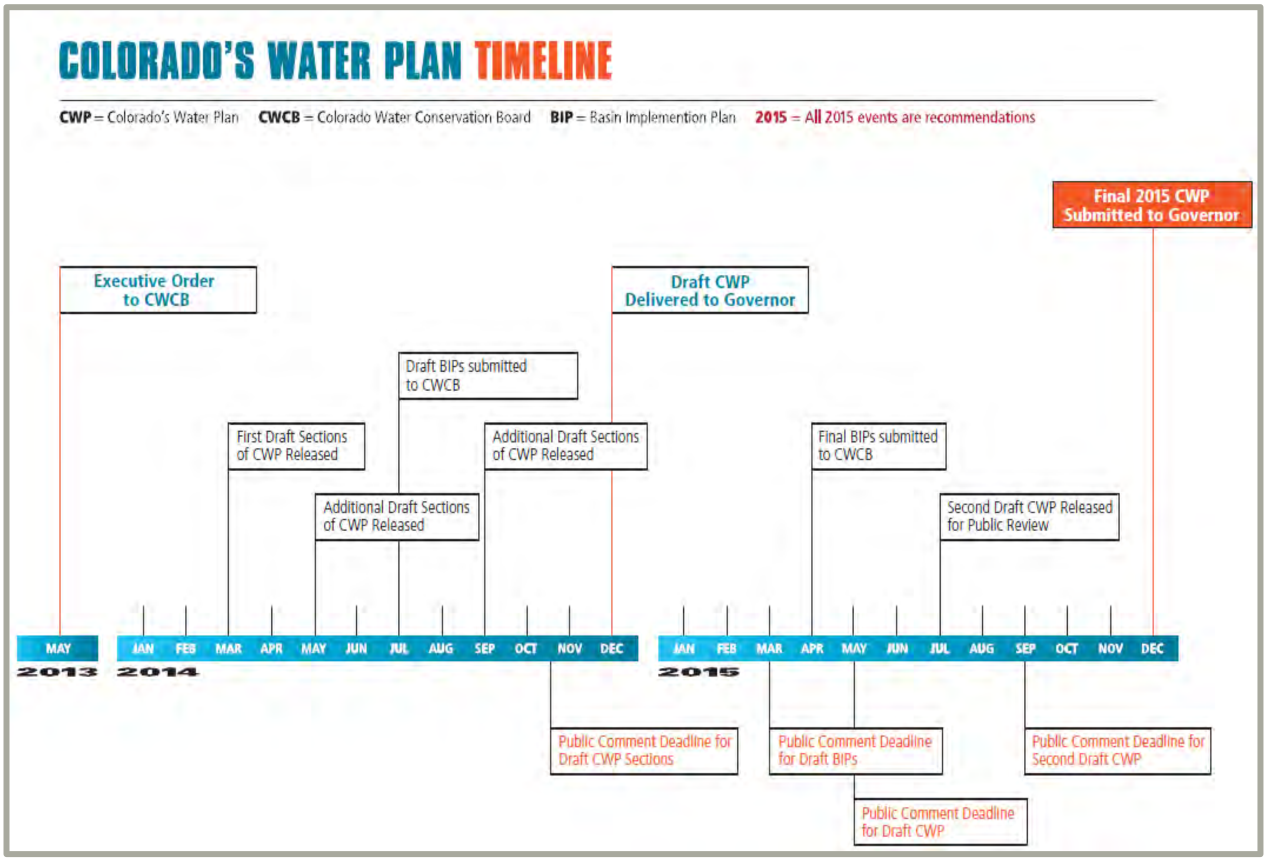



**Figure 1-6. Colorado's Water Plan Timeline**

## 1.3 Public Input Guides the South Platte Plan

An energetic and on-going outreach program provided input from all water-use sectors and areas throughout the South Platte River Basin. Throughout the development of the SP-BIP roundtables maintained a commitment to providing opportunities for input from all water users within the basin.

During the development of the Draft SP-BIP the first phase of public outreach included five sub-basin Stakeholder meetings initiated soon after contracts were executed with the consulting teams in mid-January. These meetings were to identify issues, data sources and methodologies in time to make adjustments as needed for the draft SP-BIP development. Additionally, during the development of the draft more than 26 meetings were conducted throughout the basin including SP-BIP presentations at each of the monthly Roundtable meetings.

During the development of the Final SP-BIP, six additional public meetings were held as components of roving Roundtable meetings. These meetings were held in conjunction with the regularly scheduled South Platte and Metro Basin Roundtable meetings. Each meeting was held at a unique location (Figure 1-7) and publicized through local media. The meetings included an overview of the SP-BIP and a 50-minute facilitated question and answer period, along with distribution of surveys to meeting participants. Meeting locations during the Final SP-BIP development included Loveland, Westminster, Sterling, Denver, Evergreen, and Highlands Ranch.

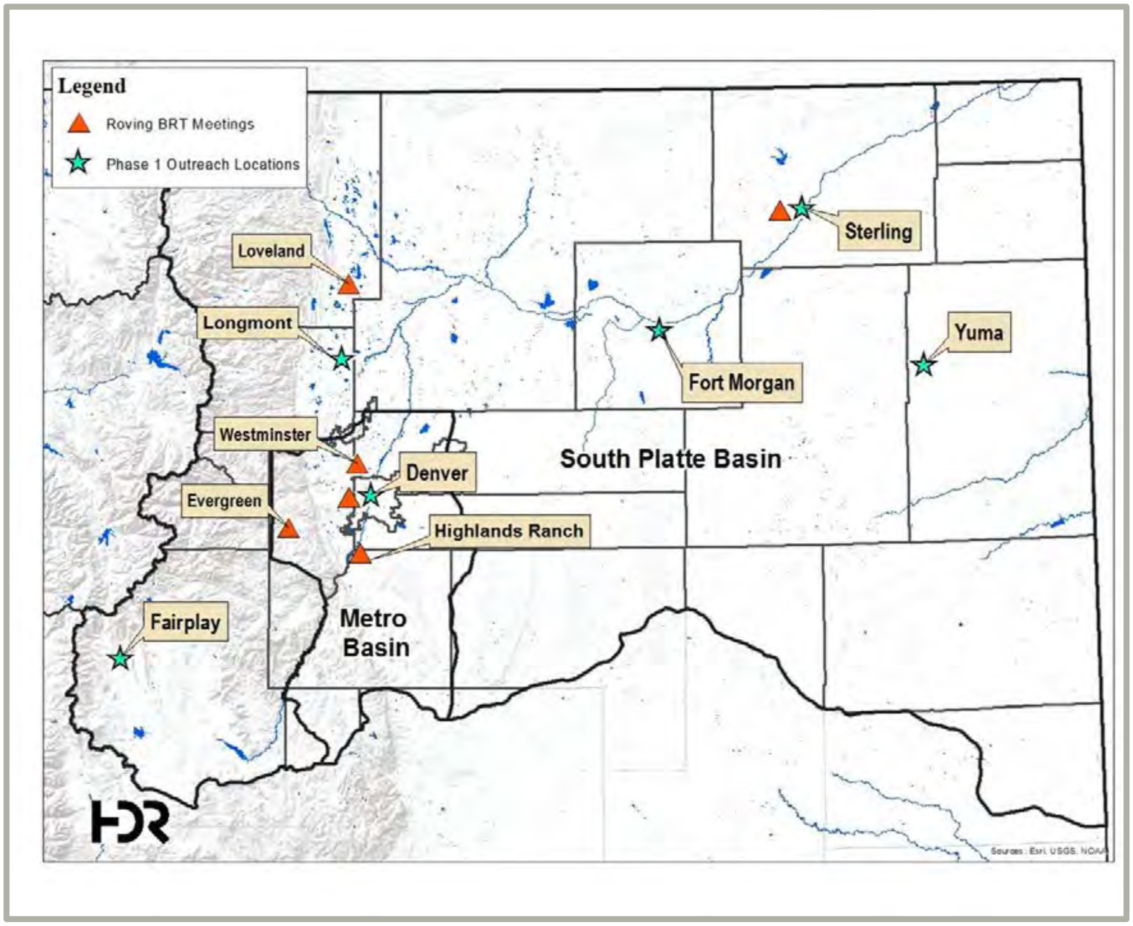



**Figure 1-7. Stakeholder Meeting Locations for the South Platte and Republican River**

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

- The SP-BIP Website – online meeting consisting of a two iterations of an interactive, web-based presentation and public response program. The online meetings was located at www.southplattebasin.com, and allowed users to access overview information, directed the public to additional information including the Draft SP-BIP, and provided an opportunity for users to comment directly on the meeting and other available content. The first meeting iteration was developed and utilized during the development of the Draft SP-BIP. It included video presentations from members of the Roundtables, Roundtable meeting information, and links for users to provide comments. The second iteration provided the Draft SP-BIP for review and comment, information about the Roundtable meetings, and included an animated video.

- SP-BIP Animated Video – an animated video was created and housed within the online meeting. The video content was shareable on social media through vimeo, youtube, facebook, and other venues using buttons. The video content described the process of developing the SP-BIP, included descriptions of the main issues within the basin and the proposed solutions, and called on users to provide input for the plan.

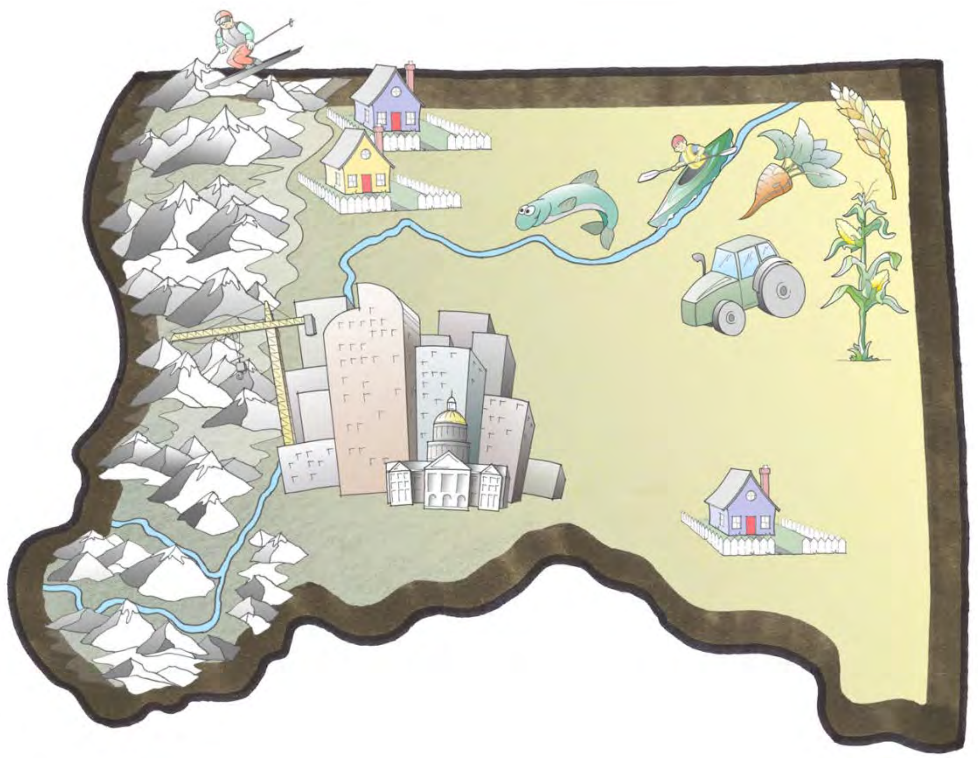


**Figure 1-8. Image from animated South Platte video**

- 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.
- Online Town Halls - During the development of the Final SP-BIP two online town halls were held to reach a broader population within the basin and state. These town

halls were hosted through an online webinar on February 03, 2015 at 7:30 pm and on February 05, 2015 at 11:00 am.

- 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.
- Status calls – During the development of the Draft SP-BIP and Final SP-BIP on a weekly basis or bi-weekly basis, respectively, 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 included outside environmental and recreational representatives, to promote transparency and obtain timely input and guidance given the short timeframe for developing the Draft SP-BIP.

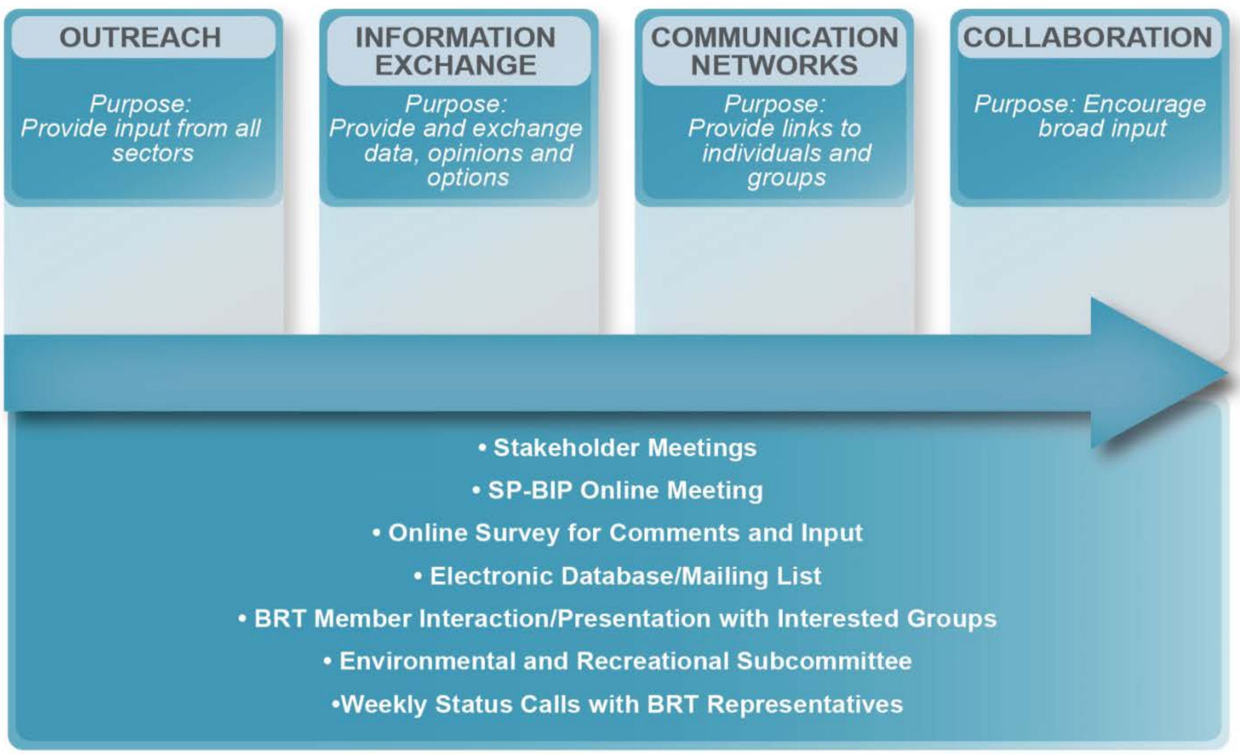



**Figure 1-9. Public Involvement Mechanisms**

## 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 large portions of the agricultural, recreational, and tourism sectors of the State's economy. Eighty percent of Colorado's population and job growth is forecasted be on the eastern slope (Figure 1-10). Given the interdependence of the State's regional economies, it is critical to Colorado's prosperity that the water supply gap be filled throughout the state.

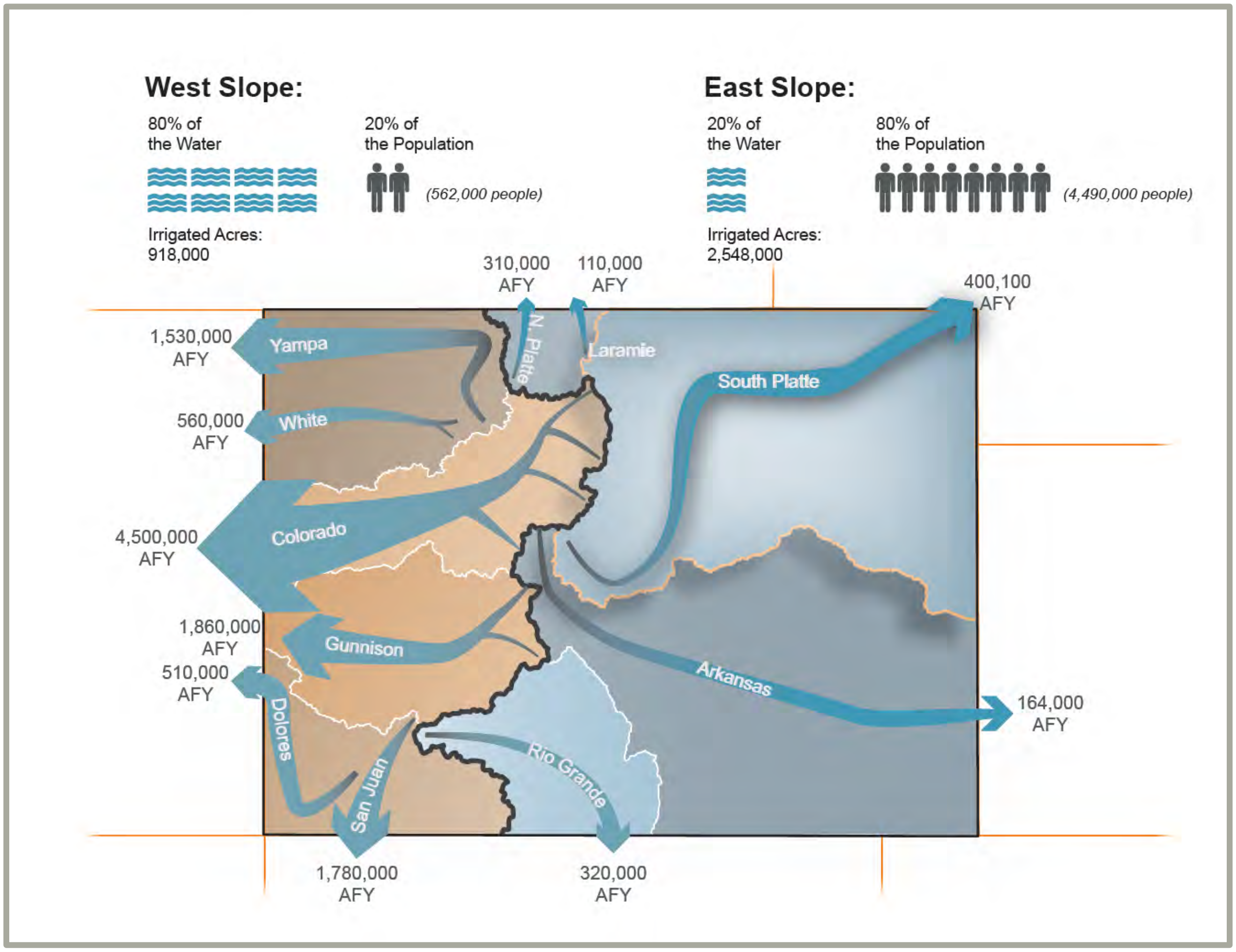



**Figure 1-10. Colorado Population, Irrigated Acres and Flows**

In addition to economic interdependency between the State's river basins, there are many other important inter-relationships impacting our approach 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 that new legislation 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 must be handled consistently across river basins to maintain the authority of the State's water administration. 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 how water supply solutions are implemented.

- 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 take into account that water diversions and uses are interconnected and interdependent 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 take great pride in our State. Colorado is renowned worldwide for its natural beauty and hospitality. Its residents share a culturally rich heritage, founded in western individualism and pragmatism. As a result, Coloradoans seek practical and collaborative solutions that respect this culture, especially in federal legislative and executive agency interactions. These cultural traits tend to unite Coloradoans across river basins, allowing them to relate to each other's challenges and potential solutions. Moreover, as the state's demographic trends show, regional affiliations are increasingly fluid with offspring of West Slope residents increasingly finding employment and raising 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 (Figure 1-11). 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 1-11. 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 medium population growth and medium project implementation rates, the water supply shortage could be even greater than 196,000 acre-feet per year (Figure 1-12). This east slope municipal water supply gap is about 75% of the projected statewide municipal supply gap (SWSI 2010).

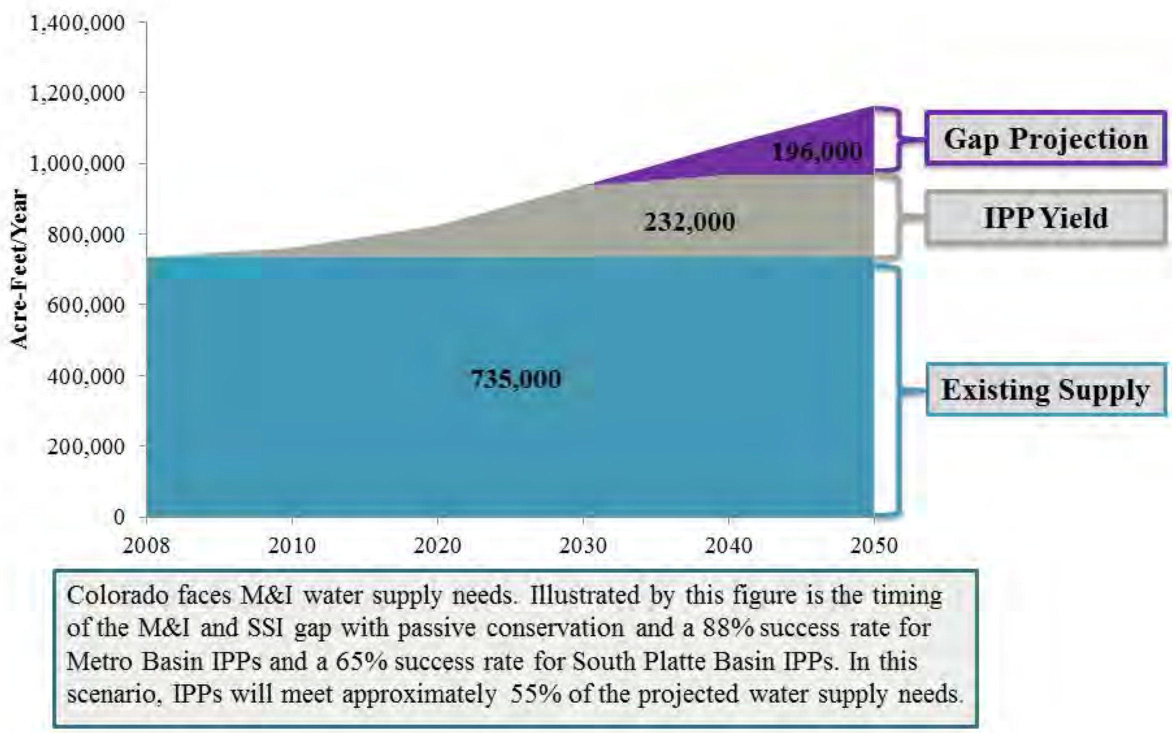



**Figure 1-12. South Platte Metro Basin Medium Scenario M&I and Self Supplied Industrial (SSI) Gap Projection**

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 nontributary groundwater, the consumptive use component of changed native water rights, and transbasin imports (with notable exceptions such as the Colorado-Big Thompson project for which subsequent use is not permitted) is possible but may 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 (Figure 1-13).

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, additional development of supplies native to the South Platte River Basin is unfortunately limited to wet years. 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.

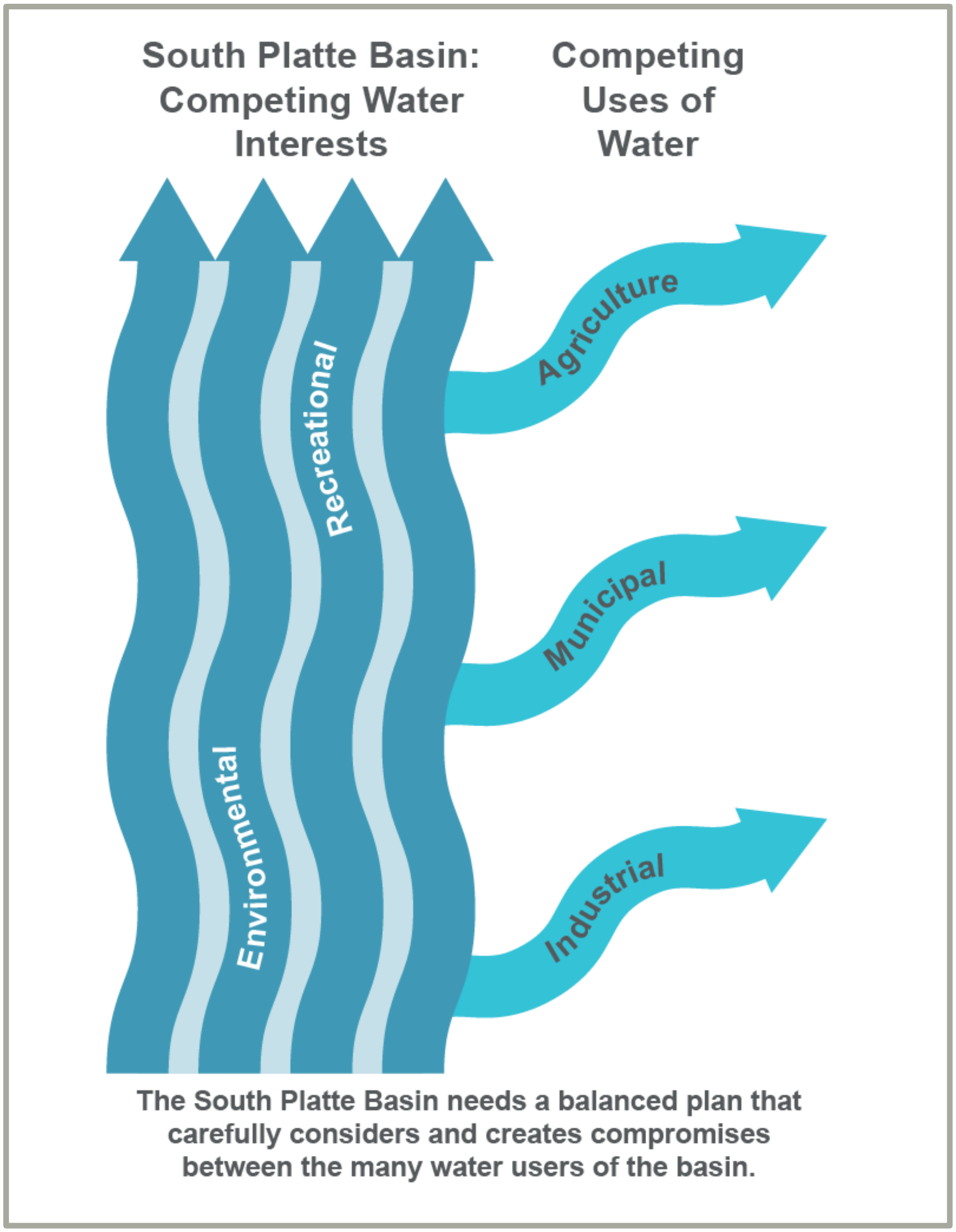



**Figure 1-13. Creating a Balanced SP-BIP**

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.
7. 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).

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, one or more state water projects.

## 1.7 Approach and Overarching Themes

After reviewing the documents above and considering the various conversations with South Platte Basin stakeholders, it seems that one of the key overarching messages that should 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. (Figure 1-14)

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 many factors that support 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.

Solutions for reducing the basin's water supply gaps need to be ***pragmatic, balanced and consistent with Colorado water law and property rights***, and is a theme expressed in many of the BRT documents and communication. 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

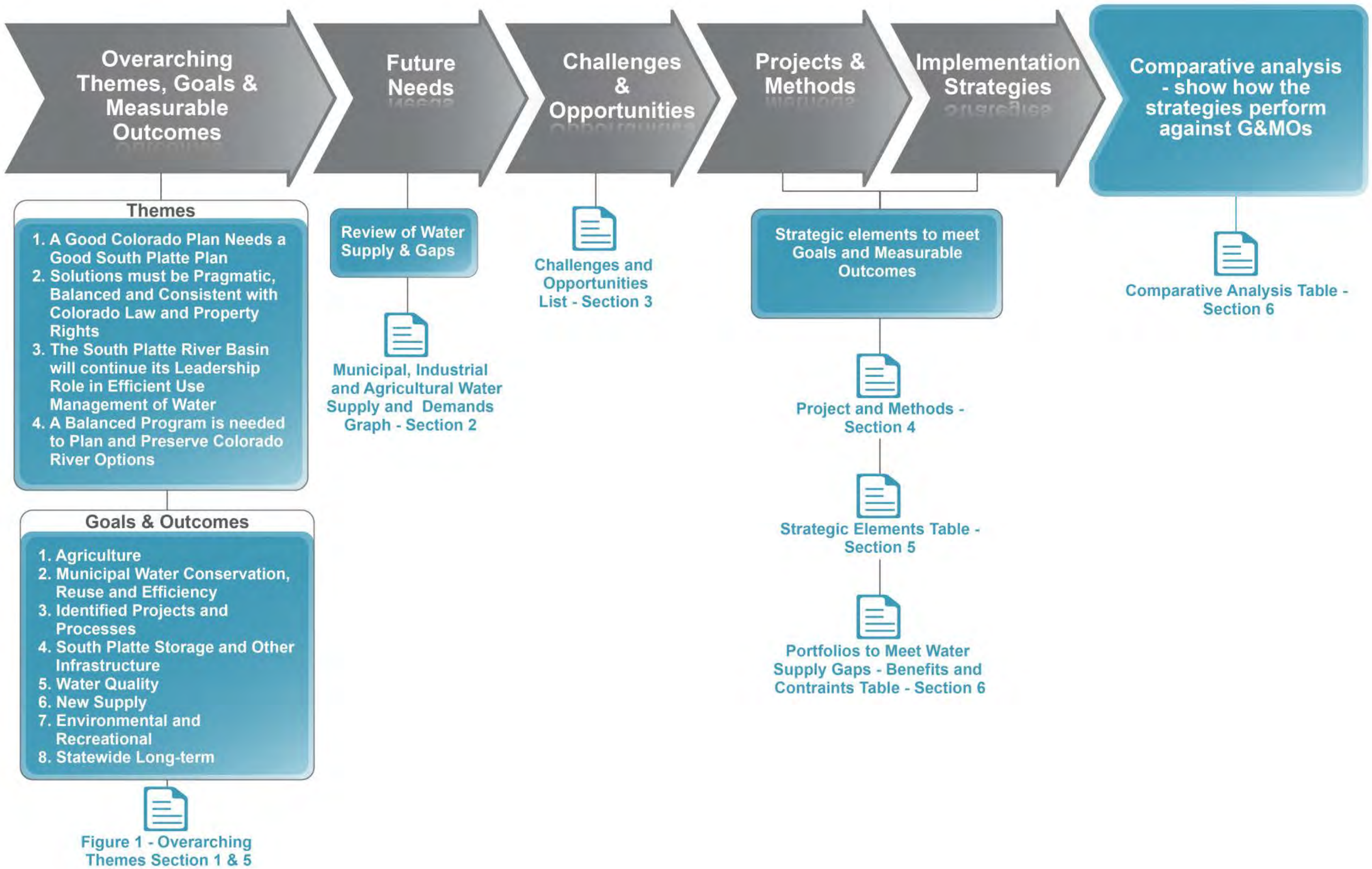



**Figure 1-14. Basin Implementation Plan Development**

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 Colorado River 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.*** This awareness is critical 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 goal 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 as shown in Figure 1-15 on the next page.

**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 Basin Options -*** A balanced program to plan and preserve options to responsibly develop Colorado River Basin 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 1-15. 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 Measurable Outcomes presented in the next section.

## 1.9 Goals and Measurable Outcomes

The CWCB has requested that each BRT prepare and submit Goals and Measurable Outcomes (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.***

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

[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.

3. Identified Projects and Processes
4. South Platte Storage and Other Infrastructure
5. Water Quality
6. New Colorado River Basin Supplies
7. Environmental and Recreational
8. Statewide Long-term

Goals and Measurable 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.

### 1.9.1 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.

*Measurable Outcome (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.

*Environmental and Recreational (E&R) MO#1* – Encourage maintenance of existing wetlands in focus areas associated with agricultural lands.

*E&R MO #2* - Ensure agricultural dry-up and alternatives take into consideration environmental and recreational focus areas and attributes.

### 1.9.2 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* –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.

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

### 1.9.3 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.*

*E&R MO#1* - Encourage multi-purpose projects that also provide environmental and recreational considerations.

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

### 1.9.4 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 and alluvial recharge) storage.

*E&R MO #1* - Encourage multipurpose projects that provide environmental and recreational considerations.

*E&R MO#2* - Take into consideration environmental and recreational attributes when considering Storage and Other Infrastructure projects and methods.

### 1.9.5 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.

*E&R MO#1* – Monitor, protect and improve watershed water quality and identify and document progress and improvements.

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

### 1.9.6 New Colorado River Basin 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* – Through the IBCC, negotiate a conceptual agreement or framework 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.

*E&R MO#1* - Encourage multipurpose projects that provide environmental and recreational considerations.

### 1.9.7 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.

*E&R 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 environmental and recreational 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.

iv. Develop tools and methodologies to adequately assess what is needed to maintain or increase aquatic, riparian and wetland habitats throughout the basin

*E&R 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.

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.

vi. Develop tools and methodologies to adequately assess what is needed to maintain or improve recreational opportunities derived from ecosystems throughout the basin.

*E&R 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.

v. Develop tools and methodologies to adequately assess what is needed to protect, maintain or improve conditions of aquatic, riparian and wetland habitat throughout the basin.

### 1.9.8 Statewide Long-term Goals

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

*Goal* – 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 nontributary groundwater, etc.

*Goal* – 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.

*Goal* – Meet Colorado's Environmental and Recreational Needs through the goals and outcomes discussed above.

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

# 2

# Future Water Needs: Municipal & Industrial, Agricultural, Environmental & Recreational

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# 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 recreational 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 specified 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 River 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 | | |
| ***Water Supply Needs*** | | | | | | | | | |
| **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

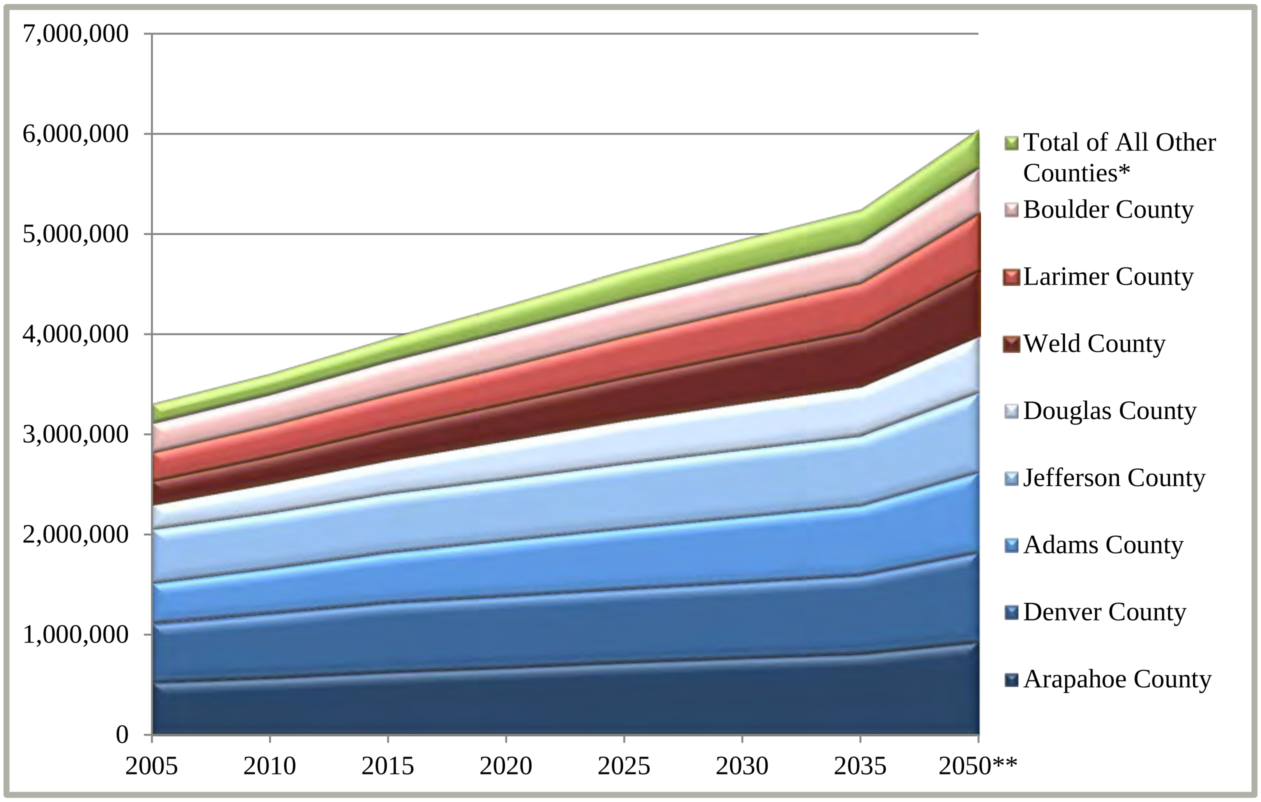


**Figure 2-1. South Platte and Metro Basin Population Projection by County through 2050**

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 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 | 59,000 | 77,000 | 86,000 | 89,000 | 97,000 | 69,000 | 77,000 | 80,000 | 88,000 |
| Cheyenne | 58 | 68 | 72 | 80 | 90 | 61 | 64 | 72 | 82 |
| Clear Creek | 2,400 | 3,800 | 4,300 | 4,700 | 5,300 | 3,600 | 4,000 | 4,400 | 5,000 |
| Gilpin | 450 | 700 | 850 | 1,100 | 1,300 | 550 | 680 | 900 | 1,200 |
| Kit Carson | 3,100 | 3,600 | 4,000 | 4,300 | 4,700 | 3,400 | 3,800 | 4,100 | 4,500 |
| Larimer | 59,000 | 95,000 | 110,000 | 110,000 | 120,000 | 86,000 | 97,000 | 100,000 | 110,000 |
| Lincoln | 220 | 280 | 310 | 340 | 370 | 260 | 290 | 320 | 350 |
| Logan | 7,900 | 12,000 | 13,000 | 14,000 | 15,000 | 11,000 | 12,000 | 13,000 | 14,000 |
| Morgan | 7,800 | 13,000 | 14,000 | 15,000 | 16,000 | 12,000 | 14,000 | 14,000 | 16,000 |
| Park | 2,200 | 4,900 | 5,300 | 5,500 | 5,900 | 4,400 | 4,700 | 4,900 | 5,200 |
| Phillips | 2,000 | 2,200 | 2,300 | 2,400 | 2,700 | 2,100 | 2,200 | 2,300 | 2,500 |
| Sedgwick | 950 | 1,100 | 1,200 | 1,300 | 1,300 | 1,000 | 1,100 | 1,200 | 1,300 |
| Teller | 10,000 | 16,000 | 17,000 | 19,000 | 20,000 | 14,000 | 15,000 | 17,000 | 19,000 |
| Washington | 1,700 | 1,800 | 1,900 | 2,000 | 2,200 | 1,700 | 1,800 | 1,900 | 2,100 |
| Weld | 53,000 | 120,000 | 130,000 | 140,000 | 150,000 | 110,000 | 120,000 | 130,000 | 140,000 |
| Yuma | 3,200 | 3,800 | 4,000 | 4,300 | 4,700 | 3,500 | 3,700 | 4,000 | 4,500 |
| ***Metro Basin*** | | | | | | | | | |
| Adams | 69,000 | 110,000 | 120,000 | 130,000 | 140,000 | 98,000 | 110,000 | 110,000 | 120,000 |
| Arapahoe | 100,000 | 150,000 | 170,000 | 170,000 | 190,000 | 140,000 | 150,000 | 160,000 | 170,000 |
| Broomfield | 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 | 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.

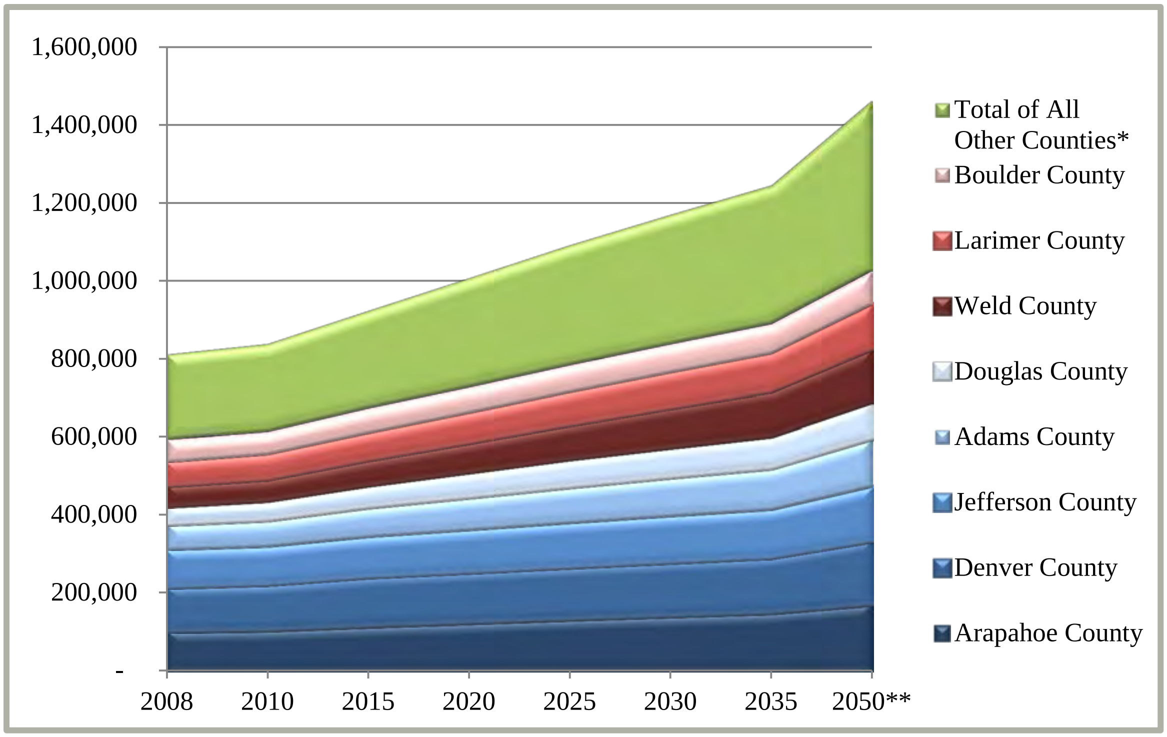


**Figure 2-2. Metro and South Platte Basin M&I Water Demands with Passive Conservation**

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.

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

**Reference Document**

The following discussion is extracted from:

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

Minimal energy development was predicted within the Metro or South Platte Basin during the SWSI 2010 assessment. Water management and drought planning are a major concern of energy producers, however, because the availability of water is critical to their industry. 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.

As the population continues to grow in the South Platte Basin, citizens will continue to expect reliable and affordable electricity. A recognition of the need for water conservation continues to garner 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, 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.

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

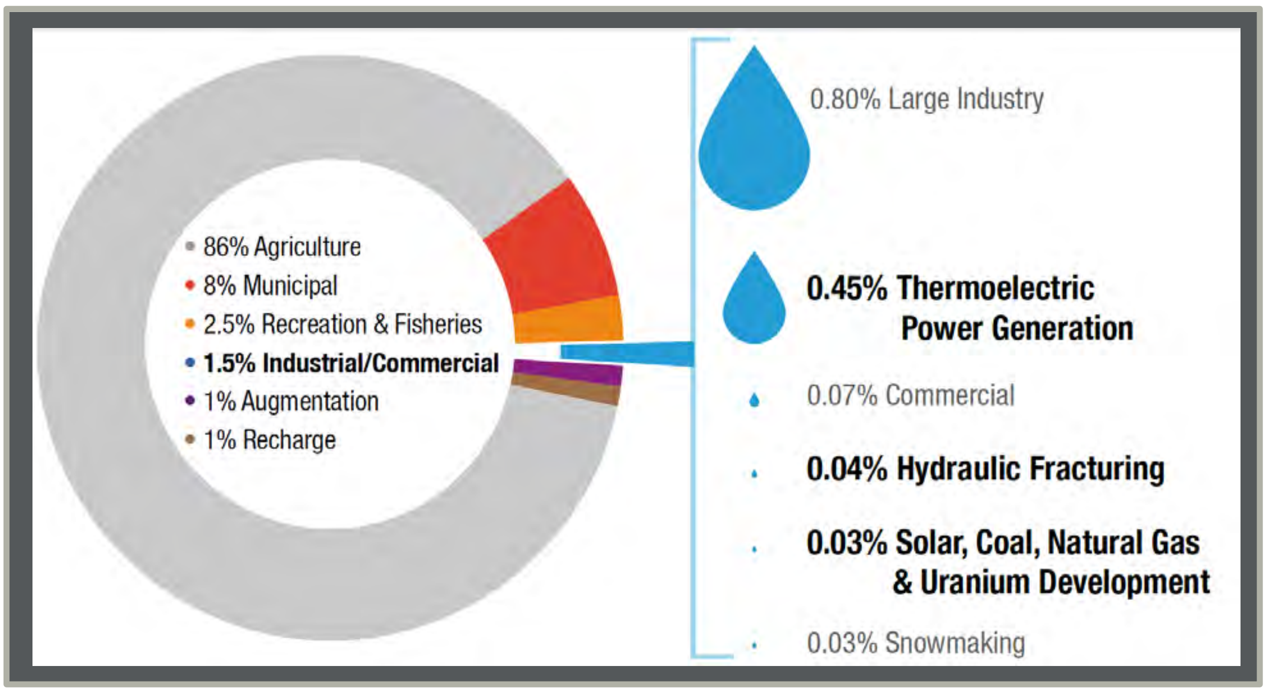


**Figure 2-3. Water Withdrawals in Colorado**

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

Natural gas plants require less water and are more efficient than coal-fired generation; 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, particularly when utilizing newer drilling methods including horizontal and directional drilling, a volume significantly greater than that required for conventional drilling.[2] The fracking process often contaminates most of the

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

fracking water. Most operations in the South Platte Basin are implementing treatment technologies to allow reuse of fracking water, however.

Another concern related to fracking is the potential impacts to water quality. There have been spills and evidence of other mistakes in the past, 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. 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 the South Platte Basin hydrocarbons are typically found at 3,000 feet to 10,000 feet below ground. At this depth there is also water, however this deep water is usually salty, high in dissolved minerals, and unfit for human consumption.[3]

Theoretically, potable groundwater supplies can be harmed by drilling and fracking 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 that steel casing and concrete extended 50 feet below the deepest aquifer being used for drinking water.[3]

Of greater concern in recent media is the water that is produced by hydrocarbon extraction. Produced water, or formation water, 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, more commonly found in the South Platte Basin 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.[3]

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 2-5 and Figure 2-4 summarize the M&I and SSI demands in the Metro and South Platte Basins.

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[3] 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 |
| ***Demands by County*** | | | | | | | | | | | | | | | |
| 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) | Medium (AFY) | 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** | **501,400** | **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** |

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

[1] M&I demands for 2035 and 2050 include passive conservation savings

[2] SSI demands include large industry, snowmaking, and thermoelectric

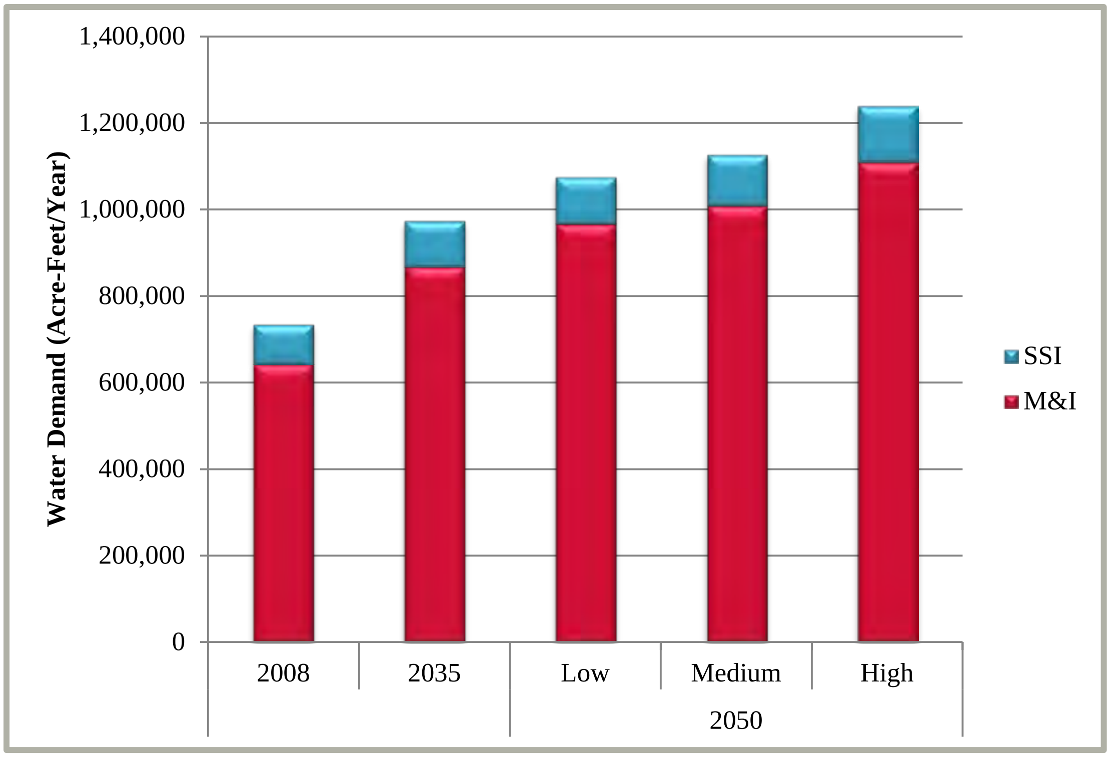


**Figure 2-4. Metro & South Platte Basin M&I and SSI Water Demands**

### 2.1.4 Climate Change Impacts

In August of 2014, the CWCB in conjunction with Western Water Assessment, Cooperative Institute for Research in Environmental Sciences, and the University of Colorado Boulder released report titled “Climate Change in Colorado”.[4] This report synthesized climate science as it is relevant for management and planning for Colorado’s water resources and focused on the observed trends, modeling, and projections of hydroclimate variables – including temperature, precipitation, snowmelt, and runoff – that determine both water supply and demand for the state.

Table 2-6 summarizes the projected and potential impacts to water resources as defined by this report.

[4] CWCB. *Climate Change in Colorado.* August 2014. http://cwcbweblink.state.co.us/WebLink/0/doc/191995/Electronic.aspx?searchid=e3c463e8-569c-4359-8ddd-ed50e755d3b7

**Table 2-6. Summary of CWCB's Projected and Potential Impacts to Water Resources for Colorado as shown in "Climate Change in Colorado"**

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

## 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.[5]

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[6]. Sales further increased in 2012 to $5.8 billion. A summary table of the total sales in each county is given in Table 2-7.

**Table 2-7. 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.

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. The CU does not include water that is diverted and then returned to the system through return flows.

**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

[5] USDA. (2012). 2012 Census of Agriculture. National Agricultural Statistics Service.

[6] USDA. (2009). 2007 Census of Agriculture. National Agricultural Statistics Service.

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.

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.

**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.

### 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

**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

- Yield and productivity
- Open space and conservation easements
- Economics of agriculture

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:

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

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 impacts were summarized in Section 2.1.4. Climate change is projected to decrease annual runoff resulting in diminished overall water supply. Warmer temperatures will likely result in an earlier peak runoff and lower late summer flows as well as an increased evaporative loss of water from plants and soil, lengthened growing seasons and on overall increase in agricultural water demand.

#### 2.2.1.3 Current Agricultural Water 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.

**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

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.

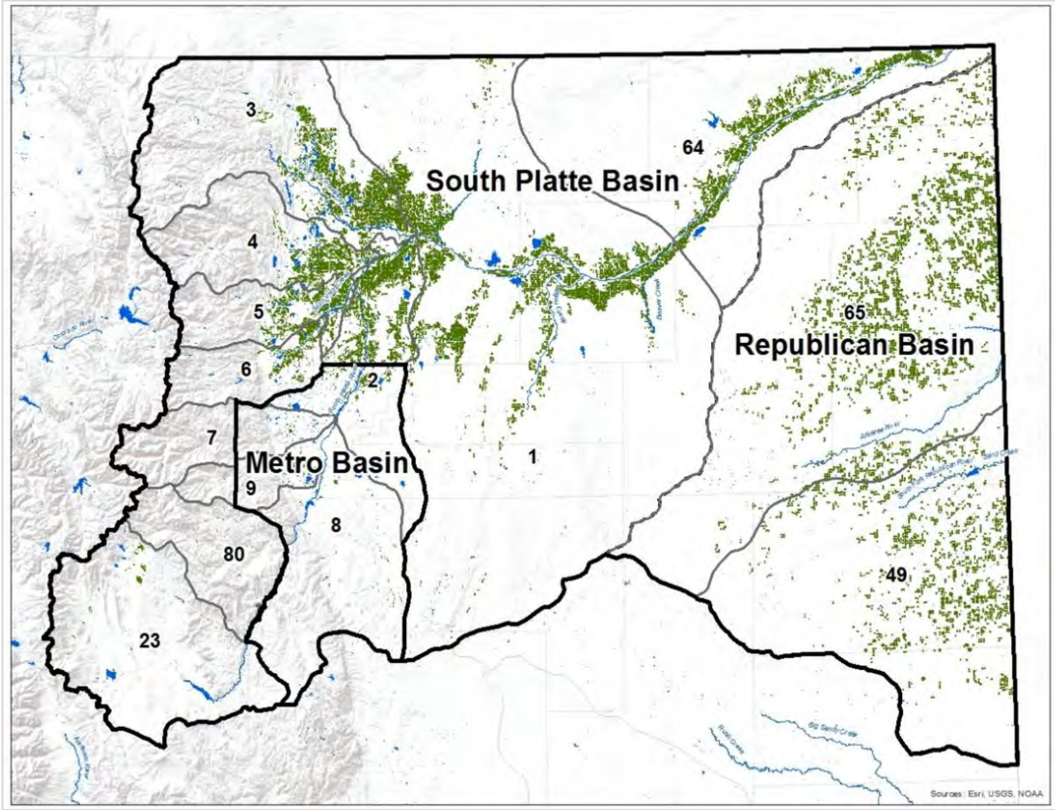


**Figure 2-5. Irrigated Acres by Water District**

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 2-8.

**Table 2-8. 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

Table 2-9 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.

**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

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 2-9. 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.

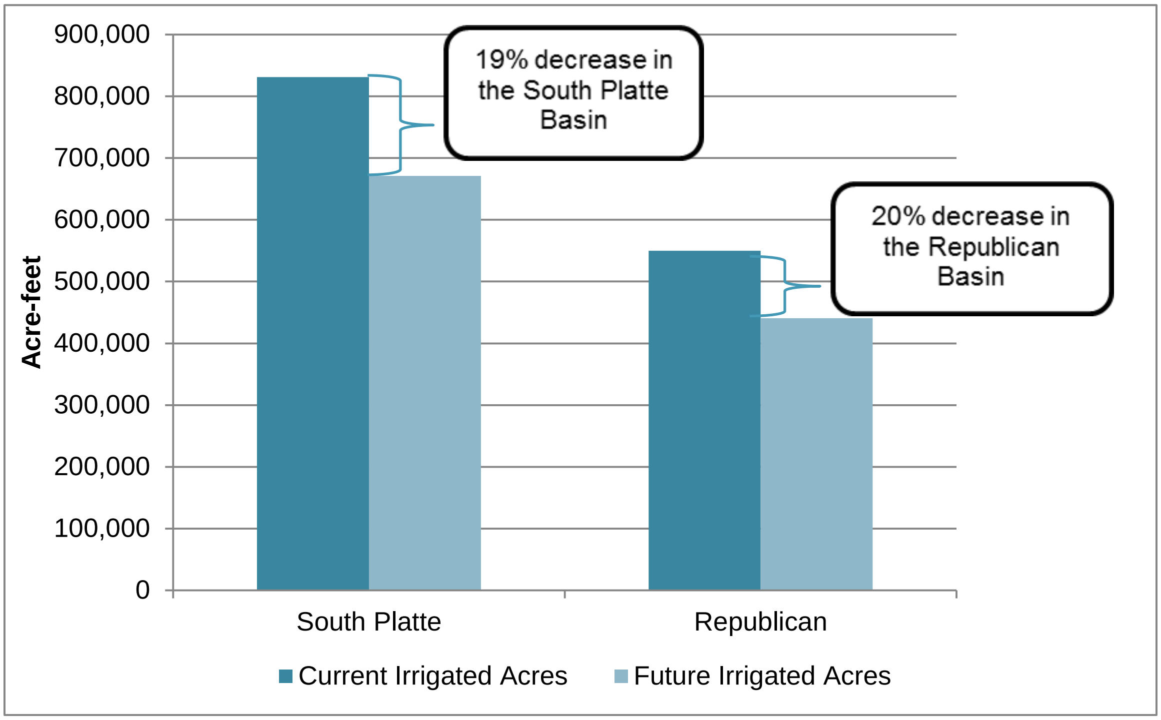


**Figure 2-6. Potential Change in Irrigated Acres by 2050**

### 2.2.2.3 Current Agricultural Demand Results

Table 2-10 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 2-10. 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

Table 2-11 summarizes the average annual agricultural demand in each basin by the year 2050, assuming that historical climate and hydrology continues into the future.

**Table 2-11. 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** | 671,000 | 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[7]
- 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, skiing 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. Assessments of environmental and recreational needs must be

[7] 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.)

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 driven by water supply decisions should be assessed regarding the potential impact or benefit to 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.[8] The South Platte Basin's environmental and recreational attributes are listed in Table 2-12.

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

### Table 2-12. 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[9] | 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 | |

[9] 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 actually 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.[10]

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, skiing, 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 to include several areas 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.
- Various reaches in Park County with significant riparian plant communities as well as recreational attributes not previously mapped. The focus area mapping was updated

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

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 2-7. A larger version of the map is attached in Appendix B.

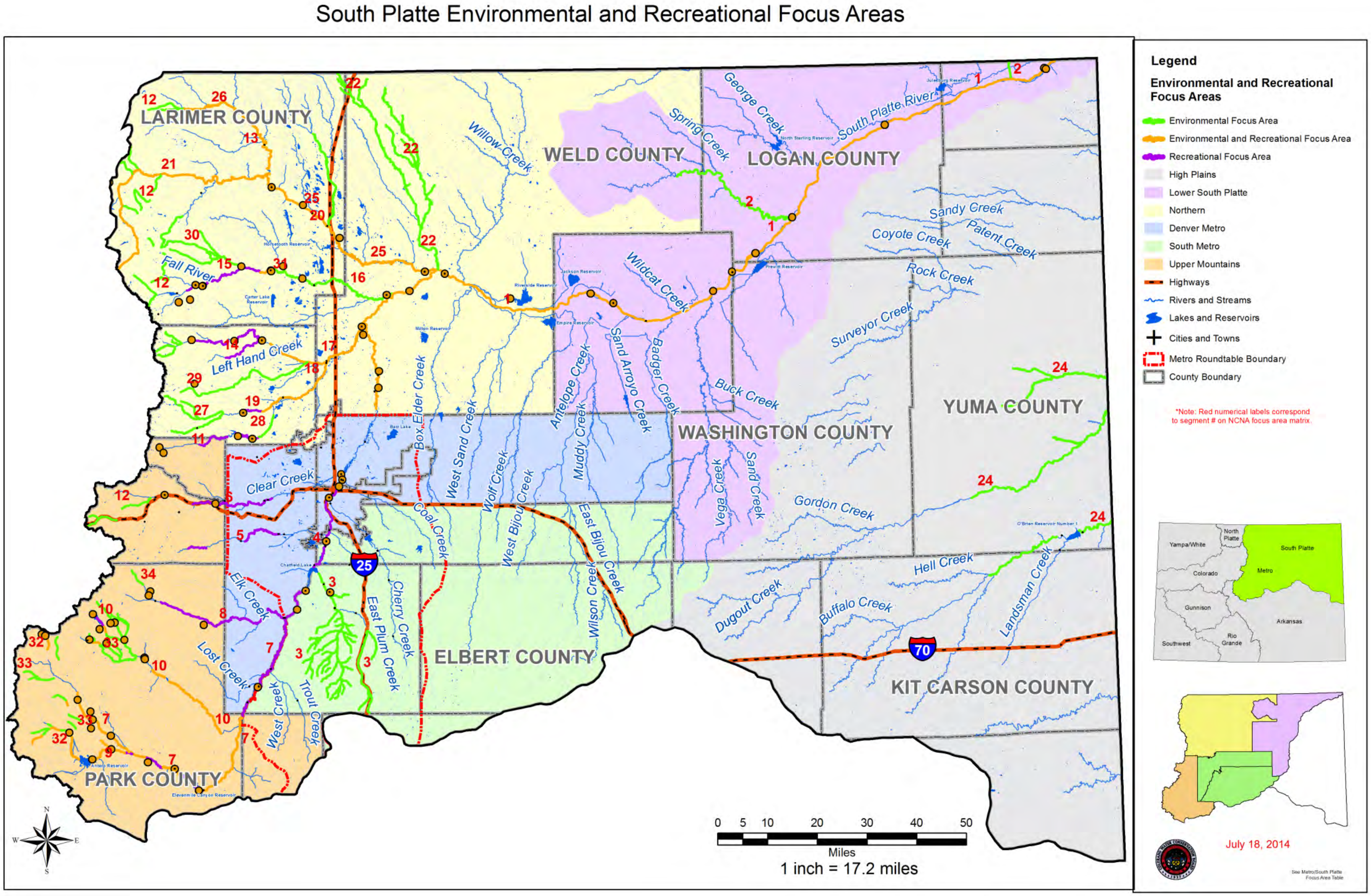


**Figure 2-7. South Platte Focus Area Map**

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 2-13 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 Figure 2-11. The gap is also show by county in Figure 2-11.

**Table 2-13. 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

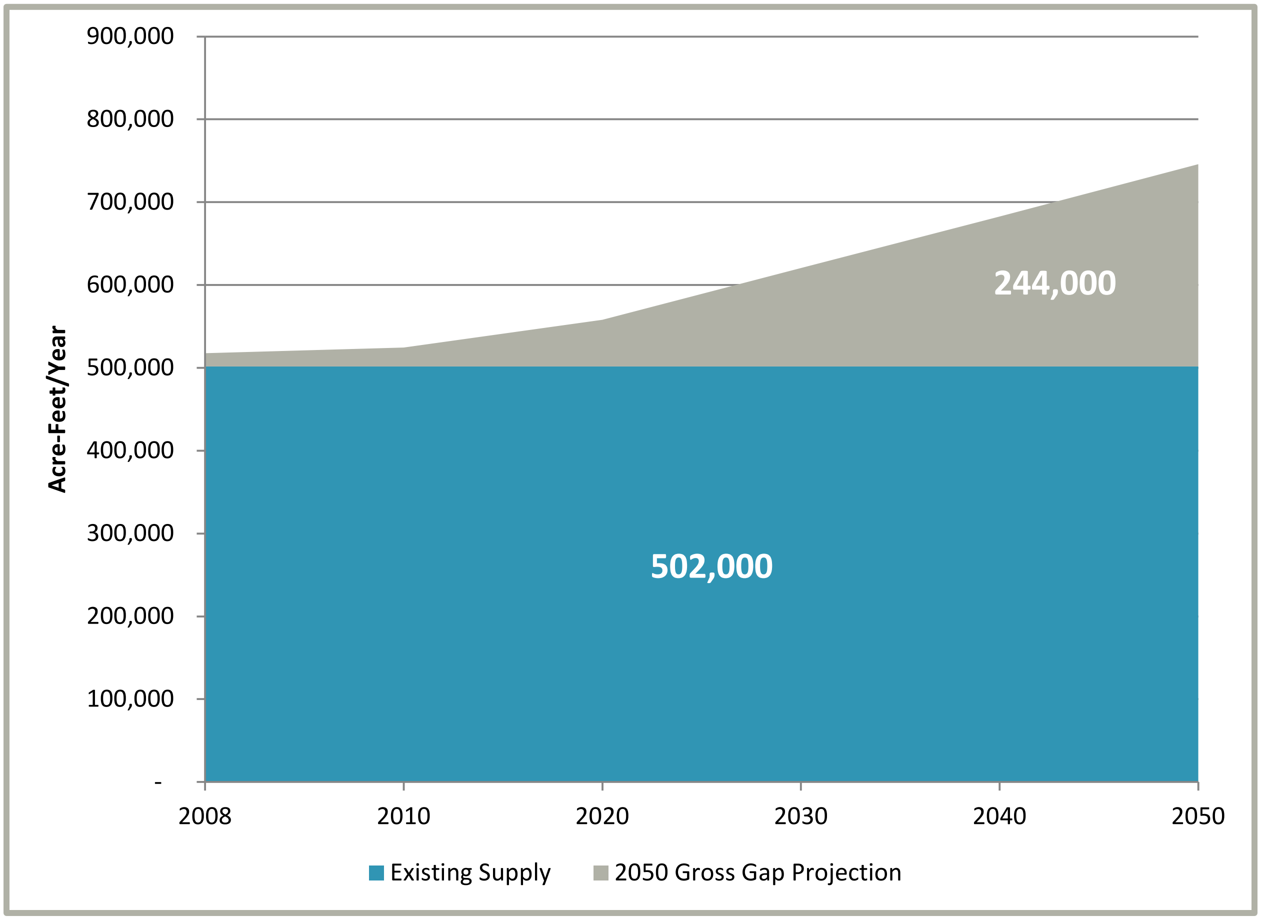


**Figure 2-8. Metro Basin M&I and SSI Gap Summary Medium Scenario (Medium Demand Projection)**

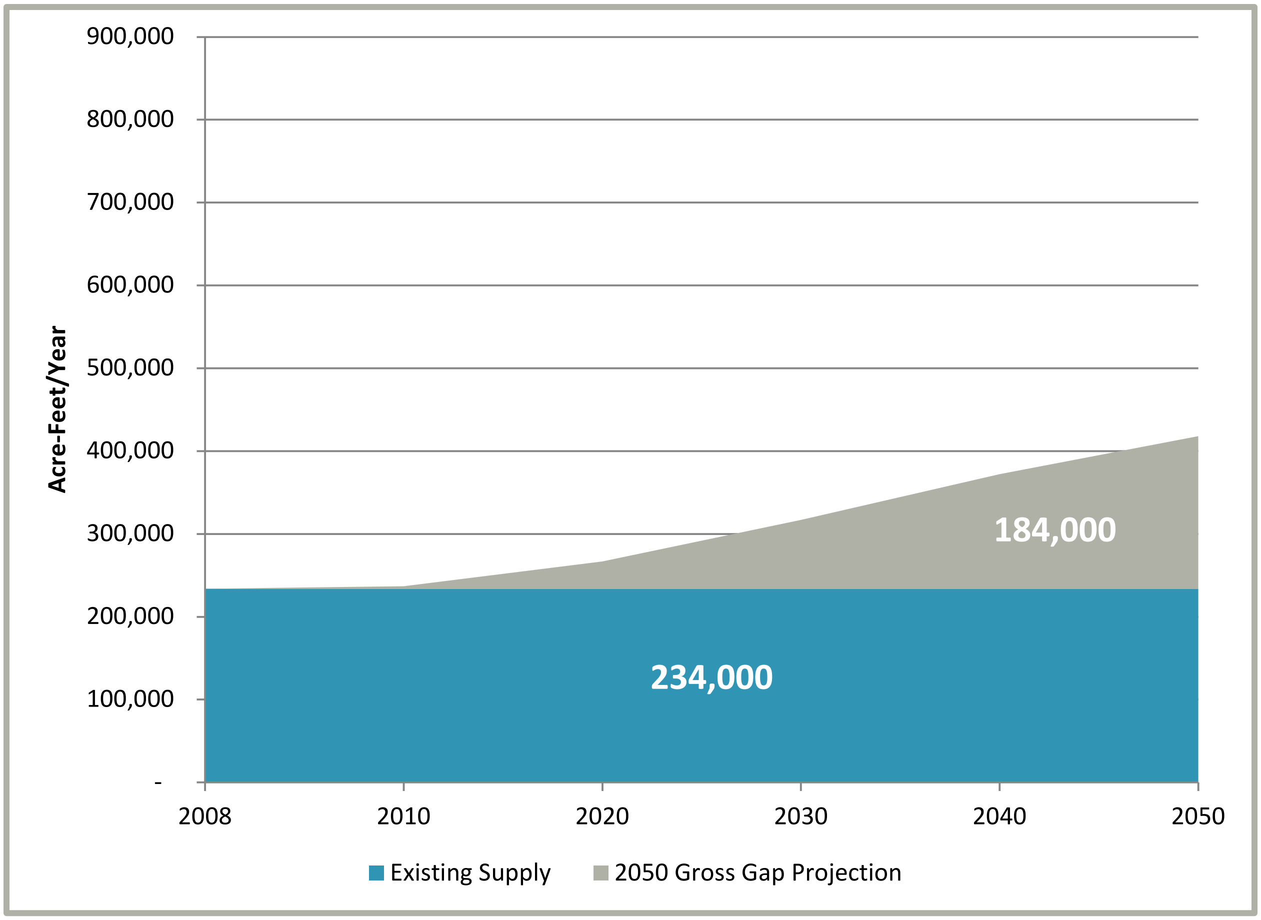


**Figure 2-9. South Platte Basin M&I and SSI Gross Gap Summary Medium Scenario (Medium Demand Projection)**

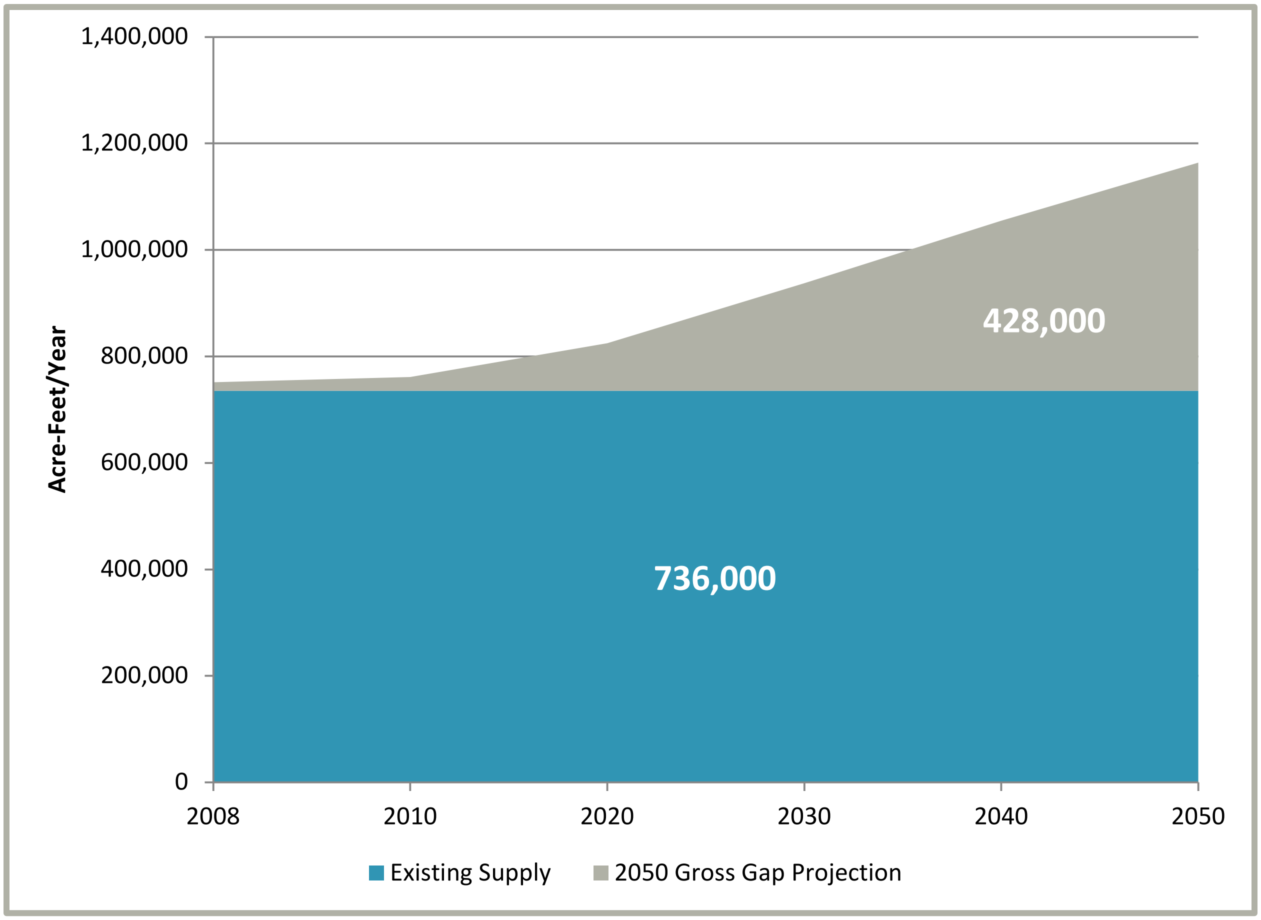


**Figure 2-10. Metro and South Platte Basin M&I and SSI Gross Gap Summary Medium Scenario (Medium Demand Projection)**

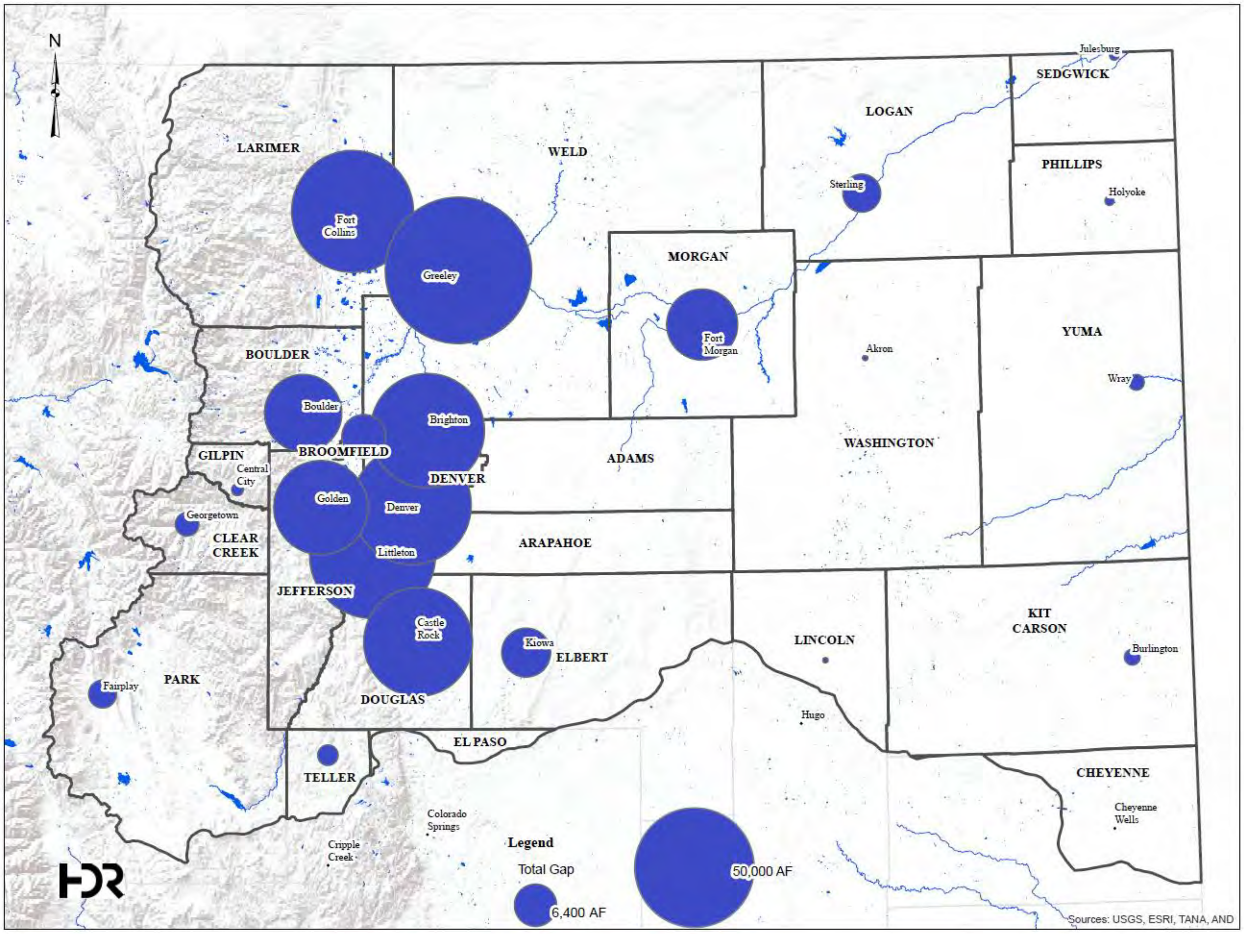


**Figure 2-11. Disaggregated Gap by County**

## 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 2-14 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. Figure 2-12 shows the current WSL CU and gross gap amounts in the South Platte and Republican Basins.

**Table 2-14. 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

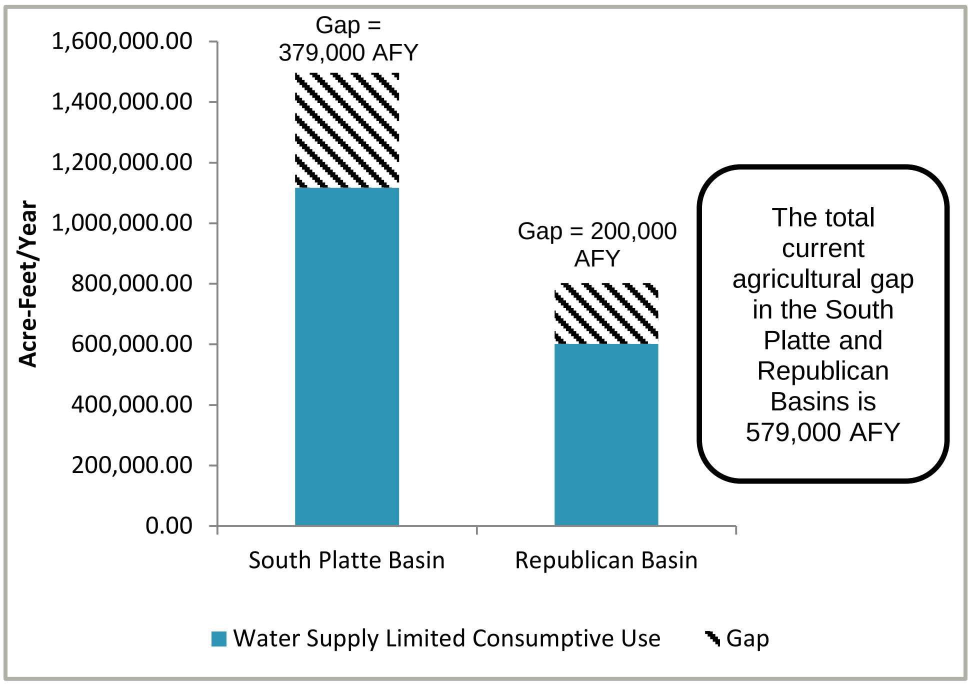


**Figure 2-12. Current Agricultural Demands and Gap**

### 2.4.2.2 2050 Agricultural Gap

Similar to Table 2-14, Table 2-15summarizes 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 2-13 shows the 2050 WSL CU and gap amounts in the South Platte and Republican Basins.

### Table 2-15. 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.

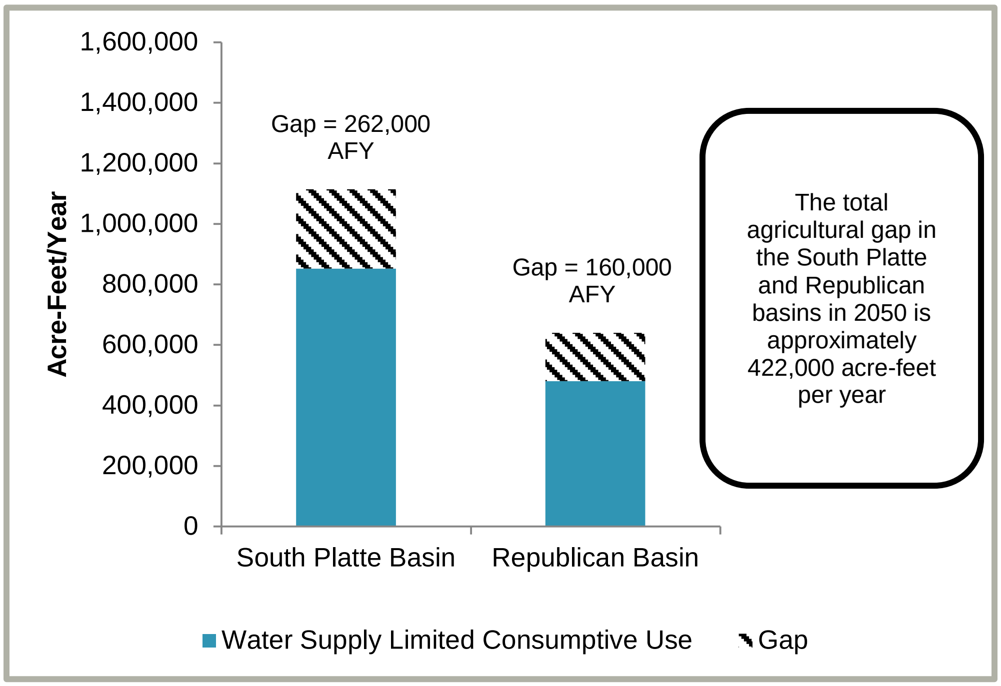


**Figure 2-13. 2050 Agricultural Demands and Gap**

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 2-14 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[11].

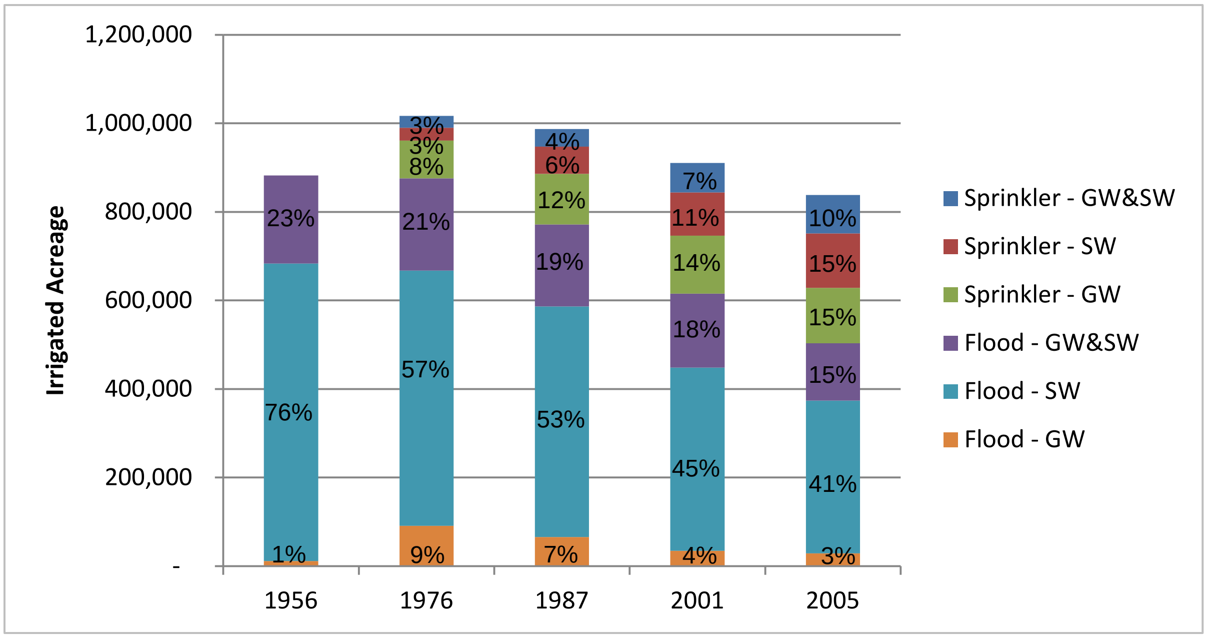


**Figure 2-14. Water Division 1, Irrigated Acreage by Irrigation Type and Water Source**

* 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 "Gap"

Based on the environmental and recreational needs discussed in Section 2.3, a methodology and framework were 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 for 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 and framework were developed to review the attributes and projects and methods in the future are 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 the existing protections, as well as the possibility of increase under future projects and protections. This potential

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

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 do not sufficiently 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 to properly assess the presence of attributes, and the presence and/or sufficiency of protections.

Although full assessment of the gap is not possible due to a lack of data regarding the presence of attributes and sufficiency of protections, the framework developed for assessment is a valuable starting point in identifying key environmental and recreational gaps for the basin.

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# 3

# South Platte Basin Water Availability

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# 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 system 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
  - Diverse environmental and recreational water needs and concerns
  - 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) system 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- Reduction in stream flows due to further development of water supplies as well as the reduction of return flows from agricultural and municipal uses can impact aquatic, riparian, and wetland habitat. 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.

## 3.1 Water Supply Challenges and Opportunities

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.**

The following subsections introduce 16 issues that present challenges and/or opportunities which could affect the implementation of projects and methods for South Platte Basin water management that would be consistent with the overall well-being of the State of Colorado:

### 3.1.1 Lack of Unappropriated South Platte and Republican River Water

Many previous studies including SWSI 2010 concluded that there is little or no additional water available in either the South Platte or Republican Basins for new uses. While the Surface Water Availability study completed for the SP-BIP demonstrated potential water availability during above average streamflows, a large amount of storage and transmission/treatment infrastructure would be required to make beneficial use of this water and provide a reliable yield. 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.*

### 3.1.2 Needs for Water in the South Platte Basin Exceeded the Native Water Supplies

South Platte water leaders realized decades ago that the economic development of this basin was critical 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*.

### 3.1.3 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 treatment and permitting challenges as presented below*.

### 3.1.4 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 nontributary groundwater, the consumptive use portion of agricultural transfer water, and most water imported from another river basin (the C-BT Project is an important exception) can 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 to pay municipal return flow requirements, or by use as an augmentation supply by many entities that use wells as their water source. Further, due to the return flow dependent nature of the basin, expanded reuse is often simply a reallocation of water from current uses to municipal uses and reduces the supply of water in the river.*

### 3.1.5 Further Reductions in Per-Capita Water Consumption

Opportunities exist to further reduce per capita water consumption but they face the following challenges:

1) Most water providers 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. *<u>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.</u>*

### 3.1.6 Additional Use of Denver Basin Aquifer System 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 system. 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 system 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 system is not uniform throughout. Certain areas may provide additional groundwater supplies. *<u>Denver Basin Aquifer system 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</u>*.

### 3.1.7 Opportunity for Groundwater Storage in Denver Basin Aquifer System

The Denver Basin Aquifer System provides the opportunity for small water providers to store excess water through Aquifer Storage and Recovery (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 system 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.*

### 3.1.8 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 in acquiring augmentation sources.[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 formed a "Technical Committee" to investigate the HB 1278 recommendations and develop specific direction, where appropriate, for those recommendations. The current focus of this Technical Committee has been the development of a Basin-wide groundwater monitoring network and the mitigation of localized high groundwater conditions in the LaSalle/Gilcrest and Sterling areas. *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*.

### 3.1.9 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 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.

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[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

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.

### 3.1.10 Programs to Manage and Recover Protected Species and Their Habitats (PRRIP)

The most notable species protection program in the South Platte Basin is the Platte River Recovery Implementation Program or 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. (Additional information on PRRIP can be found at www.platteriverprogram.org)

In Colorado, the water portion of this commitment related to water 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. These measures also utilize the Tamarack Plan of managed groundwater recharge. If a new proposed project in the South Platte Basin cannot utilize the program's protection mechanisms, its proponents would instead have to accomplish NEPA and ESA compliance and obtain related federal permits with processes independent of the PRRIP - a much more difficult challenge than obtaining coverage under the PRRIP considering the U.S. Fish and Wildlife Service has required one-for-one replacement of depletions for projects permitted prior to the PRRIP.

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. Colorado's Plan for Future Depletions (Attachment 5, Section 9 of the PRRIP) sets forth the conditions for accounting for new (post-June 30, 1997) depletions to be covered by the PRRIP for ESA compliance purposes. New water-related activities will not be covered once new native South Platte water and/or wastewater exchange/reuse result in additional gross water deliveries exceeding 98,010 AF in the February to July period (Section 1.H.1).

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. A "major" reservoir is defined as exceeding 2,000AF of storage capacity. 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. These restrictions are based on concerns over further impacts to sediment movement through the river system.

In the event a proposed 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.

As provided in the Program, the definition of "new water related activities" requiring either coverage under the PRRIP or a stand-alone ESA compliance process does not include augmentation for wells existing pre-June 30, 1997, provided the augmented wells and the augmentation sources for those wells included in any court-approved plans for augmentation do not increase irrigated acreage beyond that irrigated on June 30, 1997.

The South Platte Water Related Activities Program (SPWRAP) is a Colorado nonprofit corporation established by Colorado water users to represent their interests and partner with the State of Colorado to implement the PRRIP. Membership in SPWRAP serves as the vehicle by which Colorado water users participate in the PRRIP and obtain the regulatory benefits the PRRIP provides. (Additional information on SPWRAP can be found at http://www.spwrap.org )

*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.*

### 3.1.11 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 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*.

### 3.1.12 Time and Cost to Obtain Regulatory Decisions on New Water Supply Projects

Regardless of the outcome of these decisions, a key challenge 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 millions of dollars of preparation costs, 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.*

### 3.1.13 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.*

### 3.1.14 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).*

### 3.1.15 Opportunities for Further System Interconnections

In the South Platte Basin there are probably 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.*

### 3.1.16 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 to allocate water among competing municipal, industrial, agricultural, environmental and recreational needs there is an opportunity to engage the creative input of diverse parties to help develop solutions consistent with a combined vision for the South Platte Basin and the State. Support for identified solutions among elected officials, the public, and the business community 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 Colorado River 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.

# 3.2 Current South Platte Water Operations and Hydrology

## 3.2.1 Identification of Unappropriated Water

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 in the South Platte and Metro basins. 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).

**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

- Development of augmentation/recharge projects that capture surplus flows for agricultural well augmentation programs in order to prevent injury to senior rights.
- Decreased 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.
- Change in river administration following the 2002 drought resulting in significant increase in number of days with a call affecting districts basin-wide.
- Climate change creating a warmer and drier environment and affecting the amount of available water.

### 3.2.1.1 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 3-3 show 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.

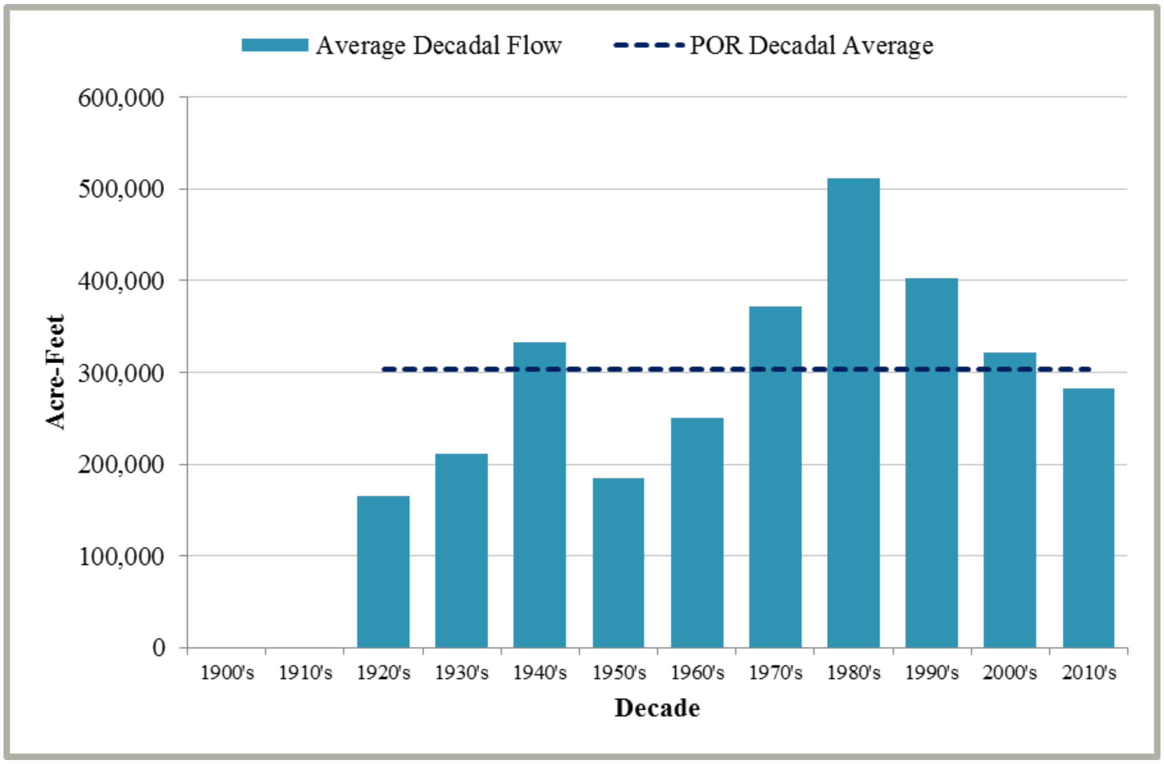


**Figure 3-1. South Platte River at Henderson POR: 1927 through 2012**

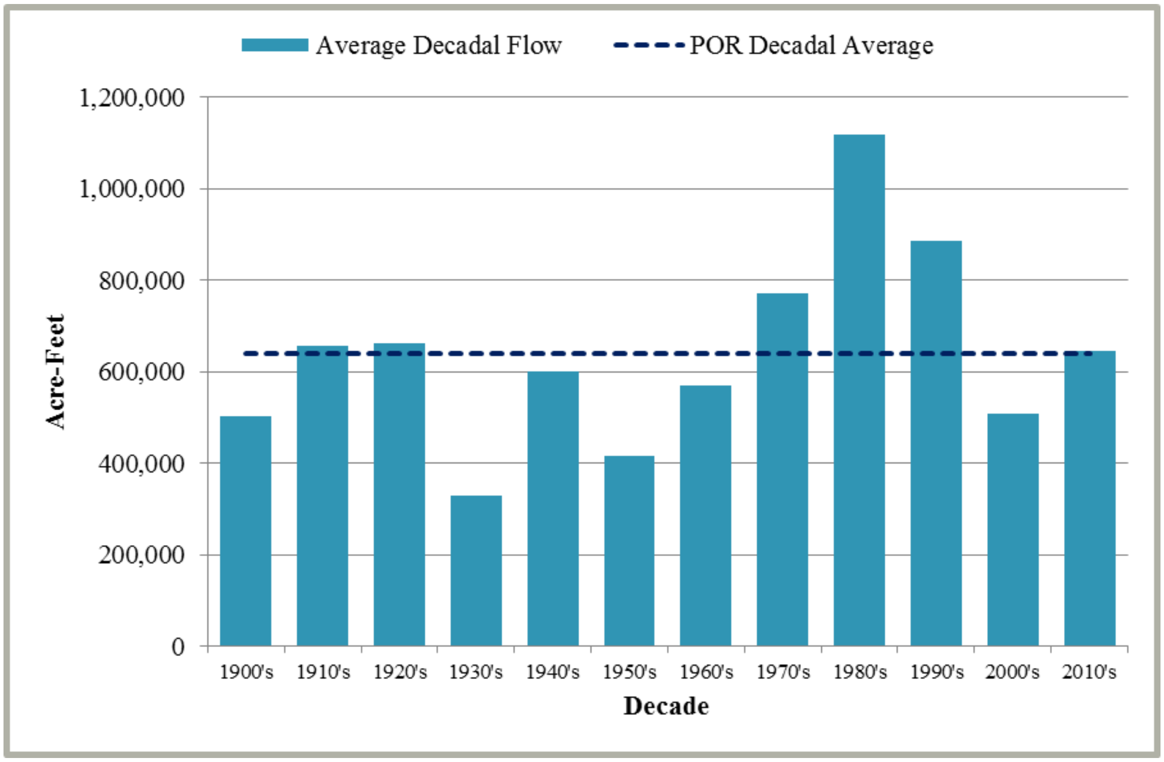


**Figure 3-2. South Platte River at Kersey POR: 1902 through 2012**

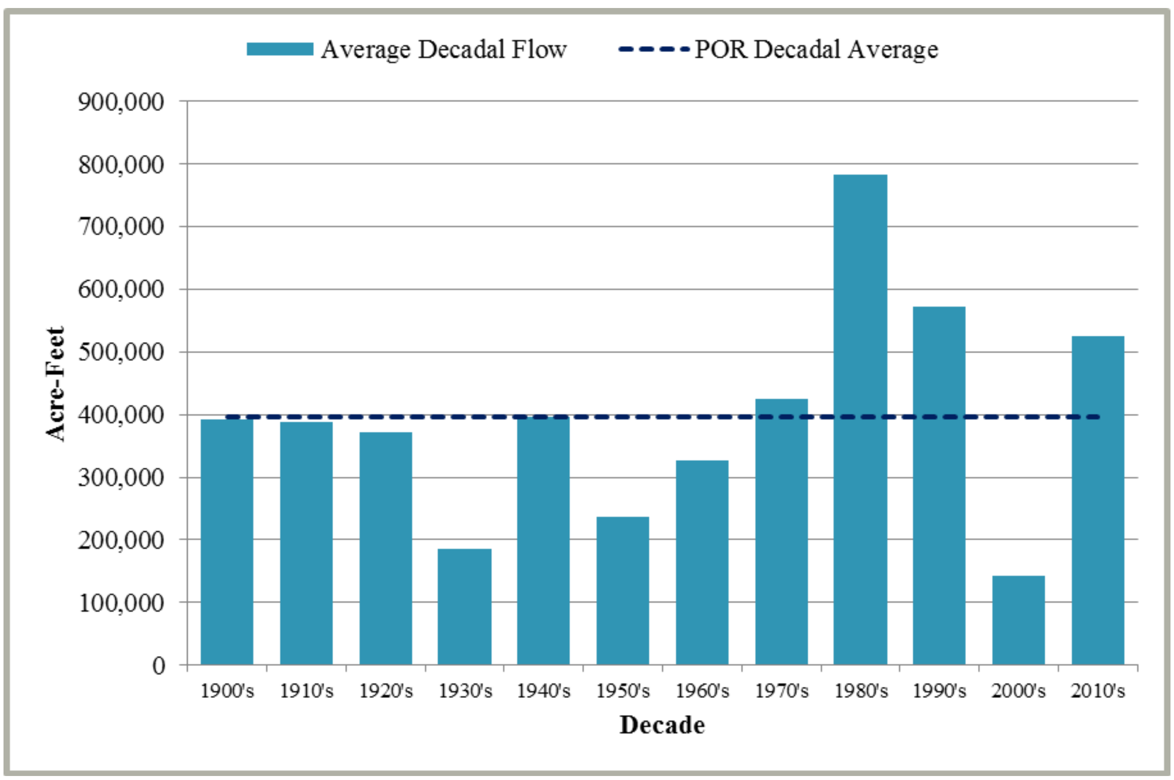


**Figure 3-3. South Platte River at Julesburg POR: 1903 through 2012**

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 system. In both the alluvial and DBA system, junior rights are very important to alluvial augmentation plans.

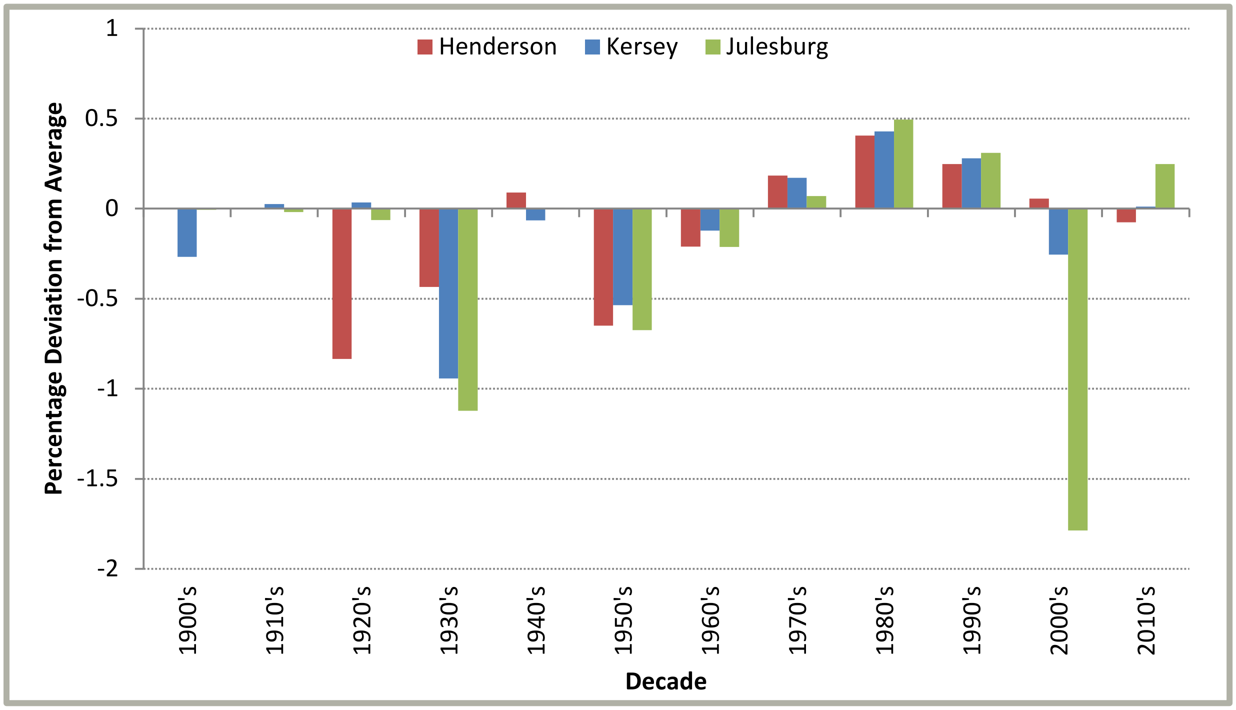


**Figure 3-4. Percent Deviation from POR Averages**

### 3.2.1.2 Surface Water Supply Availability in the South Platte Basin

The previous assessments of surface 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 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 surface 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]

[3] For more information on NISP, visit: http://www.northernwater.org/WaterProjects/NISP.aspx

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

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 change in river administration following the 2002 drought
3. Additional exchange and operating agreements to support additional M&I reuse programs, and
4. Potential for future projects to utilize the PRRIP program (see page 3-6)
5. Potential water development through the many identified future projects such as the Chatfield Reallocation project.

When presented in the original State-sponsored reports, results of the previous analyses 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, and has been corroborated by analyses conducted as part of this BIP.

The Colorado Water Conservation Board (CWCB) and Colorado Division of Water Resources (DWR) are in the process of expanding the Colorado Decision Support System (CDSS) to the South Platte River Basin. The CDSS integrates water resources planning tools for Colorado's major water basins encompassing hydrologic and climatic data, water management documentation, and water allocation and crop consumptive-use models to evaluate alternative water management strategies, wide-ranging hydrologic conditions and potential water supply projects. The South Platte Decision Support System (SPDSS) will be a valuable tool to analyze current and future water availability in the South Platte River Basin.

In the absence of the SPDSS, an interim technical analysis was conducted as part of this BIP to refine the understanding of South Platte Basin water availability, and to advance discussion of potential water sources for conceptualization of economically viable projects and methods to meet future South Platte Basin water needs. The final Technical Memorandum associated with this analysis is included within Appendix G. The analysis evaluated the potential water availability in the South Platte Basin at the following stream gage locations:

##### *3.2.1.2.1 Tributaries*

1. Bear Creek at Morrison (06710500; BCRMORCO)
2. Big Thompson River near Loveland (BIGLOVCO)

3. Boulder Creek near Orodell (06727000; BOCORO)
4. Clear Creek at Golden (06719505; CLEGOLCO)
5. St. Vrain Creek at Lyons (06724000; SVCLYOCO)

#### *3.2.1.2.2 Mainstem Points:*

1. South Platte River at South Platte (PLASPLCO) located below confluence of North Fork South Platte and South Platte River
2. South Platte River below Chatfield Reservoir (PLACHACO)
3. South Platte River near Henderson (06720500; PLAHENCO)
4. South Platte River near Kersey (06754000; PLAKERCO)
5. South Platte River near Weldona (06758500; PLAWELCO)
6. South Platte River at Cooper Bridge near Balzac (06759910; PLABALCO)
7. South Platte River at Julesburg (Chan. 1, 2, 4)

Figure 3-5 shows the location of the water availability analysis points. The Cache la Poudre River was not included in this study for several reasons including the location and magnitude of IPPs that would make use of native Cache la Poudre water supplies, the comprehensive water management modeling that is being completed to support the EIS processes for these projects, and limited budget and time for the SP BIP technical analyses.

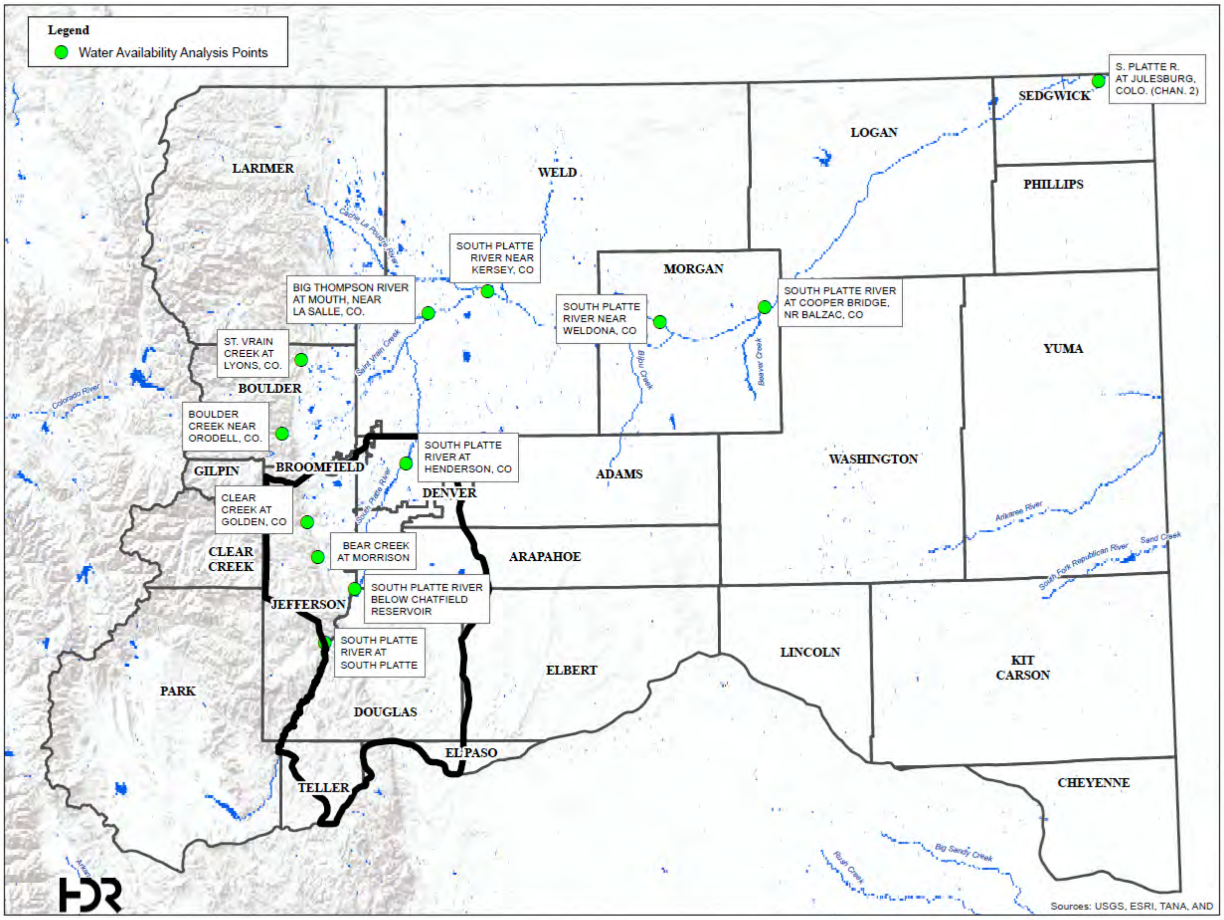


**Figure 3-5. Surface Water Availability Analysis Points**

An existing Point Flow Model and Daily Call Chronology method were adapted to support the water availability analysis presented herein. The Point Flow Model was used to develop preliminary estimates of water availability at the analysis points within in the Point Flow Model reaches (i.e., South Platte River near Henderson to South Platte River at Julesburg). The Daily Call Chronology method was used to develop preliminary estimates of water availability for points not included in the Point Flow Model reaches (i.e., mainstem upstream of South Platte near Henderson and tributaries). A layered refinement approach was developed to estimate water availability using the available tools, methods, and information. The layered approach starts with a preliminary estimate of water availability at a given point using the tools described above, and then incorporates location-specific information and knowledge to refine (i.e., reduce) the preliminary estimates.

Water availability estimates developed as part of this analysis include a number of refinement elements based on historical records and operations. However, there are elements not included in this analysis, for example, conditional water rights, future exchanges, and impacts of IPP's, whose inclusion would result in reduced future water availability. The estimates represent availability at the individual analysis points and are non-additive. Analysis points are located in the same basin, so some of them are hydrologically connected. Therefore, water that is available upstream, if not diverted, will be part of the water available at the downstream analysis points. The results presented herein should be viewed individually for each analysis point and careful consideration of dependencies should be exercised when attempting to infer combined basin-wide availability. Figure 3-6 shows the relative spatial distribution of water availability in the South Platte Basin. The detailed methodology and results for each analysis point are presented in the South Platte Basin Water Availability Technical Memorandum included as Appendix G of this document.

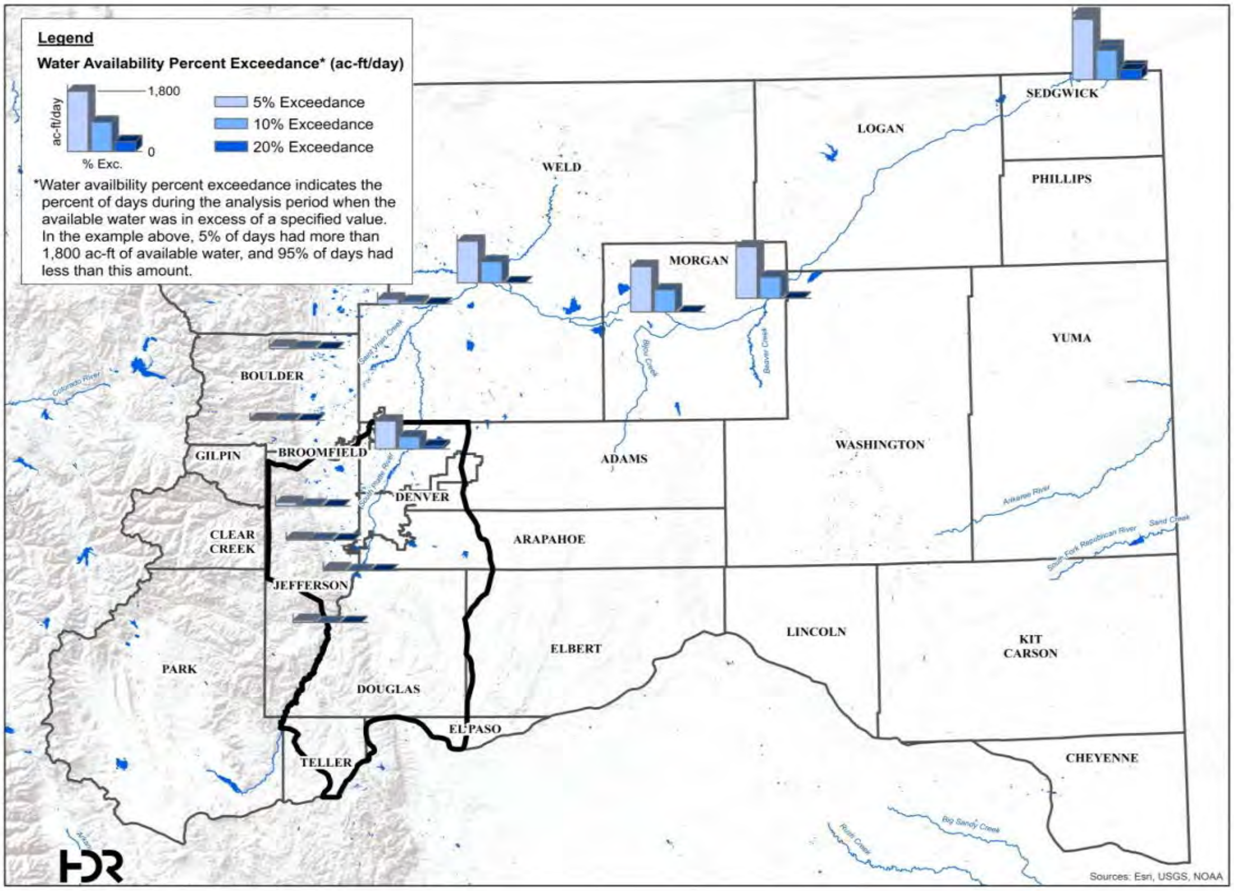


**Figure 3-6 Spatial Distribution of Daily Water Availability Volume Exceedance WY 2003 -WY 2013 (from left to right, bars indicate 5%, 10%, 15%, and 20% exceedance, respectively)**

Figure 3-7 and Figure 3-8 depict the percent exceedance of daily water availability (ac-ft/day) for the period of WY 2003 through WY 2013 for the tributary and mainstem analysis points, respectively.

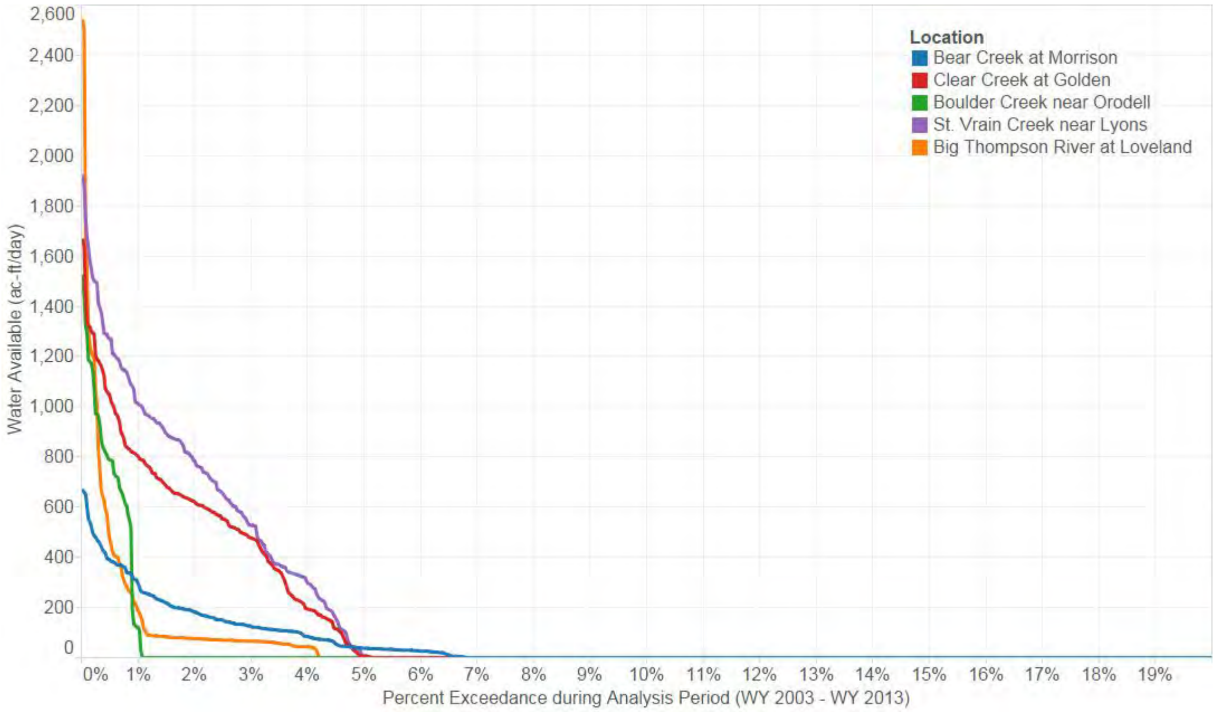


**Figure 3-7 Tributary Daily Water Availability Volume Exceedance (WY 2003 – WY 2013)**

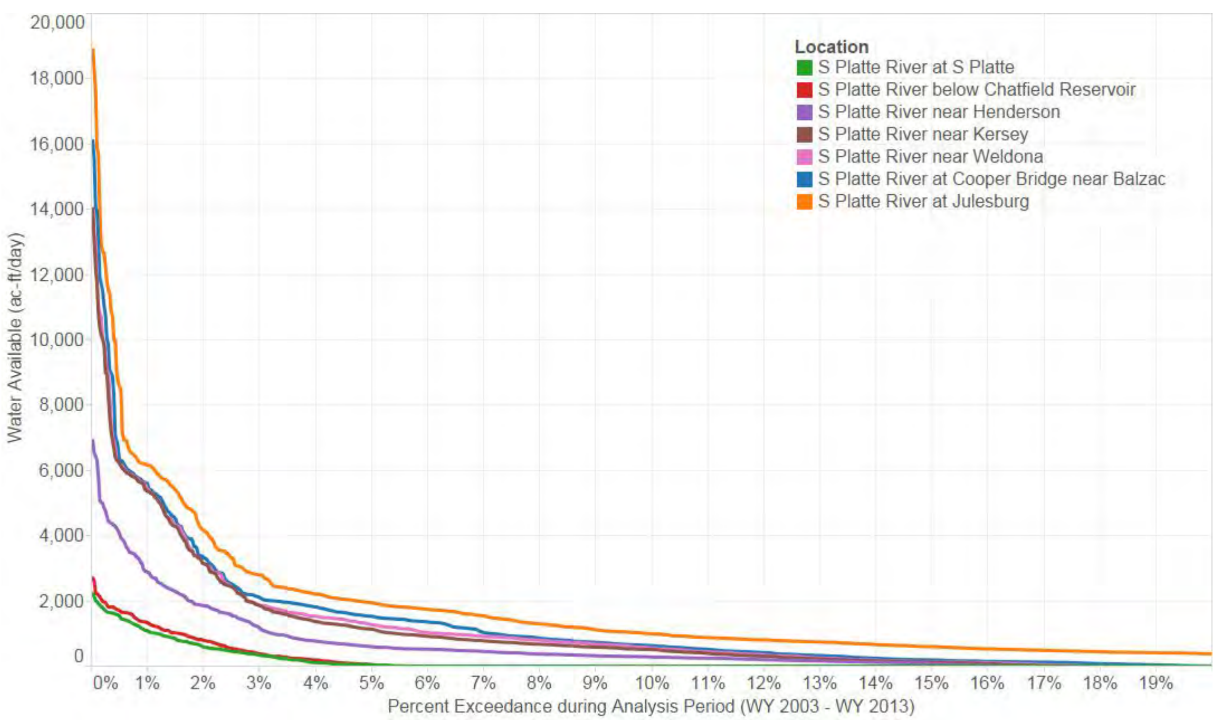


**Figure 3-8 Mainstem Daily Water Availability Volume Exceedance (WY 2003 - WY 2013)**

Boulder Creek and Big Thompson River have the most sporadic and least volume of remaining water availability of the 5 tributaries analyzed. Clear Creek and St. Vrain Creek have the largest annual potential water availability tributaries, although, water is only available 6 out of 11 years (2003 to 2013). The annual percent of days with a call in the tributary districts shows a distinct change in pattern around 2003. This change appears to be primarily associated with changes in basin water administration rather than changes in hydrologic conditions.

Potential water availability at the "South Platte River at South Platte" (located below confluence of North Fork South Platte and South Platte River mainstem) and "South Platte River below Chatfield Reservoir" gages show the most sporadic water availability of the mainstem analysis points on an annual basis with multiple consecutive years without any water available. Water availability increases in the downstream direction along the South Platte mainstem, with an increased number of days with water potentially available and greater flows potentially available. Downstream of Henderson, there is an increase in the magnitude and frequency of water availability compared to the upper basin (upstream of Chatfield Reservoir) analysis points. However, water is only available 7 out of 11 years (2003 to 2013) and significant water is only available 4 out of 11 years during this period.

In years of drought and subsequent drought recovery, it is expected that little to no water would be available to new water rights anywhere in the South Platte Basin, especially when the analysis presented herein is considered in relation to the implementation of IPPs and conditional water rights not included in the current analysis. Years with potential water availability show large peaks in flow that present significant challenges to either immediately using the water or being able to store it for future use. The practicality of capturing these peaks should be carefully considered when evaluating the water available to meet future demands.

Multi-year cycles between dry and wet periods were observed in the analysis period. Evaluation of longer time periods (as can be done with the SPDSS when it becomes available) will likely show even greater challenges in developing projects that could reliably capture and utilize such intermittent flows with such dramatic, but infrequent, peak flows. Based on the intermittent nature of water availability for new water rights in the South Platte Basin, very large storage-to-yield ratios for new reservoirs, especially new "off-stream" reservoirs, could be required to capture and use the available water. These ratios are an effective measure of the hydrologic and economic feasibility of new projects to make use of potentially available, but infrequent, water supplies.

Analysis of remaining water availability, after the implementation of IPPs, was explored with Roundtable representatives. These analyses would require significant assumptions and approximations in the context of the schedule and budget for the SPBIP and would involve a high degree of uncertainty. Considering the limitations of the currently available methods to simulate very dynamic current and potential future hydrologic conditions, assessment of the effects of IPPs is deferred to when a more robust tool, such as the SPDSS, becomes available.

#### 3.2.1.3 Conjunctive Use of Denver Basin Aquifer System and Surface Water

A possible alternative for new storage in the South Platte Basin is conjunctive use of 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 the Chatfield Reservoir Reallocation Project's average 20,600 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.

##### *3.2.1.3.1 Water Availability in the Denver Basin Aquifer System*

The DBA system, as shown in Figure 3-9, is a structural sedimentary 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]

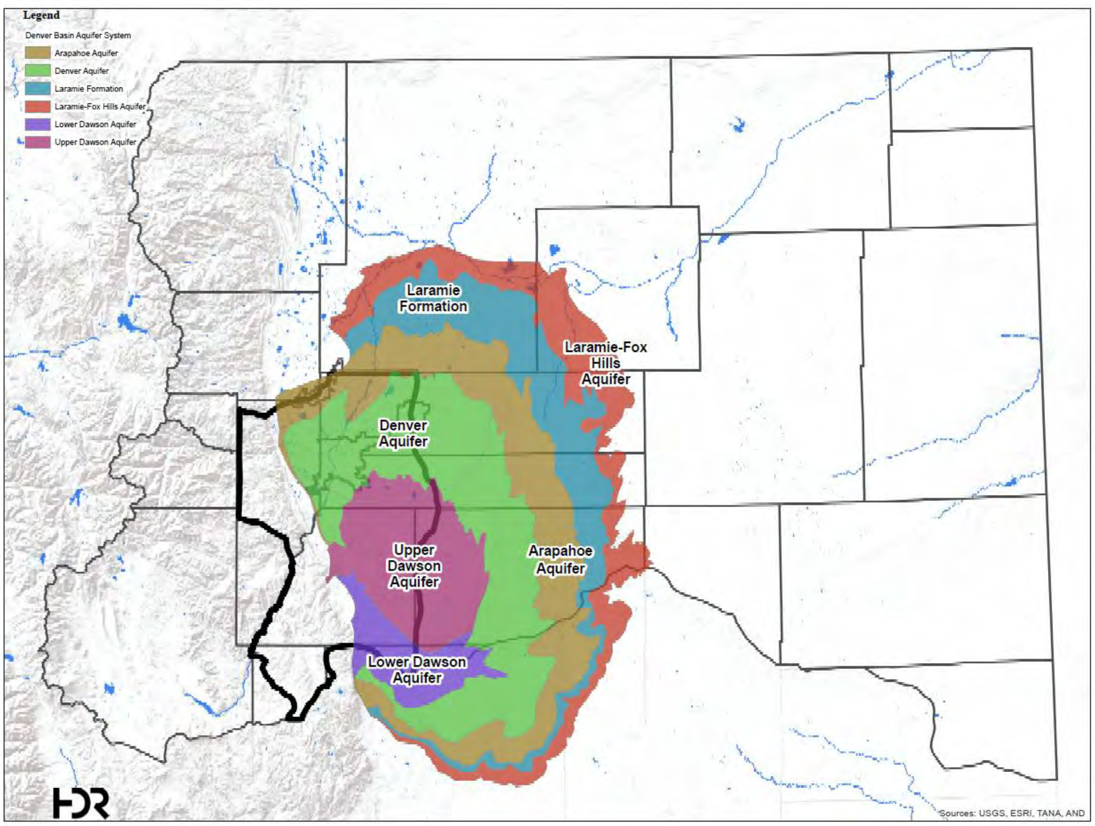


**Figure 3-9. Denver Basin Aquifer System**

[4] Groundwater Availability of the Denver Basin Aquifer System, Colorado, 2013
Source: Colorado Division of Water Resources

The center of the basin lies just west of Parker, where the lowermost of the four aquifers, the Laramie-Fox Hills aquifer is approximately 3,000 feet deep. The depth of the layers of the DBA system are illustrated in Figure 3-10.

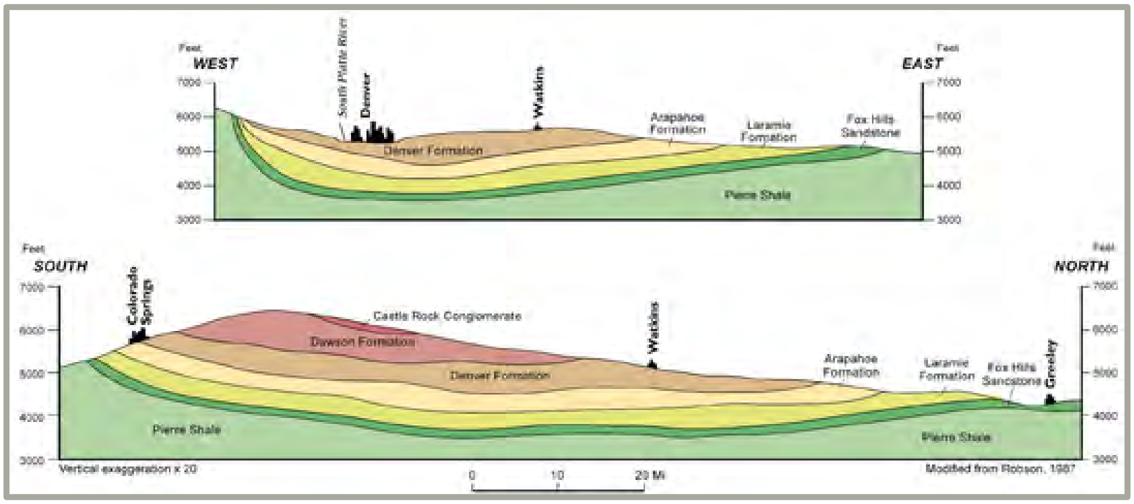


**Figure 3-10. Cross-section of Denver Basin Aquifer System**

Source: USGS Groundwater Atlas

In certain locations on the edges of the DBA system, the aquifer is connected to the surface and lacks a confining layer creating an unconfined aquifer. However, a large majority of the DBA system is deep underground, separated from surface streams by intervening impermeable layers of shale and claystone, making it a confined aquifer and considered a nontributary source. As a "nontributary groundwater source" it is considered to be a non-renewable resource that deserves special management.[5] This aquifer has a special classification under Colorado water law. The Colorado legislature exercises absolute authority over how the Denver Basin aquifer system is allocated, whereas surface water and tributary groundwater are subject to the Colorado constitution's prior appropriation doctrine.

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

### Groundwater Terms

**Alluvial aquifer** is formed by geologic sediments deposited in a stream channel or on a floodplain.

**Conjunctive use** is the coordinated use of surface and groundwater supplies to meet demand so that both sources are used more efficiently.

**Confined aquifer** is an aquifer that is bounded above and below by confining beds. Generally, confined aquifers occur at a significant depth below the ground surface.

**Nontributary groundwater** is groundwater that is physically separated from surface water by impermeable layers in the aquifer. It is also considered non-tributary when groundwater is at such a great distance from the surface water that it has little or no hydraulic connection with it.

**Structural Sedimentary Basin** – A topographically low area in the Earth's crust in which sediments have accumulated by transport via streams from the adjacent hills

**Tributary groundwater** is hydraulically connected to a surface stream and can influence the amount or direction of flow of water in that stream. Water in sand and gravel alluvial aquifers adjacent to major rivers is an example of tributary groundwater.

**Unconfined aquifer** is an aquifer whose upper boundary of the aquifer is the water table. Unconfined aquifers occur near the ground surface.

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 system over the coming decades if current or greater pumping rates are allowed.

#### *3.2.1.3.2 Denver Basin Aquifer System 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 system, 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 system 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 system provide a challenge for the communities that rely on it for municipal water supplies. As groundwater levels in the DBA system 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

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

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 system 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 system continues to provide stability of water supplies through the firming of surface water as well as a drought supply.

#### *3.2.1.3.3 Colorado Denver Basin Aquifer Administration*

Water resources located in Colorado's Denver Basin are subject to additional rules and regulations. 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 established how water pumped from deep and potentially nonrenewable aquifers should be managed and also set criteria for the State Engineer to follow in issuing well permits in these bedrock aquifers. Under this law, withdrawal of groundwater from the DBA system 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 all water in the aquifer may be recovered economically and the 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. These assumptions serve dramatically overestimate the amount of water actually available from Denver basin aquifers.). In 1985, Colorado's General Assembly provided further clarification for DBA system ground water administration under Senate Bill 85-05 (SB 85-05). This bill required the State Engineer to promulgate rules and regulations governing the withdrawal of groundwater from the Denver Basin aquifers by Dec. 31, 1985, which eventually became known as the Denver Basin Rules. 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.

About 47% of the DBA system is within designated groundwater basins and administered by the Colorado Ground Water Commission (CGWC). The remaining 53% is outside of the designated basins and administered by the State Engineer's Office pursuant to water court decrees. Though different sets of rules govern, from a substantive standpoint, Denver Basin aquifers are administered in a similar manner inside and outside designated basins.

##### *Colorado Designated Basin Administration*

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

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

as the regulatory and adjudicatory body authorized to administer rules and regulations for the Denver and designated basins (C.R.S. 37-90-102). Legislation defines "designated ground water" as ground water which in its natural course would not be available to and required for the fulfillment of decreed surface rights, or ground water in areas not adjacent to a continuously flowing natural stream wherein groundwater withdrawals have constituted the principal water usage for at least fifteen years preceding the date of the first hearing on the proposed designation of the basin, and which in both cases is within the geographic boundaries of a designated ground water basin(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. Ground Water Management Districts (GWMD) provide additional administrative authority within local boundaries in the designated basins. There are eight (8) designated groundwater basins and thirteen GWMDs. These designated basins and Management Districts can be found through the Colorado Division of Water Resources. GWMDs are authorized to adopt additional rules and regulations and to help administer ground water within their district.[8]

#### 3.2.1.4 South Platte Alluvial Aquifer

The alluvial aquifer is made up of mainly silt, sand, and gravel deposits of alluvial and aeolian origin that over an area of over 4,000 square miles of the South Platte River and its tributaries. In the mountainous areas, alluvial deposits tend to be discontinuous and serve as a water resource on a very local basis. The maximum saturated in the upstream region near Denver is 20 to 40 feet. In the eastern plains, the alluvial deposits thicken and become a continuous aquifer network with a maximum saturated thickness of more than 200 feet near Julesburg. The lower South Platte alluvial aquifer is a major source of water in the basin. It holds as much as 8.3 million AF of water in storage.[9] Infiltration into the alluvial aquifer is from precipitation, canal seepage, and pond seepage recharge. It then is typically discharged into the main channel creating the base flow of the river.

Figure 3-11 shows the areal extent of the alluvial aquifer. All groundwater in Water Division 1 that is not either designated groundwater or Denver Basin groundwater is presumed to be tributary groundwater and connected to the surface stream system.

[8] Designated Basins and Management Districts

[9] Groundwater Atlas of Colorado. Colorado Geological Survey (2003)

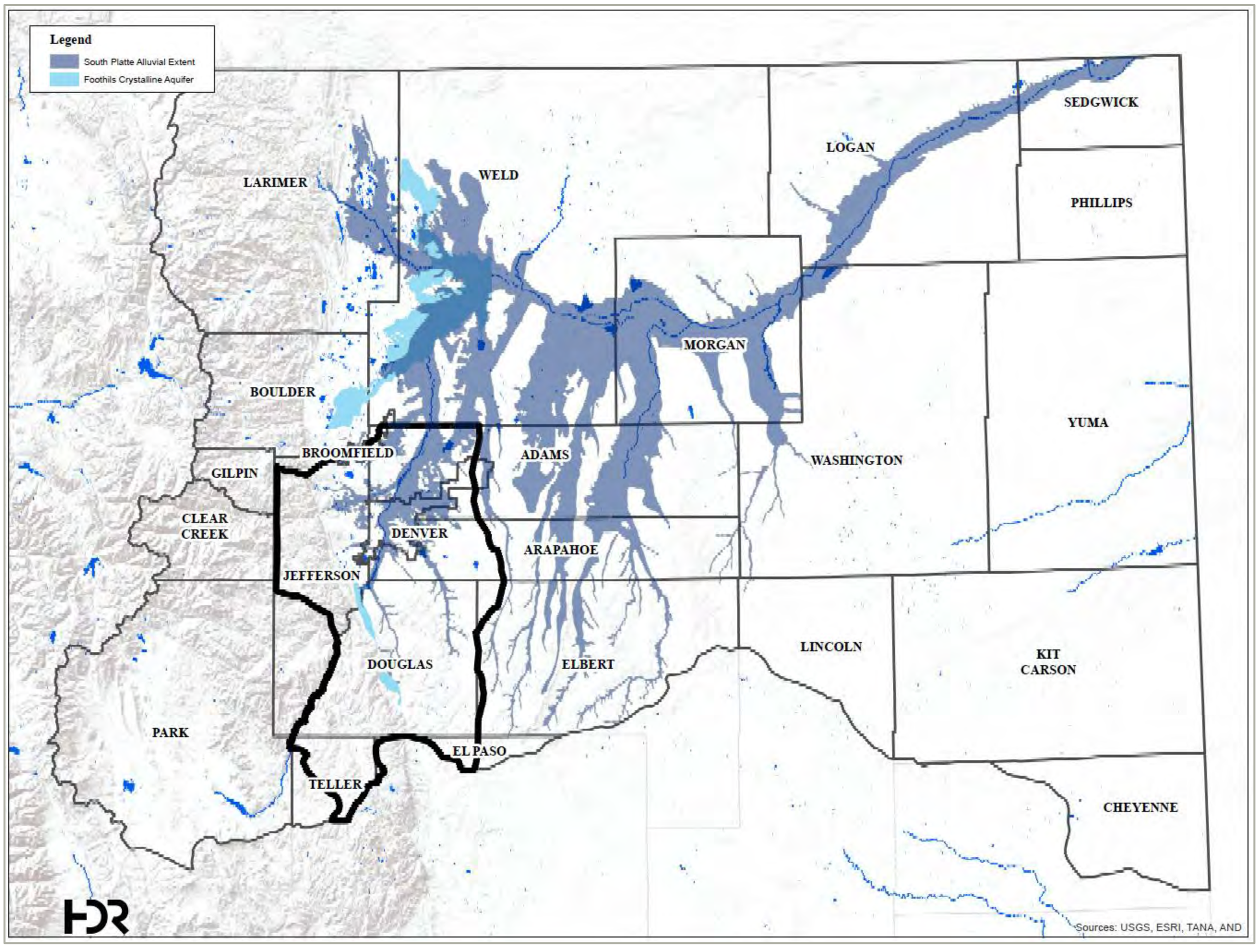


**Figure 3-11. Areal Extent of South Platte Alluvial Groundwater**

#### *3.2.1.4.1 South Platte Alluvial Aquifer Administration*

Figure 3-12 provides a summary of the history of alluvial aquifer administration within the South Platte Basin.

**1800s**

- 1860s: Earliest irrigation development in the South Platte
- 1889: The first irrigation well on record was excavated in Lone Tree alluvium east of Eaton, beginning the use of groundwater for irrigation in the SP
- 1896: SP river was being augmented by canal seepage and irrigation return flows

**1910**

- 1913: Comstock v Ramsay, the Colorado Supremem Court clarified that return flows are tributary to the river and that water right holder has no right to redirect return flows, thus the single use rule

**1930**

- 1930s: modern drilling technology and electriclalpumps became available and well yield were sufficient for large-scale irrigate crop production
- 1930: 300 high capacity wells exist in the SP Basin and and additional 1,400 wells were constructed in the following years due to the drought of the 1930s

**1940**

- 1940: 1,957 irrigation wells pumping an estimated 220,000 AF with 80% of these wells being used to supplement surface water rights.

**1950**

- 1950s: Severe drought resulted in the construction of an additional 1,200 wells
- 1953: Senate passes SB 120 entitled "Underground water" which required well drillers to be licensed, filing advance notice of well drilling, and filing well logs after drilling, all under the supervision of CWCB.
- 1956: CSU Professor Ralph Parshall observed that seepage return flow in 1956 was "nil" partly due to the 4,000 irrigation wells pumping 584,000 AF during the irrigation season which coincided with severly reduced senior surface water diversions from 1955-1957.
- 1957: Colorado Ground Water Law of 1957 established that a permit from the State Engineer was a prerequisite to drilling a well and obtaining a water right but was administrative only with no evaluation standards and therefore no basis to deny.

**1960**

- 1965: The General Assembly put groundwater within the regulatory authority of the State Engineer and allowed the State Engineer to deny well permit applications if there was no unappropriated water available or the proposed well would injure other water rights
- 1968: Colorado Supreme Court decision in Fellhauer v. People. Stated that wells should be regulated to the extent that it resulted in a reasonable lessening of injury to senior water rights.
- 1967: Legistature passed SB 407 authorizing a 2 year investigation of the relationship between surface water and groundwater
- 1969: Legislature enacted the Water Right Determination and Administration Act of 1969 which attempted to integrate surface water and groundwater use by bringing all alluvial groundwater into administration based on the prior appropriation doctrine. It also introduced the "plan for augmentation" by which a well or other junior water right could divert or operate out-of-priority so long as replacement water was supplied in time, location, and amount sufficient to prevent injury to serior water rights. Also allowed the State Engineer to approve temporary augmentation plans which would later cause the 2002 dispute.

**1970**

- 1972 and 1973: Because of the high costs of obtaining replacement water necessary for adjudication of permanent plans, two major well augmentation groups formed on the SP - GASP (Groundwater Apprpriators of the SP) and Central Water Conservancy Districts (CCWCD) Ground Water Management Subdistrict (Central GMS).
- 1974: SB 7 authorized the State Engineer to grant temporary approval while applications for augmentation plans were pending in water court
- 1977: SB 4 repeals SB 7 and revokes State Engineer's authority to temporarity approve augmentation plans. However, the State Engineer continued to approve annual temporary Substitue Water Supply Plans.

**1980-2000:**

- 20 relatively wet years masked supply shortages
- Both GASP and GMS continued to use temporary administrative approvals, but GMS set its sights on obtaining augmentation plans approved by water court and worked twards assembling permanent supples. GASP opted for arranging temporary leases and shorter term supplies that supported the annual approvals, but were less useful in permanent augmentation plan.

**2000-2005:**

- 2001: Colorado Supreme Court decision in Empire Lodge Homeowners Association v. Moyer affirmed the water court's decision that the State Engineer did not have legal authority to approve SWSPs -under the -statute (C.R.S. 37-80-120) that had historically been relied upon.
- 2002: One of the worst drought years in recorded history
- 2002: HB 02-1414 acknowledged pre-existing rulemaking authority of the State Engineer under C.R.S. 37-92-501, but it did not address the question of whether the rulemaking authority was broad enough to include annual appprovial of out-of-priority depletions without water court adjudication.
- May 2002: State Engineer Hal D. Simpson filed proposed new rules for the SP basin which would have allowed the State Engineer to annually approve replacement plans under much more stringent standards.
- April 2003: Simpson v. Bijou Irrigation Co., the Supreme Court agreed with the Division 1 Water Court that there was no statutory authority for this type of rules for well administration. Supreme Court concluded that the replacement plans contemplated by the proposed rules were the functional equivalent of temporary augmentation plans, that the State Engineer did not have legal authority to review and approve such plans, and that review and approval of augmentation plans is within the exclusive jurisdiction of the water court.
- 2003 SB03-73 gives well organizations in the SP basin three years to file a plan for augmentation with the Division 1 Water Court, and allowing State Engineer to annually approve an SWSP after conducting a hearing.
- 2003: "Gentlemen's Agreement" that eliminated non-irrigation season calls for reservoir filling on the mainstem was discontinued

**2005-Present**

- Due to lack and ability to obtain augmentation supplies, hundreds of wells in the SP basin were curtailed and GASP goes out of business
- 2007: from 1995 to 2007 the number of augmentation decrees went from 400 to 750, the number of mainstem call changes went from less than 100 days to essentially year round resulting in a reduced use of GW and a reliance on surface water. Additionally, the number of water rights for which daily diversion are recorded went from 3,250 to almost 4,900. This increase in surface water diversion was in large part a result of junior recharge projects coming online and decreed augmentation plans and changes of water rights that required daily recording of diversions.
- 2009: Colorado General Assembly passed HB09-1174 exempting new augmentation plans from having to replace out-of -priority well pumping depletions that occurred prior to 1974.
- 2008-2011: Reports of high groundwater levels in the vicinity of Sterling and the Gilcrest/LaSalle areas of District 2
- 2012: Colorado Legislature passes HB12-1278 funding a study to the South Platte alluvial aquifer
- 2013: The Division 1 Water Court approved the Rules Governing the measurement of Water Division No. 1, requiring all nonexempt tributary well diversions by Dec. 1 for previous 12 month period.

**Figure 3-12. Summary of the History of Alluvial Groundwater Administration in the South Platte Basin**

*Adapted from HB12-1278 Appendix II. South Platte Well Development Timeline.*

#### *3.2.1.4.2 Conjunctive Use of the Alluvial Aquifer*

Planned conjunctive use of the alluvial aquifer and surface water has many benefits including economic, environmental, and water use efficiency. Currently, the South Platte basin uses 450,000 AF annually from 6,500 high capacity wells. In addition, total decreed water rights in the basin equal approximately 4,000,000 AF, illustrating the system's reliance on multiple uses of return flows from upstream diversions of native water, reservoir deliveries, and imported transbasin water. [10] The challenge lays in the future development of sustainable conjunctive use of alluvial groundwater without injuring senior water rights. Arguments continue on whether the current approach is over-protecting the river, resulting in high groundwater and restricting the maximum beneficial use of the groundwater resource.

Expansion of conjunctive use of alluvial groundwater is constrained by the lack and affordability of augmentation water. Plans for augmentation allow diversion of water out-of-priority while ensuring the protection of senior water rights. Replacement water can come from any legally available source of water such as mutual ditch company shares, reservoir storage releases, successive use of transbasin water, nontributary water, augmentation wells, and/or artificial recharge of aquifers to generate augmentation credits. The most cost effective method of augmentation is to develop recharge structures that can take surface water during times of free river and allow the water to seep into the aquifer and accrue back to the river. These structures include ponds, unlined ditches or low lying areas that overly the alluvium, are hydrologically connected to the river, are permeable, and have enough unsaturated material above the water table to allow for recharge. Augmentation supplies in District 2 are inadequate to serve the needs, thus wells remain curtailed or on restricted quotas. Water District 2 has fewer opportunities to meet augmentation requirements through recharge as the District is often under administration, reducing the ability to exercise junior water rights. Additionally, there are fewer suitable places in District 2 for the optimum placement of recharge structures.

### 3.2.1.5 South Platte Basin Designated Basins

Designated groundwater is a category of groundwater under Colorado law that has been created by the Colorado legislature and is governed by the Groundwater Management Act, C.R.S. 37-90-101.Designated groundwater is managed and controlled by the Colorado Ground Water Commission (CGWC). It is defined as "ground water which in its natural course would not be available to and required for the fulfillment of decreed surface rights, or ground water in areas not adjacent to a continuously flowing natural stream wherein ground water withdrawals have constituted the principal water usage for at least fifteen years preceding the date of the first hearing on the proposed designation of the basin, and which in both cases is within the geographic boundaries of a designated ground water basin".[11]

There are eight designated basins in eastern Colorado, seven of which are in the South Platte Basin. Within the eight designated basins, there are 13 Ground Water

[10] HB 12-1278 Study of the South Platte River Alluvial Aquifer (Dec. 2013),

[11] See http://www.avvo.com/legal-guides/ugc/colorado-water-law--designated-ground-water

Management Districts (GWMD) that have additional administrative authority within their boundaries. GWMD are authorized to adopt additional rules and regulations to help administer groundwater within their district. Four designated basins (Lost Creek, Kiowa Bijou, Upper Big Sandy, and Upper Black Squirrel Creek) cover the rural eastern 47 percent of the Denver Basin aquifer system. Figure 3-13 shows the location of the designated basins and GWMDs.

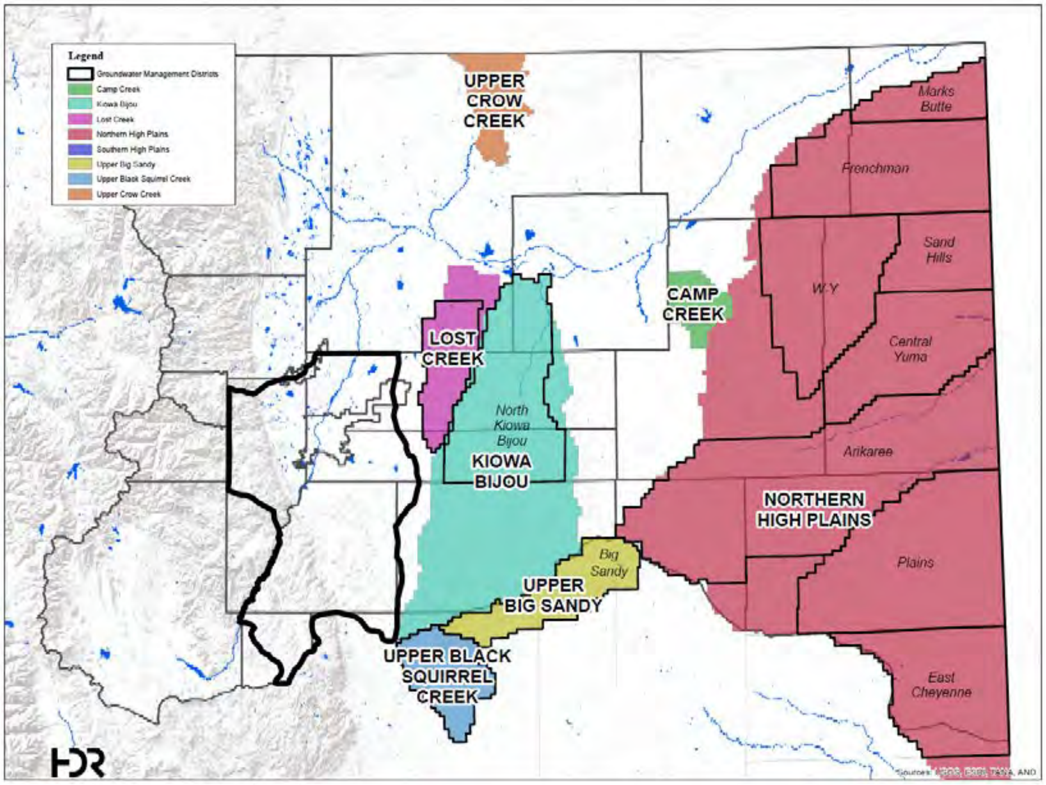


**Figure 3-13. Designated Groundwater Basins and Management Districts**

Unlike tributary groundwater or surface water, designated groundwater is regulated by the CGWC and is not subject to court adjudication. The CGWC uses a modified appropriation system to allocate designated groundwater outside of the Denver Basin on a permit by permit basis. But, the general assembly has directed that designated groundwater within the Denver Basin shall be allocated to the owners of the overlying land, based on the hundred year pumping regime that applies to the four aquifers of the Denver Basin.

### 3.2.1.6 Ogallala Aquifer

The Ogallala Aquifer is a regional aquifer that underlies approximately 174,000 square miles of the Great Plains states including South Dakota, Wyoming, Nebraska, Colorado, Kansas, Oklahoma, New Mexico and Texas. A portion of it underlies the eastern border of Colorado. The aquifer ranges from a thickness of 50 feet to approximately 500 feet in Colorado.[12] The location of the Ogallala Aquifer is shown in Figure 3-14.

[12] Colorado Geographical Survey. Colorado Groundwater Atlas. *High Plains Aquifer*. (2003)

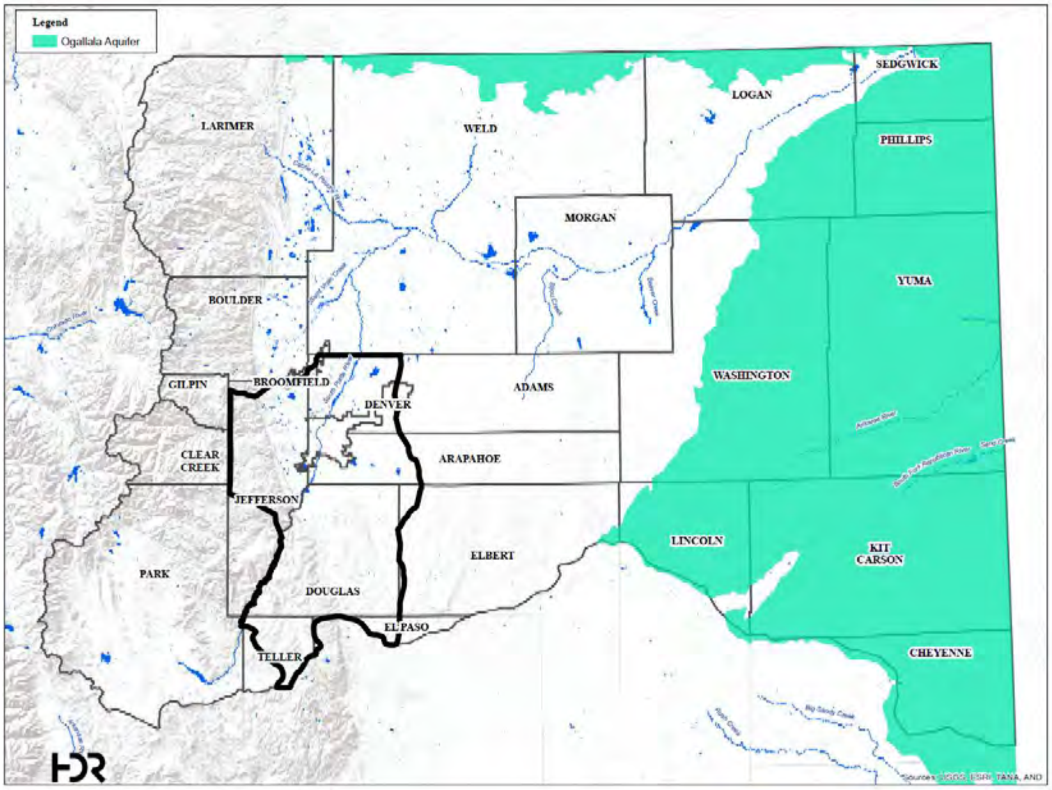


**Figure 3-14. Location of Ogallala Aquifer in the South Platte Basin**

The aquifer lies in a closed basin that does not benefit from snowmelt on the eastern slopes. The primary source of recharge of the Ogallala Aquifer is infiltration of precipitation, but infiltration is limited by the low precipitation and high evaporation rates that are common to the eastern plains.

Agriculture drives the economy in the eastern part of the South Platte basin. 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. Since the beginning of large scale pumping, Colorado has drained an average of 850,000 acre feet of Ogallala annually, three quarters of that in the South Platte Basin.[13] Decades of overpumping have lead to declines in the aquifer levels. Conservation efforts by the Republican River Water Conservation District have yet to catch on at a meaningful scale.

### 3.2.1.7 Available South Platte Basin Multi-purpose Storage Options

Stream flows vary dramatically in the South Platte basin seasonally and year-to-year. Storing water during wet year or free river conditions for use in times of shortage is a vital water management strategy. Early irrigators quickly realized that rivers and streams that swell with snowmelt from high mountain peaks in the late Spring and early Summer would often run dry or nearly dry before the farmers' crops were ready for harvest in the late Summer and Fall. They also soon realized that the stream flows in any given month

[13] Colorado Foundation for Water Education. (Fall 2014). The Will to Thrive on Colorado's Eastern Plains. *Headwaters.* https://www.yourwatercolorado.org/cfwe-education/headwaters-magazine/archive/305-headwaters-magazine/headwaters-fall-2014-eastern-plains

would vary dramatically from one year to the next. Today, South Platte water managers, including M&I, agricultural, environmental and recreational users, understand the value that stored native South Platte Basin water or imported water provides. Multi-purpose reservoir operations in the South Platte Basin are the norm. Many of the reservoirs in the South Platte basin, originally constructed solely for agricultural or municipal supply provide environmental and recreational benefits. Many of these reservoirs are now operated in part to benefit the environment and recreational users. The majority of the water storage in the South Platte Basin has been in existence for decades and reservoir operations have typically evolved over the years as the owners collaborate with others, legally change historic consumptive use to other beneficial uses such as municipal and industrial uses, and respond to environmental regulations and public desires. Many reservoirs are now operated to bypass (not store) water under certain conditions and maintain downstream flows.

#### *3.2.1.7.1 Reservoir Storage*

The larger municipalities in the basin, including Denver, Aurora, Fort Collins and Greeley, have complex water resources supply systems that include multiple reservoirs. These supply systems allow the water agencies the ability to manage the delivery of water to meet peak M&I demands, maintain stream flows and be prepared for extreme weather events. Denver Water’s system, as shown in Figure 3-15, includes a 200,000 AF strategic water reserve. Reservoirs such as Chatfield Reservoir and Cherry Creek Reservoir provide important flood protection for the reaches of the South Platte through the Denver municipal area and below.

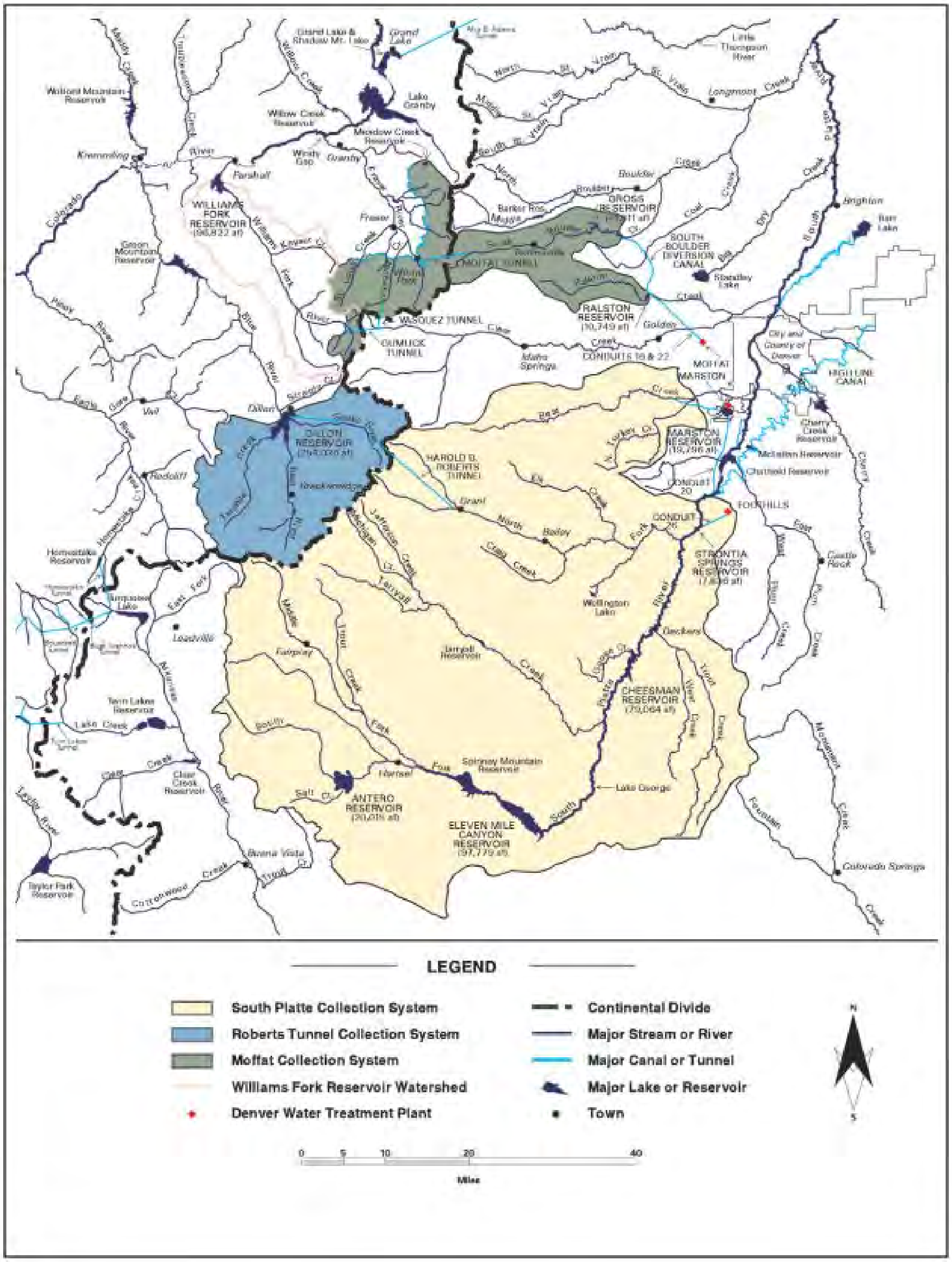


**Figure 3-15. Denver Water Collection System and Major Lakes and Reservoirs**[14]

[14] Denver Water. The History, Results, Projections and Update of the Integrated Resource Plan. February 2002. http://www.denverwater.org/docs/assets/DDA6502B-BCDF-1B42-D6B27D086AD6731A/MasterDocIRPOnline1.pdf

The more recent additions to South Platte water storage, such as Reuter Hess Reservoir (Arapahoe County) and Dry Creek Reservoir (Larimer County) are off-channel facilities (meaning that the primary water is conveyed to the reservoir with pipelines, canals and pump stations) and water is delivered from the reservoir, typically to a water treatment plant since the high-cost of off-channel storage is generally most affordable to municipal and industrial water suppliers.

The importance of water storage in the South Platte Basin may best be demonstrated by the extreme drought conditions experienced in 2002. During this historic drought, Denver Water was able to draw upon its storage in multiple reservoirs to meet water supply needs throughout its service area. This drought also led to the fast-track implementation of Aurora's Prairie Waters Project and stricter water administration throughout the South Platte Basin. In 2002, as shown in Figure 3-16, Denver Water was able to utilize its existing water supplies to meet its water supply demands.

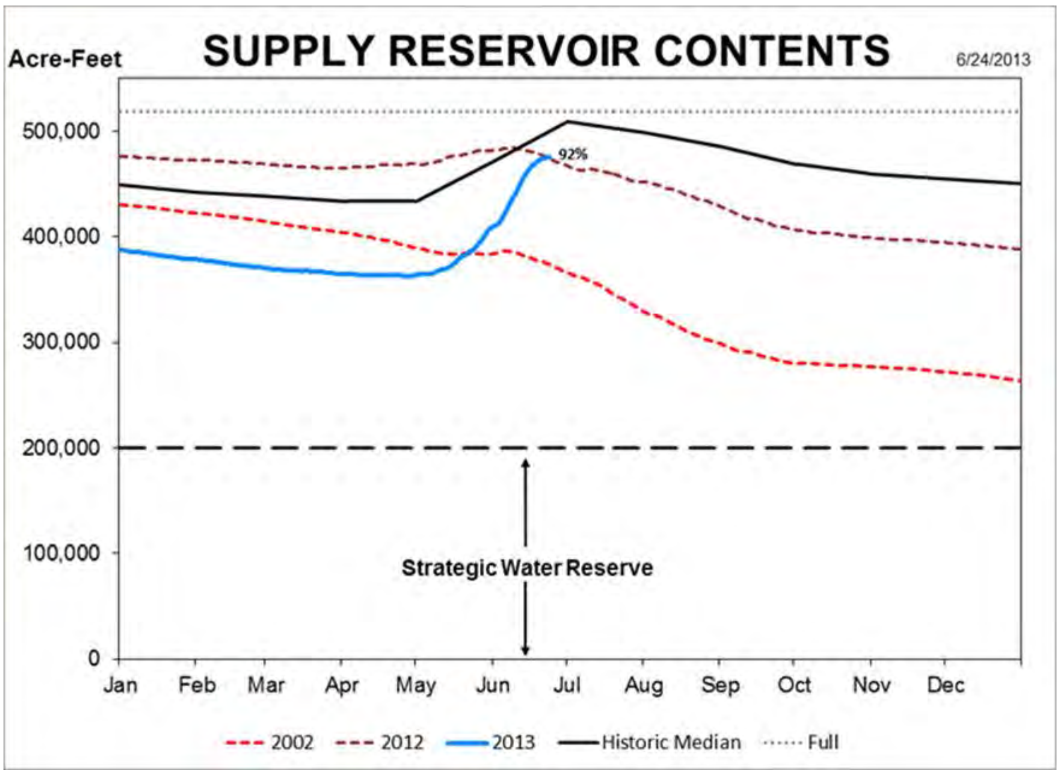


**Figure 3-16. Denver Water Supply Reservoir Contents**[15]

[15] Denver Water. *Denver Water Modifies Water Restrictions.* June 2013. http://www.denverwater.org/AboutUs/PressRoom/09EFBB44-0D5B-7EFF-49B9855FB75B79F6/

### *3.2.1.7.2 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 pit storage to capture return flows and spring snowmelt runoff along the South Platte and its tributaries. The attractiveness of these projects is based partly on more practical and predictable environmental permitting since the river corridor has already been disturbed by the aggregate mining activity. Another very attractive aspect of these projects is that they are well suited to be added incrementally to generally track a water agency's growth in water demand over time and, therefore, have less impact on water rates than implementing a much larger project with significantly higher capital costs that must be constructed all at once. Gravel pit storage now extends dramatically along the South Platte River through and downstream of Denver and along major tributaries including, but not limited to, Clear Creek, St. Vrain, Big Thompson and 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 3-17 gives an example gravel pit storage development along a portion of the South Platte River.

## 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** |

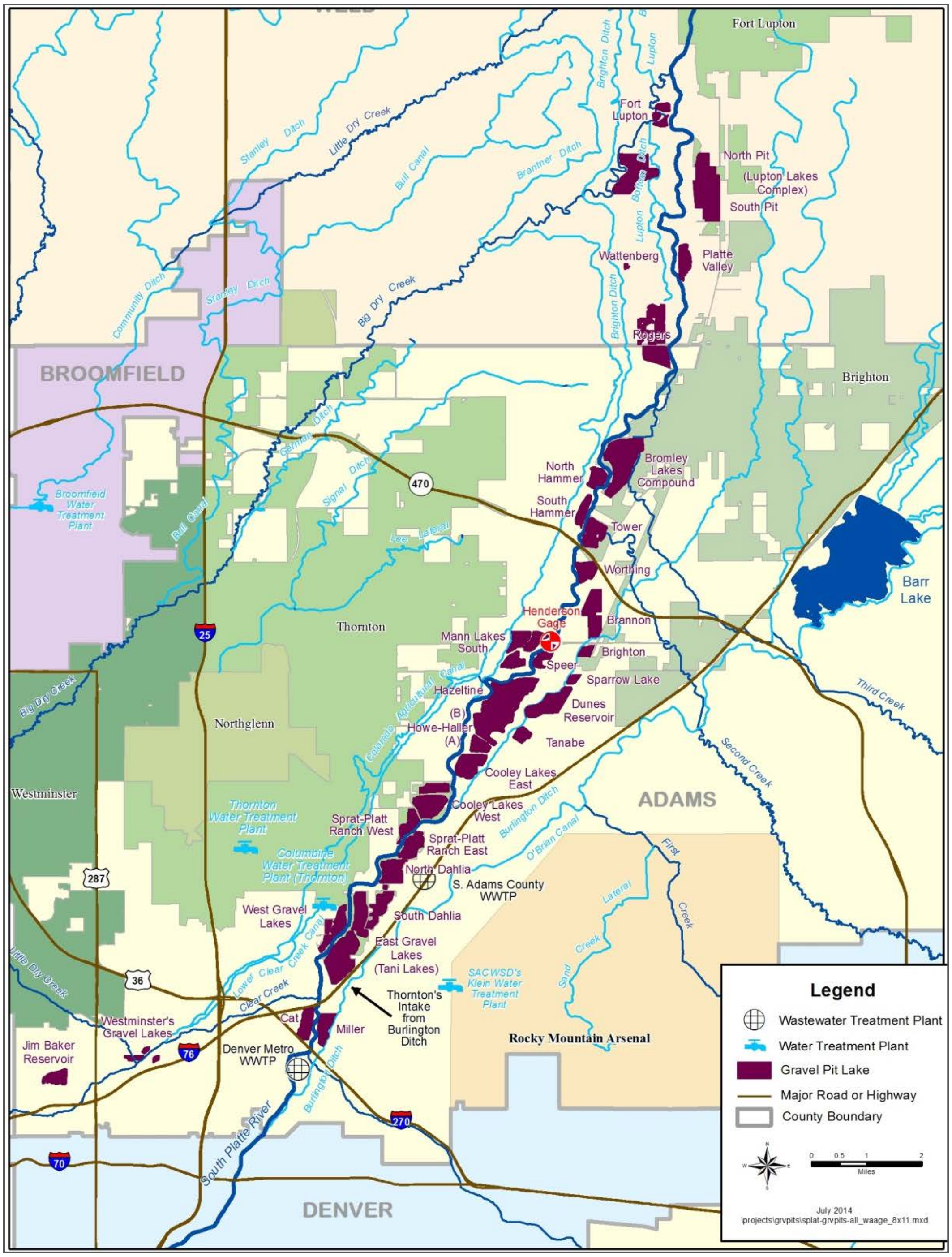


**Figure 3-17. South Platte River North of Denver Existing and Proposed Gravel Pit Reservoirs**
Source: Denver Water

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. These concerns are localized issues that in some cases have been addressed by water users utilizing engineering construction alternatives such as perimeter drains on the up gradient side of the lined reservoir.

Historic aggregate mining sites have been so fully utilized that the remaining sites are located farther downstream from the end users and will require potentially extensive, high cost conveyance systems that will greatly affect the affordability of these projects. As water quality decreases lower in the South Platte Basin, these future projects may also face significant challenges associated with high cost advanced water treatment and with major challenges in obtaining regulatory permits to dispose of chemically-concentrated waste streams from these treatment processes.

##### *3.2.1.7.3 Groundwater Storage*

Groundwater storage allows water providers in the South Platte basin the ability to utilize aquifer storage and recovery (ASR) to further firm water supplies. ASR is accomplished through injecting high-quality treated surface water into non-tributary aquifers, such as the DBA system, for later use. The amount of water injected into the aquifer is highly dependent on surface water yields from rivers and streams. Centennial Water and Sanitation District's DBA system ASR program has a long history of storing excess treated water from South Platte surface water supplies within the DBA system for future use. Other water providers, including the South Metro Water Supply Authority (SMWSA) are investigating and implementing ASR programs to provide additional storage to firm existing water supplies. ASR provides increased water yields by minimizing evaporation losses, and provides a stored source to reduce impacts of long-term droughts.

#### 3.2.1.8 Other Impacts on Surface 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. [16]
- 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, less water for agriculture and for agricultural well augmentation, and for environmental and recreational purposes.

### 3.2.1.9 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
- 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.

As outlined in Section 3.1.10, the purpose of the PRRIP is to provide ESA compliance for new and existing water related activities 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.

One way to better understand the factors affecting supply availability is through the use of the Point Flow Model, showing where exchangeable flows exist. The Point Flow Model referenced in Section 3.2.1.2, and described in detail in the South Platte Basin Water

[16] 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.

Availability Technical Memorandum (Appendix G), was used to calculate exchangeable flows at the diversion structures on the mainstem. These are used to analyze the general exchange conditions in the South Platte River and identify points that would potentially limit or control future exchanges. The median of the values is assumed to be representative of the typical exchange capacity for each point. Figure 3-18 shows the median monthly exchangeable flows from 2000 to 2013 at each of the diversion structures. The goal of this plot is to provide a visual representation of the exchange capacity from upstream to downstream and to show timing and location of potential exchanges, as well as points that are more likely to constrain future exchanges. The exchange potential from a downstream point to an upstream point can be approximated by the minimum exchangeable flows between the two points in Figure 3-18.

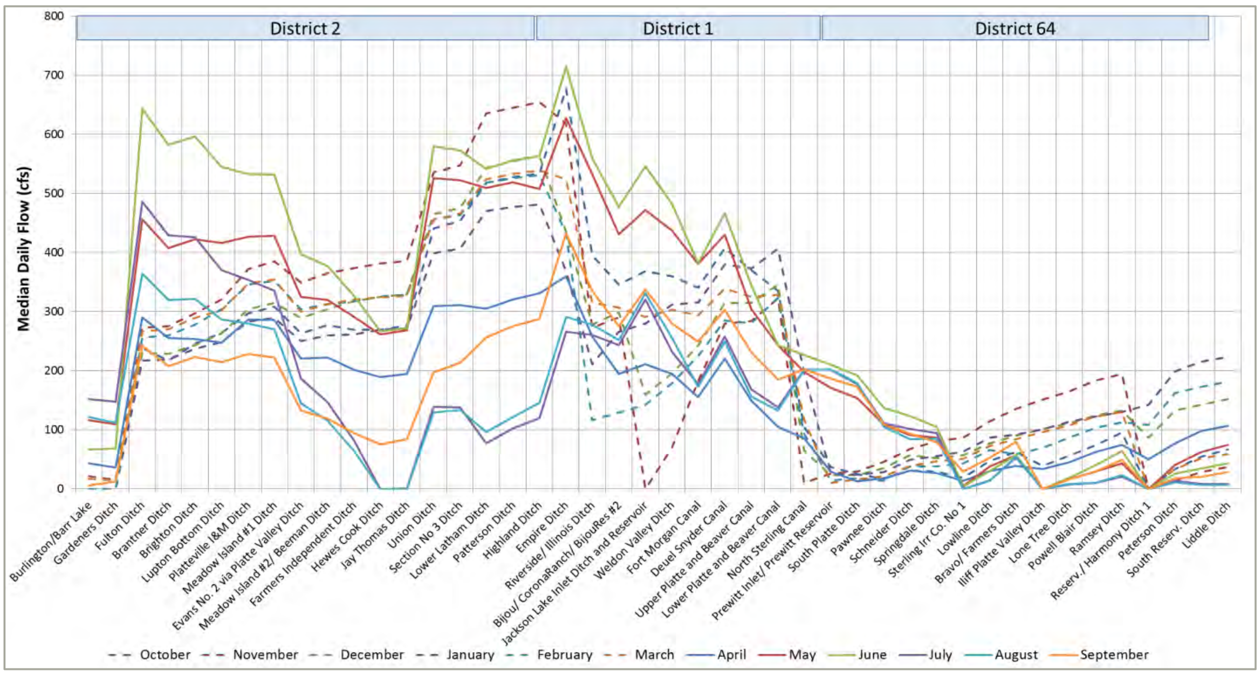


**Figure 3-18. Median Exchangeable Flow for the South Platte Diversion Structures (2000-2013)**

The months of October through March, plotted with dashed lines, and months of April through September, plotted with solid lines, each show common patterns within their groupings since October through March is a season of high water storage and the remaining months are irrigation dominated. Exchange through the Prewitt inlet diversion is very limited between October and April yet shows moderate exchangeable flow during the summer months. That pattern is reversed downstream toward the Powell Blair Ditch. Exchanges through the Hewes Cook Ditch structure seem extremely reduced for July and August, and it is likely to act as a limiting point for other months represented by solid lines. Exchanges upstream of Fulton Ditch are likely to be controlled by low flows at Burlington and Gardeners Ditches. June is the month with higher exchange capacity, while July is among the months with the lowest capacity.

South Platte River water administration and supplies will continue to evolve over time as the river responds to the changing demands, weather patterns, and competition for water.

### 3.2.2 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

#### 3.2.2.1 Colorado-Big Thompson Project

Northern Colorado Water Conservancy District 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 project, 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.

The C-BT project was constructed to provide supplemental agricultural and municipal water supply. C-BT water has increasingly been utilized as a municipal source of water supply by drinking water providers located within the 1.5 million acre Northern Water service area. The continued acquisition of 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 irrigation allottees. Figure 3-19 shows the current ownership of the 310,000 units of C-BT water.

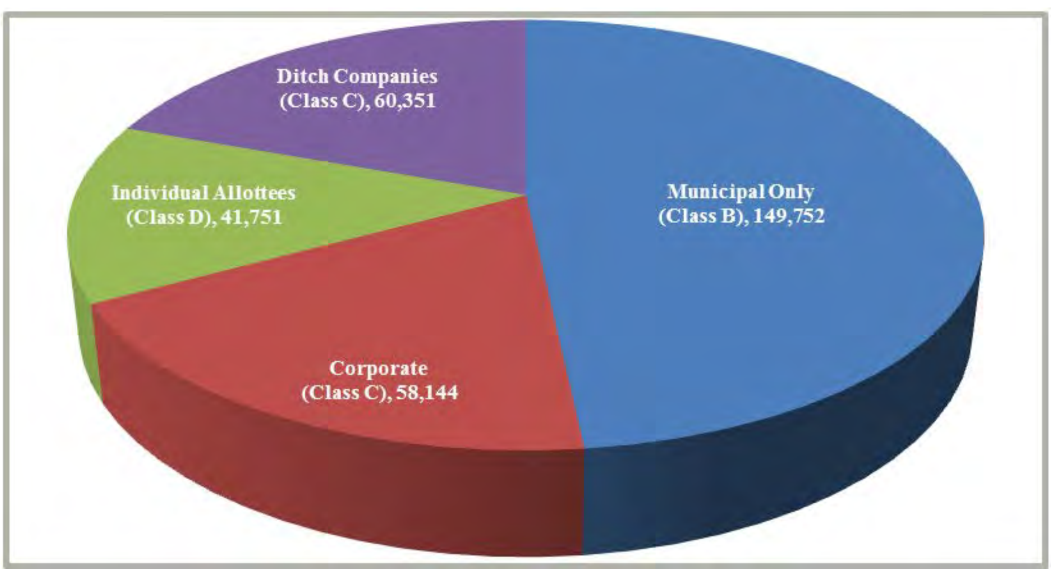


**Figure 3-19. Ownership of C-BT Water Units (2014)**

The North Poudre Irrigation Company (NPIC) owns 40,000 C-BT units. The majority of shares in the NPIC are owned by municipal water providers including the City of Fort Collins and the Tri-Districts. 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

### 3.2.2.2 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 methods (ATMs) such as rotational fallowing programs or interruptible supply agreements. Historically, acquisition of M&I agricultural water rights acquisitions has resulted in the permanent dry-up of irrigated land.

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 River mainstem in Water Districts 1, 2, and 64 as well as the 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.

#### 3.2.2.3 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.

#### 3.2.2.4 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 made absolute. 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 likely is not sufficient water available to develop all of the existing conditional water rights, therefore, putting limits on the development potential for native South Platte water to meet future consumptive needs.

### 3.2.3 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, in some locations, 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 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 and recreational benefits
- Water supply operations can introduce unnatural variations in streamflow
- Water quality issues may arise due to human impacts

Environmental and recreational needs are 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.

#### 3.2.3.1 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.[17] 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 3-20.

[17] Straightline Diagrams available on the DWR website: http://water.state.co.us/Home/Pages/default.aspx

South Platte Dry Up Points

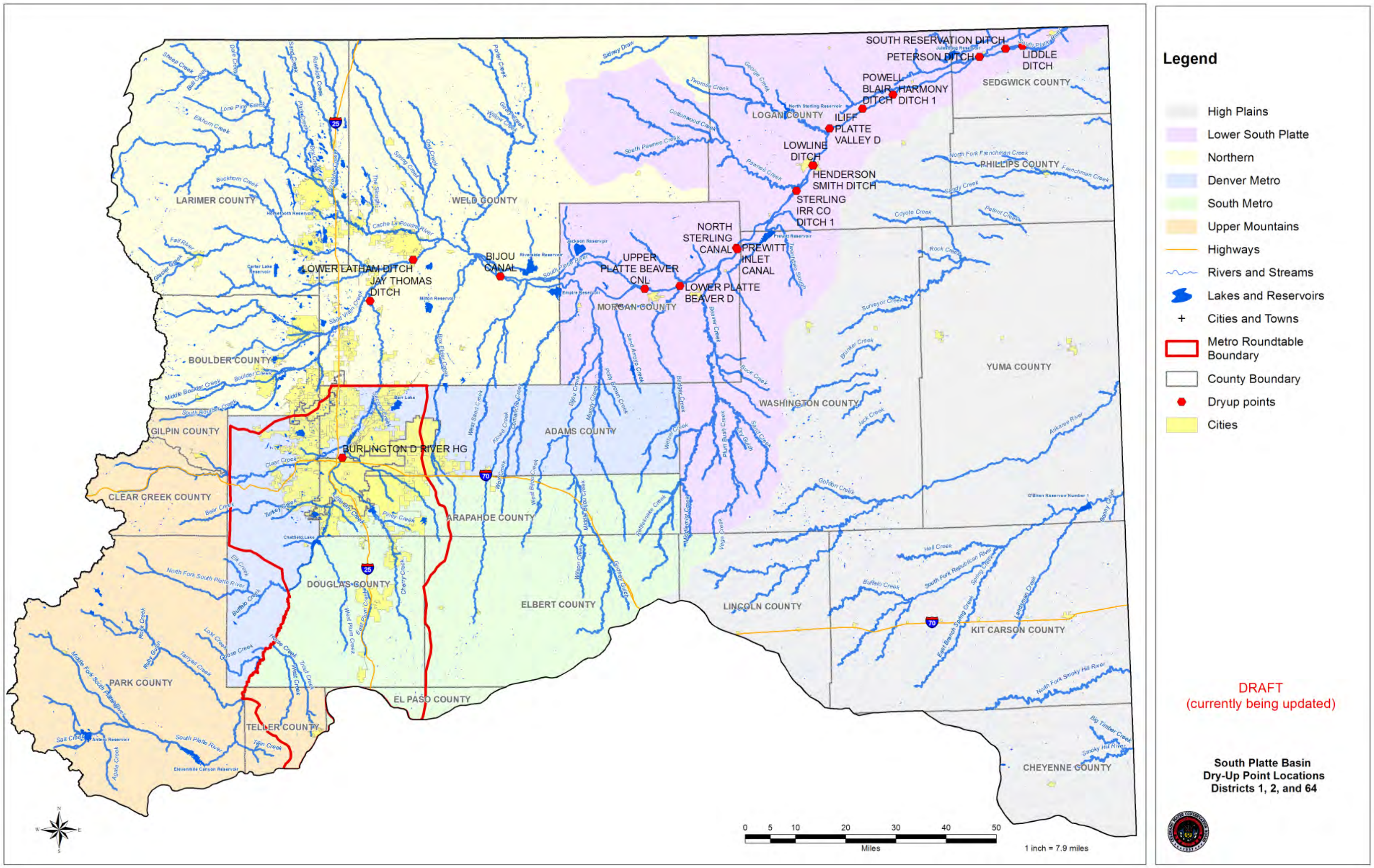


**Figure 3-20. South Platte Dry-Up Locations in Water Districts 1, 2, and 64**

### 3.2.3.2 Potential Impacts and Benefits of Agricultural Use to Environmental and Recreational Attributes

Agricultural use of water helps 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 3-21.

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 3-21 and in Appendix C.

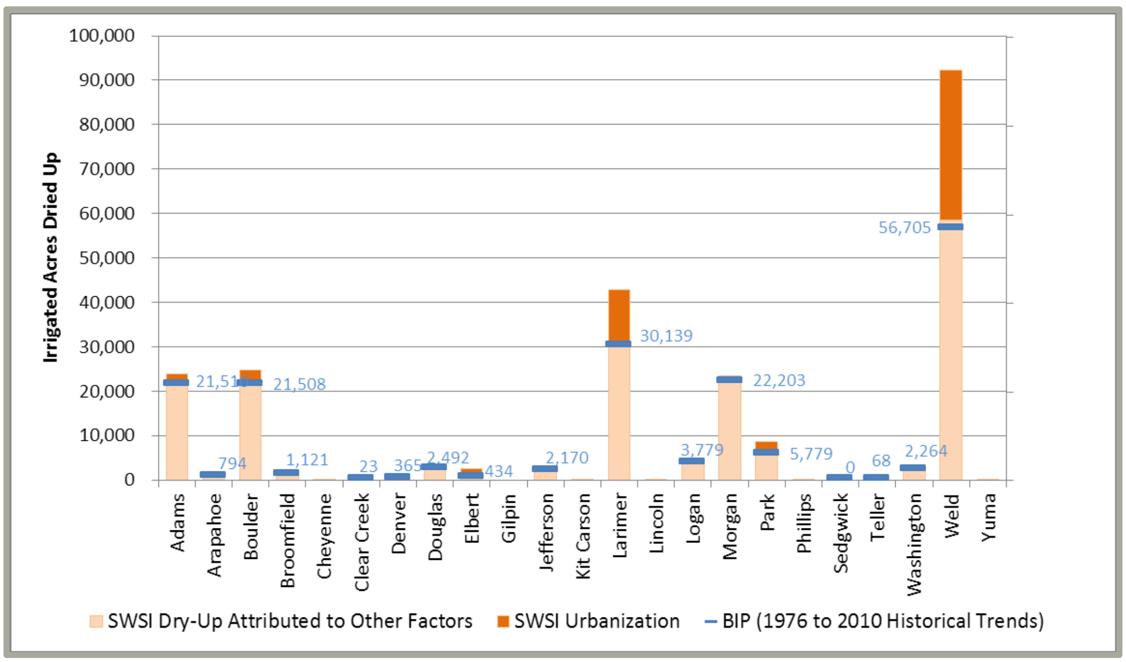


**Figure 3-21. South Platte Dry-Up Acreages (SWSI 2010 and trend analysis)**

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 movement of 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. Additional discussion regarding the impacts of the future trend of additional agricultural dry-up is found in Appendix C.

#### 3.2.3.3 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 when possible and protecting the return flows in water rights change of use cases is important to maintaining streamflows for environmental and recreational attributes.

#### 3.2.3.4 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 3-22.

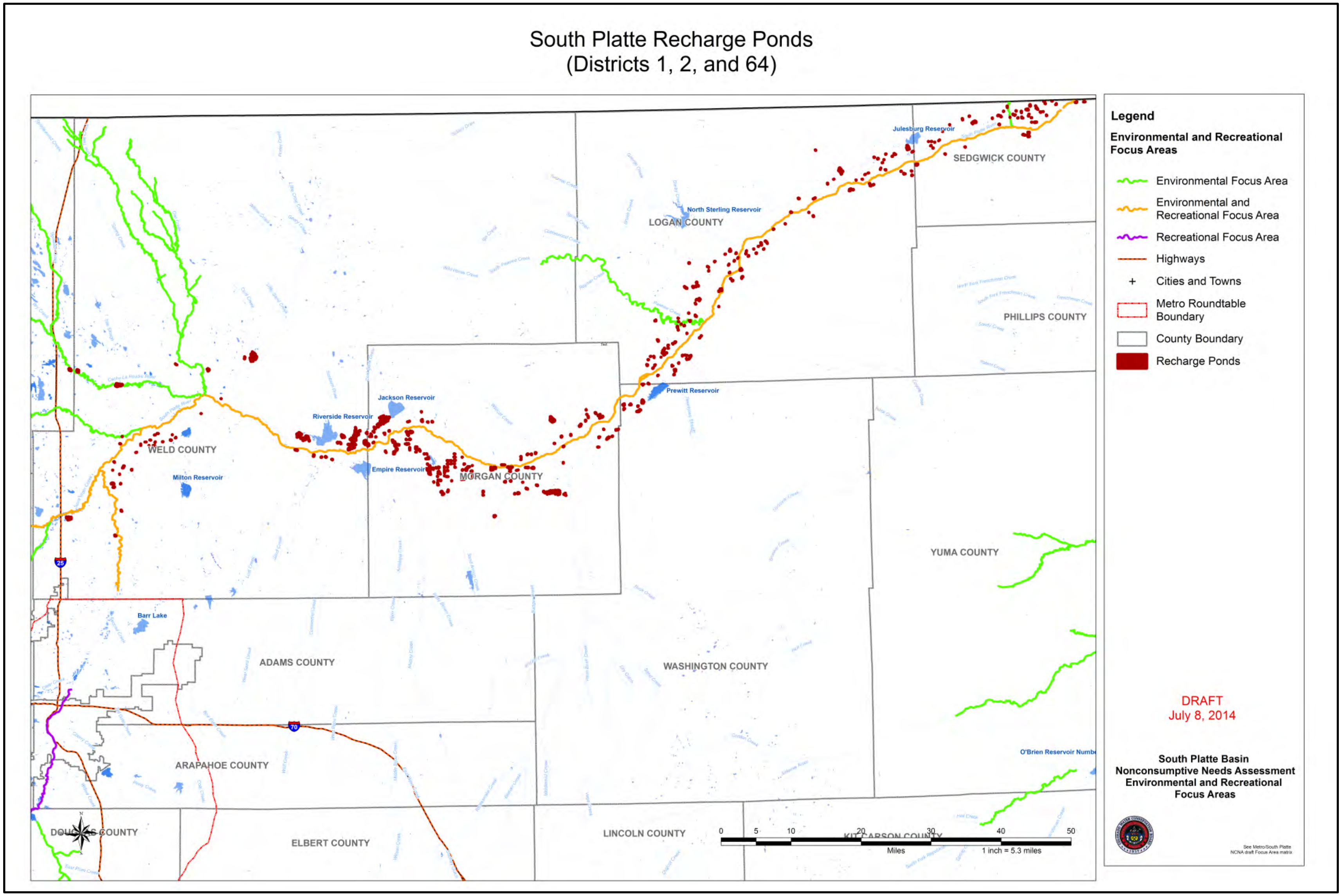


**Figure 3-22. South Platte Recharge Locations in Water Districts 1, 2, and 64**

#### 3.2.3.5 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.

## 3.3 Water Management and Water Administration

Section 3.2 primarily summarizes water management and water administration information extracted from SWSI 2010, except where noted.

### 3.3.1 Interstate Compacts and Endangered Species Recovery Programs

The South Platte Basin is subject to an interstate compact and one endangered species recovery program. The Republican Basin is also subject to an interstate compact. The interstate compacts and endangered species recovery programs impact the water availability within the basin. They 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 downstream end of 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.[18]

**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

[18] Colorado Foundation for Water Education. Citizen's Guide to Colorado's Interstate Compacts. 2010.

water each year to Nebraska. If the water supply of any source varies, the allocation also changes.[19]

**Platte River Recovery Implementation Program** - A detailed description of the PRRIP is provided in Section 3.1.10. 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 utilizes, 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.

### 3.3.2 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.
- 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.

[19] Colorado Foundation for Water Education. Citizen's Guide to Colorado's Interstate Compacts. 2010.

- 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 and well user groups acquire gravel pit storage to provide augmentation supplies for out-of-priority depletion of wells.
- 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.

### 3.3.2.1 South Platte Evaluation

#### *3.3.2.1.1 River Calls*

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

**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

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 3-23 shows the location of the water districts in the South Platte and Metro basins.

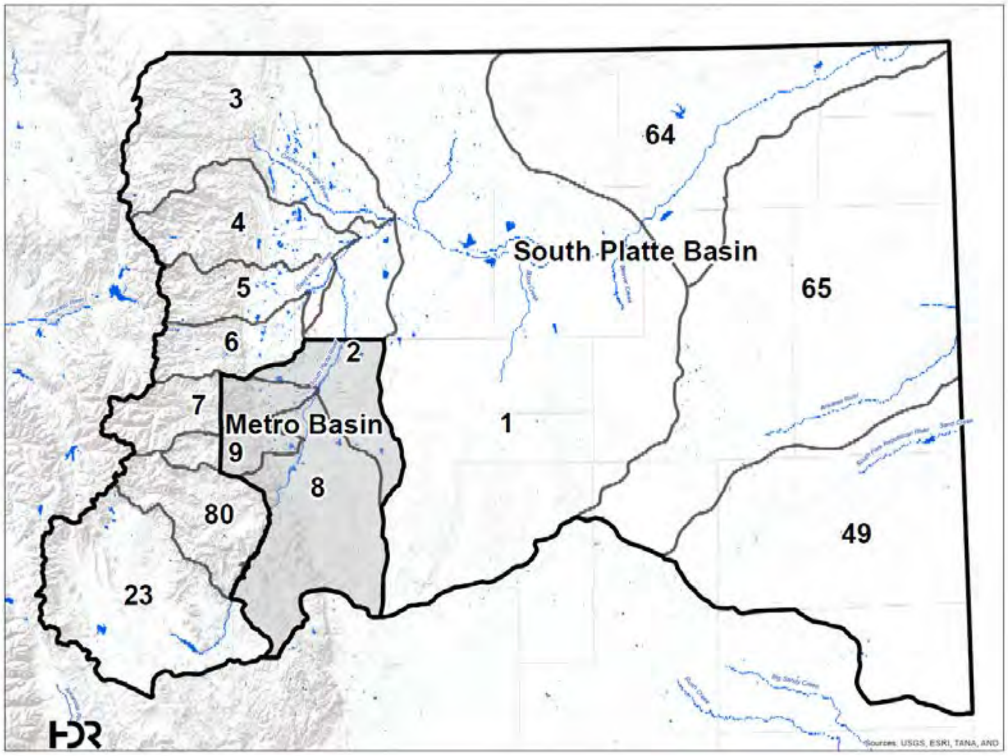


**Figure 3-23. Water Districts in the South Platte Basin**

### *3.3.2.1.2 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.

A 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".

##### *3.3.2.1.3 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.

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. Figure 3-24 illustrates the major reservoirs along the South Platte River downstream of Denver.

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.

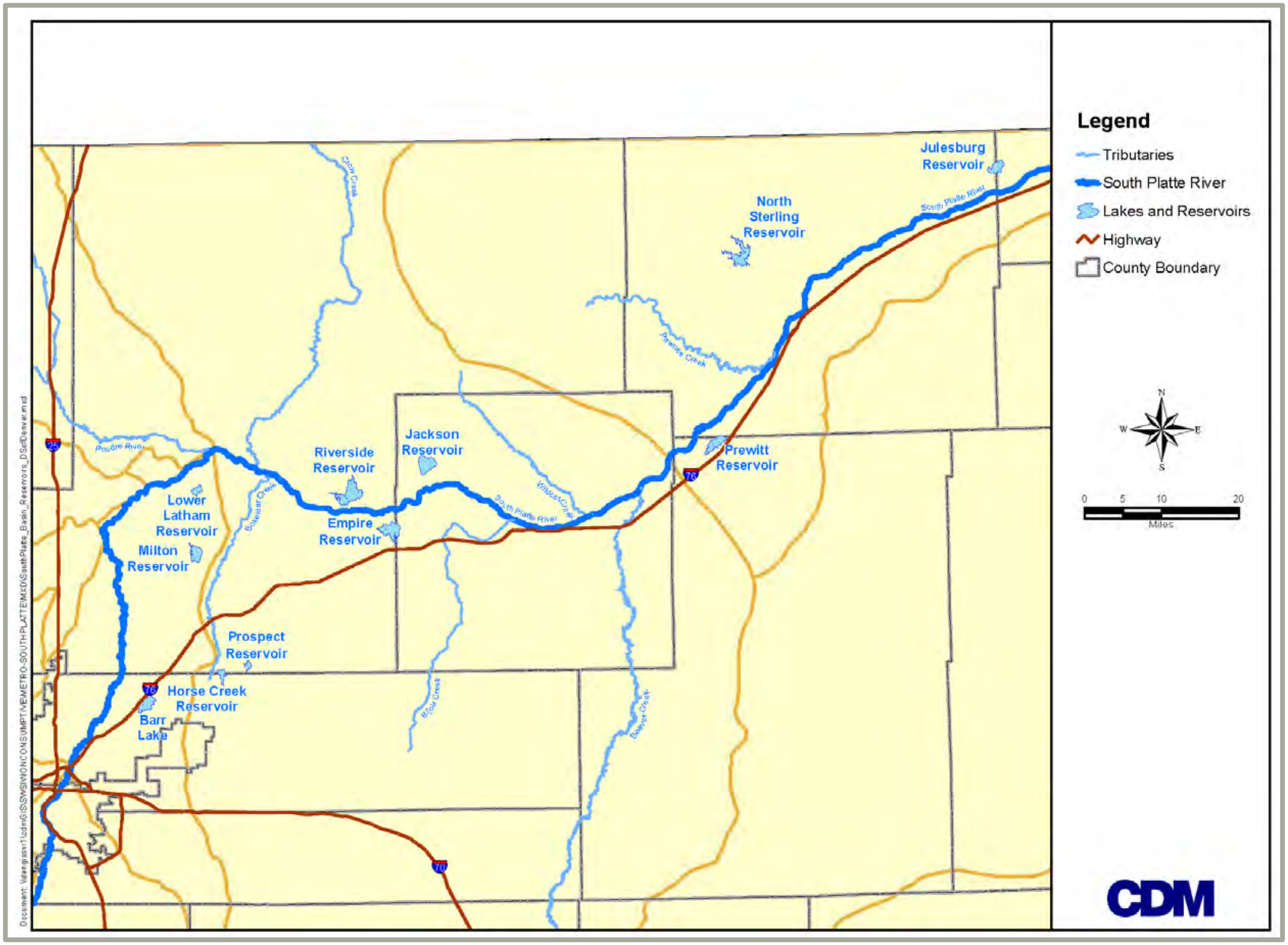


Figure 3-24. Major South Platte Reservoirs Downstream of Denver

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. Since the development and use of alluvial groundwater, producers typically irrigated in the early season (i.e., for germination) with groundwater and did not request surface deliveries. Historically, this led to reduced spring call seniority as compared to current practices. Today, irrigation canals divert for a longer duration and therefore require additional volumes which have led in some instances, to localized groundwater rise due to a shift in the water balance (surface inputs greater than groundwater withdrawals).

The increasing adaptation of automated sprinklers, as opposed to the previous flood/furrowing irrigation method has in many instances reduced return flows, resulting in increased calls on the river during many times of the year.

Figure 3-25 illustrates the comparison of frequency of calls in District 1 for 1982 through 2012.

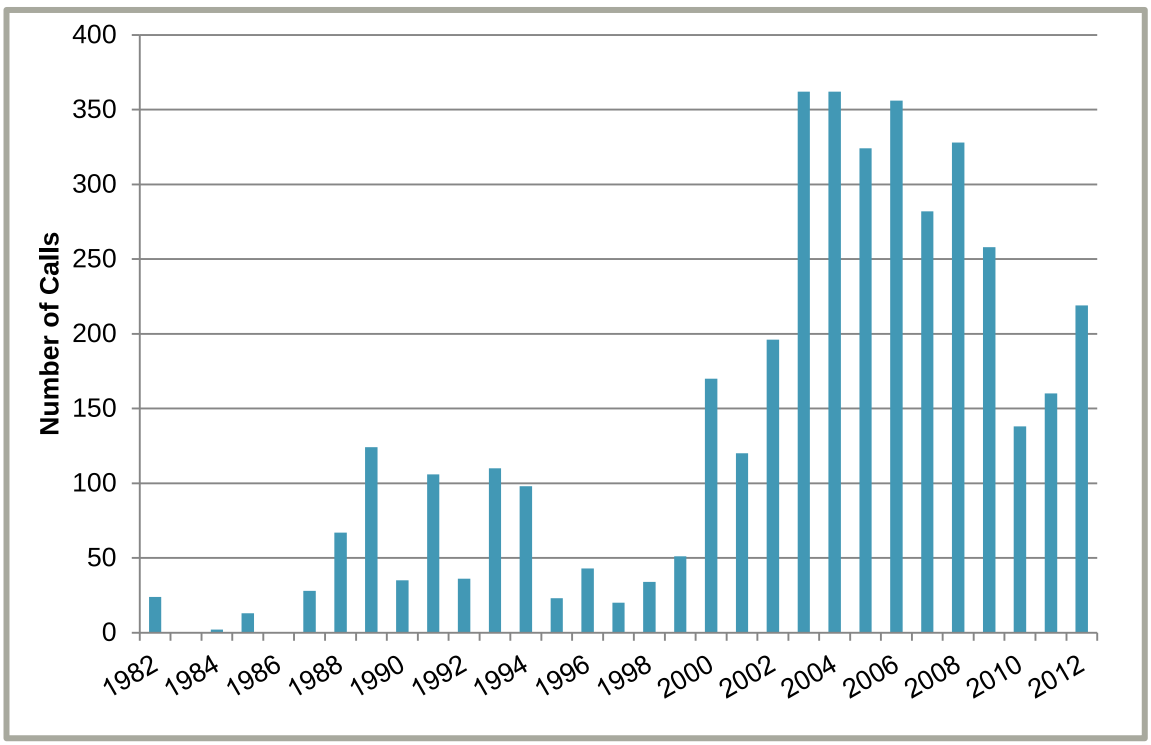


**Figure 3-25. Days of Call per Irrigation Year in District 1**

#### *3.3.2.1.4 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. Additionally, similar to Districts 64 and 1, irrigators are now heavily reliant of surface water supplies and storage rights instead of groundwater. Further, due to the return flow nature of the basin, expanded reuse will continue to decrease the amount of water available to agriculture and other water users as a large percentage of current downstream flows come directly from reusable wastewater that is discharged into the river.*

### 3.3.2.2 Tributary Water District Evaluation

#### *3.3.2.2.1 Water District 3 (Poudre River)*

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.

**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

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 as reflected in Figure 3-26.

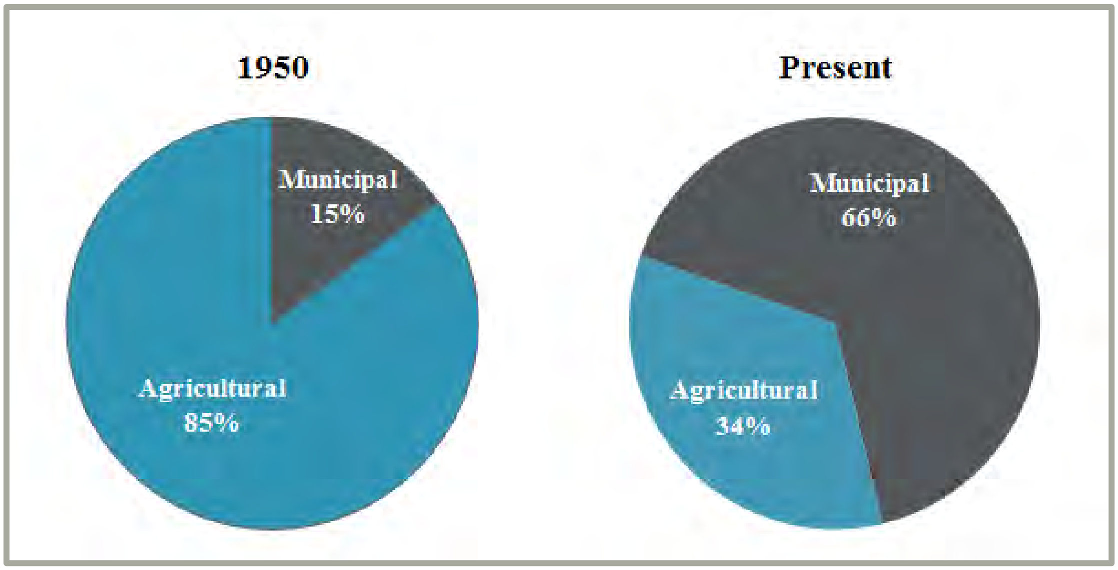


**Figure 3-26. C-BT Units in 1950 to the Present (2014)**

#### *3.3.2.2.2 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.

#### *3.3.2.2.3 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.

#### *3.3.2.2.4 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.

##### *3.3.2.2.5 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.

##### *3.3.2.2.6 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.

### 3.3.2.3 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 3-27 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.

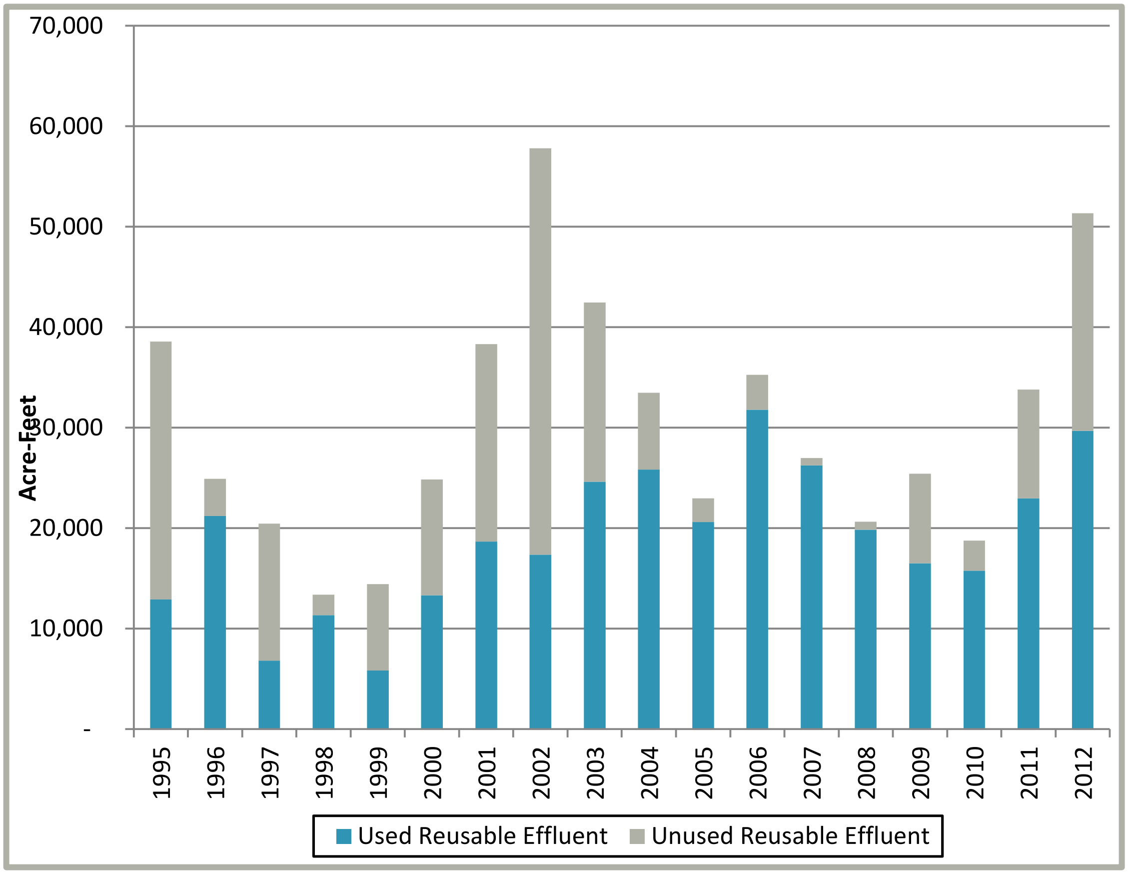


**Figure 3-27. Average Daily Used and Unused Denver Water Reusable Effluent at the Metro and Bi-City Wastewater Plants (1995-2012)**

### 3.3.2.4 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 between 128,000 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.

### 3.3.3 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.

#### 3.3.3.1 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.

#### 3.3.3.2 Exchange Water Rights

Exchanges that operate 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. Legally, 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.

#### 3.3.3.3 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 to October 15). While at times the compact call may result in additional 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.

#### 3.3.3.4 Recharge Water Rights and Augmentation Plan Management

As discussed above, there are many groundwater recharge projects operated in conjunction with augmentation plans along the South Platte River. One additional benefit derived from the recharge projects, in addition to augmentation water for groundwater well pumping, is 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 environmental and recreational needs in the lower reach of the South Platte River. Additional examples include 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.

#### 3.3.3.5 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.

#### 3.3.3.6 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.

As discussed in Section 3.1.10, 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 ESA. The Department of Interior along with Colorado, Wyoming, and Nebraska abide by the Three States Cooperative Agreement which fosters a basin-wide, cooperative effort to improve and maintain habitat for the ESA listed species.

Because it is assumed that the PRRIP protects critical habitat for ESA listed species, compliance with the PRRIP allows existing Platte River basin water projects to continue operating, and lets new water projects develop if they maintain compliance with the ESA. The Tamarack Recharge Project discussed previously is one way in which Colorado complies with PRRIP obligations to 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.

### 3.3.3.7 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.

#### *3.3.3.7.1 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. [20, 21]

#### *3.3.3.7.2 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. [22]

> *[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*

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

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

[22] Sources: NRCS Colorado

*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.*[23]

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.

## 3.4 Hydrologic Modeling for Water Availability

Section 3.3 was presented by the CWCB as optional. In the absence of the SPDSS, an interim technical analysis was completed as outlined in Section 3.2.1.2 to refine the understanding of South Platte Basin water availability and to advance discussion of potential water sources to conceptualize economically viable projects and methods to meet future South Platte Basin water needs. Appendix G provides the full Technical Memorandum for this analysis.

For future work, the SPDSS should be used 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 tools such as SPDSS could also 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.

## 3.5 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 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

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

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.
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### 3.5.1 Consumptive

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 once the SPDSS tool has been completed.

### 3.5.2 Environmental and Recreational

Based on the environmental and recreational needs discussed in Section 2, a methodology and framework were 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 Appendix B.

In order to determine the gap in protections 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 available under 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, 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 whether protections are adequate. 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.

## 3.6 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 3-28 shows the annual flow from 1927 to 2013 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.

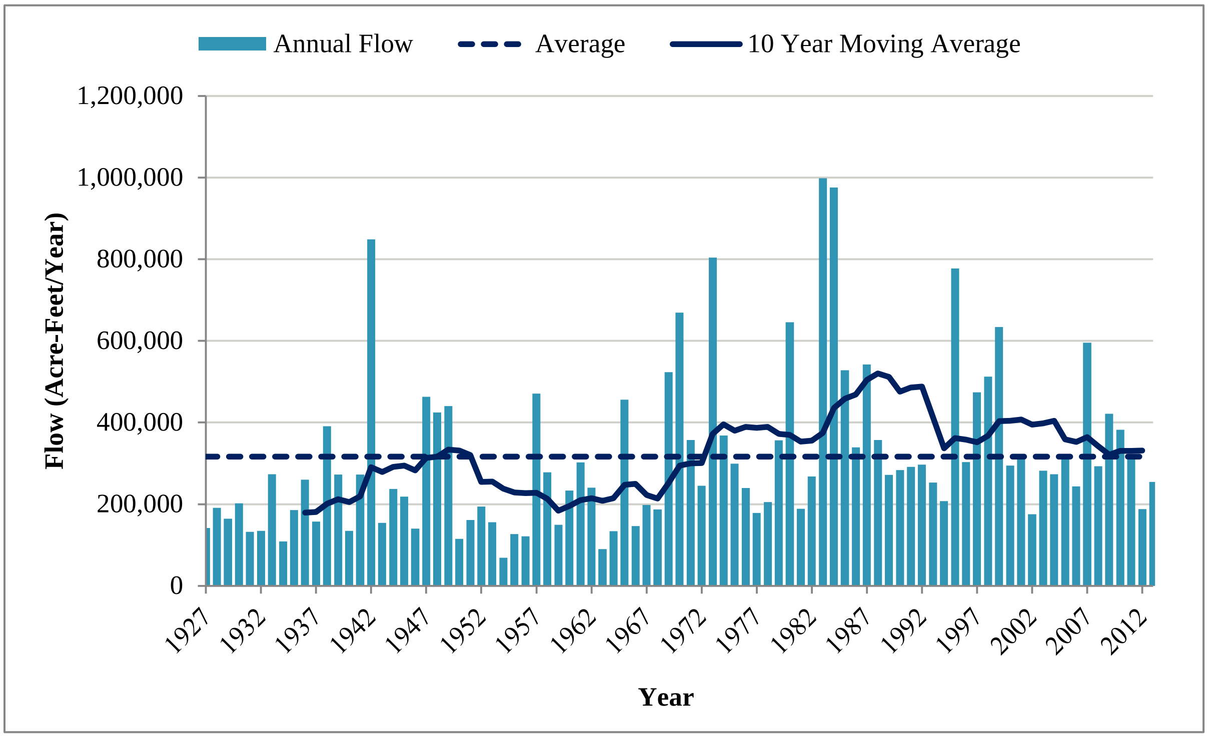


**Figure 3-28. Annual South Platte Flow for at Henderson from 1927 to 2013**

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 previously shown in Figure 3-25, 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.

## 3.7 South Platte Basin Water Supply Availability Conclusions

The future water supply gap in the Basins is an urgent problem that must be urgently addressed.

- 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 likely be insufficient 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. Prompt 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.

Competing water supply projections, unappropriated water, changing river administration and consumable effluent reuse further complicate the growing gap.

### 3.7.1 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 fierce.
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.

### 3.7.2 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 and only sporadic water availability in wetter 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 much, if not all, of 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 believe that what water is available for development will either be developed as part of existing projects that are either advanced in planning or already underway, or occurs in such infrequent and high magnitude peaks that it can not be feasibly captured and converted to reliable yield.
3. Therefore, it does not appear that remaining unappropriated South Platte Basin surface water can be relied upon as a significant water source to meet future consumptive needs within the basin.

### 3.7.3 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.

### 3.7.4 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.

### 3.7.5 Water Conservation Plans

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

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# 4

# Projects and Methods

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# 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. From January through March 2015 the South Platte and Metro BRTs undertook “roving” meetings in six locations throughout the basin to facilitate public involvement in and comment on the Final SP-BIP. In addition, an animated video was created to share the SP-BIP process, issues, and recommendations.
- 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 - Environmental and recreational projects are needed to maintain or enhance environmental and recreational attributes. In addition, 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 Phase I 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 (Table 4-1). 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<br>Denver, CO | 46 |
| **Northern South Platte** | March 5, 2014 | Southwest Complex Weld County<br>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 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 in Figure 4-1.

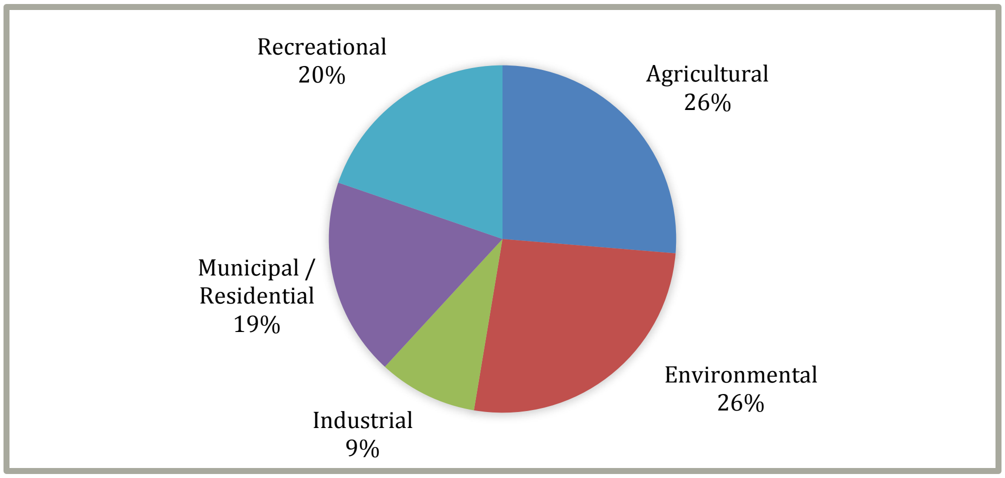


**Figure 4-1. Most Important Water Needs***

*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. Twenty-one presentations were made by BRT members as shown in Table 4-2.

**Table 4-2. Presentations 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 Phase II Activities: July 2014 – March 2015

The primary purpose of this second round of engagement was to share the results presented in the Draft BIP. The table below provides an overview of activities, tools and intended audience.

Six public meetings were held from January to Mid-March of 2015 as components of roving Roundtable meetings. These meetings were held in conjunction with the regularly scheduled South Platte and Metro Basin Roundtable meetings. The meetings included an overview of the Draft SP-BIP and a 50 minute facilitated question and answer period, along with distribution of surveys to meeting participants.

Roving Roundtable meeting locations included Loveland, Westminster, Sterling, Denver, Evergreen, and Highlands Ranch. Comments from these meetings have been compiled and are available in Appendix H.

In addition to these the roving BRT meetings, the activities described in Table 4-3 further comprised Phase II public outreach.

**Table 4-3. Engagement Tools and Intended Audiences for Phase II Activities**

| Activities and Outreach Tools | Intended Audience |
|---|---|
| **Webinars – Online Town Halls** | Two online town halls were held to reach a broader population within the basin and state. They were hosted through an online webinar on February 03, 2015 at 7:30 pm and on February 05, 2015 at 12:00 pm. |
| **The SP-BIP Website** | Two iterations of an interactive, web-based presentation and public response program, located at www.southplattebasin.com. It allowed users to access overview information, directed the public to additional information including the SP-BIP, and provided an opportunity for users to comment directly on available content. In Phase II, the website included the SP-BIP for review, information about the Roundtable meetings, and included an animated video. |
| **SP-BIP Animated Video** | An animated video was created and housed within the SP-BIP website. The video content was shareable on social media through vimeo, youtube, facebook, and other venues using "share" buttons. The video content described the process of developing the SP-BIP, and included descriptions of the main issues within the basin and the proposed solutions. |
| **Online Survey for Comments and Input** | A survey form soliciting public input on the overall SP-BIP program and key issues. Commenters could provide 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 presentations to interested groups** | Roundtable member representatives provided direct links to all types of water users including agriculture, municipal, industrial, environmental and recreational. Many Roundtable members participate in special interest and civic groups and provide periodic input and presentations directly to their memberships. |
| **Collaboration with Environmental and Recreational Subcommittee** | The Environmental and Recreational Subcommittee was 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. |
| **Status calls** | During the development of the Draft SP-BIP and Final SP-BIP on a weekly basis or bi-weekly basis, respectively, 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 included outside environmental and recreational representatives, to promote transparency and obtain timely input and guidance given the short timeframe for developing the SP-BIP. |

### 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 a 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 and 2015 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 element of the plan would 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 would 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 that have water education in their mission would provide opportunities for further collaboration.

**Develop and Maintain Basin-Specific Outreach Tools and Approaches:** An assessment would 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 www.southplattebasin.com site would be maintained and updated to function as the foundation of all education, participation and outreach activity and content. A possible outcome of the assessment 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 would 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, controlled burns, 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 ideal for coping with dry

[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

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 of targeted stands 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. Parts of the South Platte basin have experienced significant loss of forested areas due to insect and disease.

#### 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 as in Figure 4-2 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.

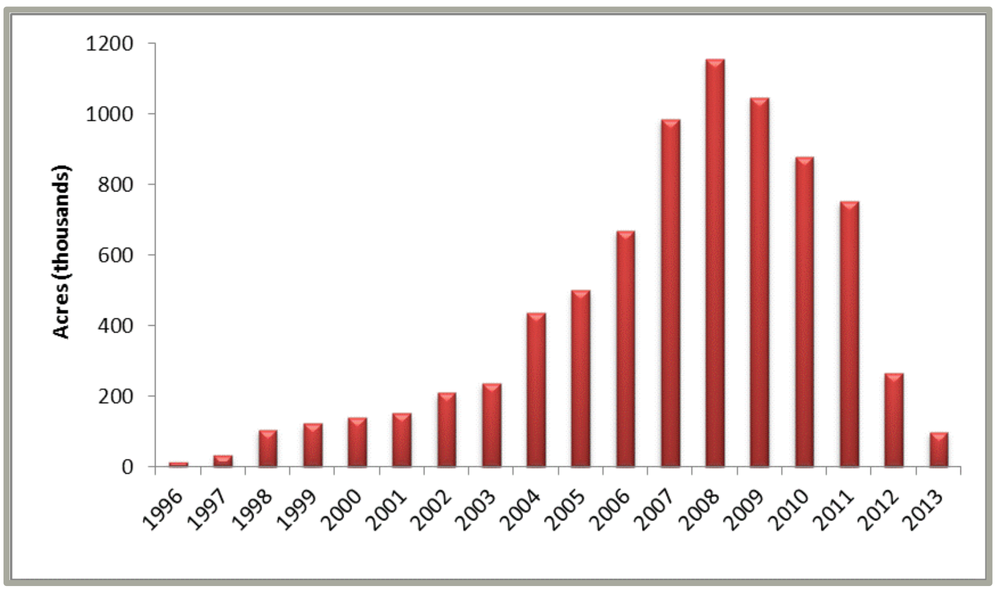


**Figure 4-2. Annual Acres Affected by Mountain Pine Beetles in Colorado**

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, as shown in Figure 4-3, 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] 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.

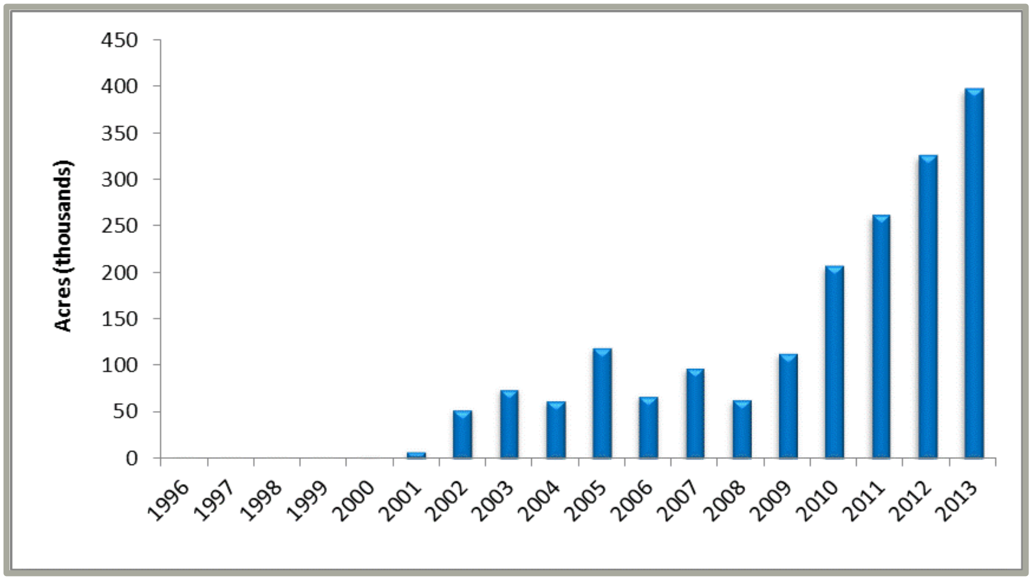


**Figure 4-3. Annual Acres Affected by Spruce Beetles in Colorado**

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

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

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

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

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.

#### 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.

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[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.

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

### 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 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 environmental and recreational 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. In addition, the Colorado Department of Health and Environment (CDPHE) monitors water quality throughout the State.

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. 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.
2. Water quality changes, generally beneficial, due to West Slope transfers of water into the Basin.
3. 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.
4. Mountain communities relying upon bedrock wells, providing limited supplies and impacting in some areas by cross-contamination from individual wastewater treatment systems.
5. The threat of emerging contaminants (including pharmaceuticals and personal care products) 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 and septic systems. To date, these types of

contaminants remain unregulated, due to low detection limits. However, water supply providers in the Basin are beginning to gather baseline information on these substances.

6. Forested areas of mountain tributaries of the South Platte Basin are being impacted by climate variability, 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.
7. 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 in concerns of trace metals concentrations and controls to reduce these through various forms of remedial actions.
8. Cherry Creek and other plains streams move great quantities of sand through their respective watershed each year, increasing sediment and releasing phosphorus.
9. 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.
10. 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 Aquifer system 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.
11. There are salinity concerns related to wastewater treatment plant discharges and salted roads. These salinity issues can impact both surface water and groundwater supplies.
12. Changing regulatory temperature standards can create additional consumptive use for the additional cooling water needed to meet these standards.
13. 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.
14. 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 concerns 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.

For this plan, water use is measured in gallon per capita per day (GPCD). GPCD is calculated by the total water use, including indoor and outdoor residential use, non-residential (including commercial, industrial or institutional) indoor and outdoor use and water lost during transportation,

#### 4.3.1.2 Municipal Conservation Plans in Colorado


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

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

#### 4.3.1.2.1 *Conservation Plan Components*

**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.

**Little Thompson Water District**

Little Thompson Water District has a unique system that presents challenges to applying more traditional water conservation practices. The district serves rural areas and a wide expanse (larger lot size and greater transmission distance than an urban setting). However, the District has successfully implemented a conservation tap option for new customers. The rates and installation fees associated with this option allow for a financial compensation if the user agrees to a lesser consumptive rate.

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.

**City of Greeley**

The City of Greeley has reduced average residential consumption from 154 gpcd (2007-2002) to 121 gpcd (2011-2013). This reduction has allowed the metered demand to remain essentially unchanged in sixteen years in spite of a 31.5% population growth.

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.

**Slow the Flow Program**

In an addendum to the 2014 Annual Report Putting Conservation into Action, 18 South Platte Basin water providers participated in the Slow the Flow Program. Weather data, landscape type, and size of irrigated area were used to evaluate the evapotranspiration requirement and compared the results to water use data of previous years. At the time of the audit 77% of participants were overwatering. Providing this information to the users resulting in an average savings of 7,000gallons per participant.
Center for ReSource Conservation

**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.

**Conservation Education Programs**

Denver's water use from December 2014 made headlines. "The last time December use dropped this low was in 1973 when Denver had 350,000 fewer people." Conservation education, programs like Denver Public Schools low flow toilets, and current events and awareness were cited as major influences on this achievement.
Finley, The Denver Post, *Denver water use dips to a 40-year low in 2014.* February 10, 2015.

#### 4.3.1.3 Municipal Conservation Plans in the South Platte Basin

There are currently 45 water providers within the South Platte Basin with formal conservation plans filed with the CWCB and each plan is tailored to conditions of the community and the system. Consistent themes of these unique plans are:

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

The data analysis associated with House Bill 1051 will encourage further refinement and investment in conservation practices by comparing volume of water conserved and program costs. Impacts should be well understood for future plans regarding downstream return flows as well as adjustments to rate structures.

#### 4.3.1.4 Metro and South Platte Conservation Successes – 2000 to 2010

The Metro and South Platte Basin have long-standing conservation practices that are nationally known for their rigor and have documented success.

The Metro Basin supplies nearly half of the state's population and growing economic base. 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]

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 during this ten year period.

**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*

All of conservation savings (100 percent) during this time period was applied to the M&I water supply gap, significantly reducing the M&I gap in the Metro and South Platte basin. Table 4-5 shows the total amount of conservation savings (active and passive conservation) during 2000 to 2010 that was applied to the M&I gap.

**Table 4-5. 2000 to 2010 Total (Active and Passive) Conservation Savings in the Metro and South Platte Basins**

| Basin | Total Conservation Savings (AF) | Percent Applied to the Gap | Amount Applied to Gap (AF) |
|---|---|---|---|
| **Metro** | 167,000 | 100 | 167,000 |
| **South Platte** | 68,000 | 100 | 68,000 |
| **Total:** | **235,000** | **Total:** | **235,000** |

#### 4.3.1.5 Conservation Goals 2010 to 2050

The South Platte and Metro Basins are leaders in conservation and will continue to pursue increasingly aggressive conservation levels. Metro and South Platte Basin Roundtables do not agree with "low, medium, and high" terms used in SWSI 2010 to

[10] *Updated Metro Roundtable Conservation Strategy*

define conservation levels because they do not 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.

*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 the SWSI 2010 medium strategy (34 gpcd) is a realistic goal for their area which will still require water providers to actively pursue new ordinances or legislation.
- South Platte Basin water providers envision 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:*

Water needs will continue to grow as the Metro and South Platte areas grow which means that there may be fewer opportunities to save water in non-residential indoor use. Additionally, less is known about the non-residential customer base as the last Water Research Foundation study was done in the early 1990s. Opportunities for additional water conservation should be identified through updated water use studies specific to non-residential users throughout the South Platte basin.

Results have shown that increasing business productivity and economic growth can mask achieved efficiencies as companies use water more efficiently and productively but diminish the total water savings by increasing output.[11] As an example, Denver Water’s industrial class of customers has reduced use by 2 percent since 2000, while the residential class has reduced use by more than 20 percent.

*Outdoor Use:*

The Metro and South Platte Basins have seen outdoor use change over the last ten years. Many customers have lowered water use for 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. However, providers have seen a sharp decline in outdoor use in the past three years, particularly in the residential sector, which could be due to the economic decline; water use could rebound as the economy recovers and homeowners reinvest in lawns and landscapes.

[11] Updated Metro Roundtable Conservation Strategy. November 2011.– 11-14-11

- Residential and commercial densification is expected to continue in the Metro Basin as population increases; this will contribute to marginal reductions in water demand.[12]
- Outdoor use in the South Platte Basin will continue to be higher than in the Metro Basin due to a higher percentage of single family dwellings and rural domestic areas with larger lot sizes.

*Water Loss:*

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

*South Platte and Metro Conservation Future Goals:*

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 as well as current water users and types of expected development.[13]

The revised conservation goals presented herein are aggressive given contemporary best management practices; as stated previously, conservation beyond these levels will require broad statewide support and political will beyond the purview of water utilities within the South Platte Basin alone.

- The Metro Basin Roundtable will pursue additional conservation programs to reduce per capita water use from a baseline of 155 gpcd in 2010 to 129 gpcd by 2050.
- The South Platte Roundtable will pursue additional conservation programs to reduce per capita water use from a baseline of 188 in 2010 to 146 gpcd by 2050.

Table 4-6 shows future conservation goals for each basin.

### Table 4-6. 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%** |

12 Appendix L of SWSI 2010

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

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

### 4.3.1.6 Impact of Future Conservation on M&I Water Supply Gap

#### 4.3.1.6.1 *Metro Basin M&I Conservation Savings*

As summarized in Table 4-7, by 2050 the Metro Basin is estimated to further reduce per capita M&I demand to 129 gpcd. If this goal is achieved, an additional 121,000 AF of overall M&I conservation savings would be realized between 2010 (or current) and 2050. Of this total, 75,000 AF is considered passive conservation savings with the assumption that 100 percent would be applied to the future M&I gap. The remaining 46,000 AF is considered active conservation savings and 50 percent would be applied to meeting the M&I gap. In total, 98,000 AF of future M&I conservation savings within the Metro Basin would be applied to meeting the M&I gap. The other 50 percent of conservation savings will be applied towards maintaining system reliability.

**Table 4-7. Metro Basin Conservation Savings Applied to the Gap**

| Timeframe | Type of Conservation | Conservation Savings (AF) | Percent Applied to the Gap | Amount Applied to Gap (AF) |
|---|---|---|---|---|
| **2010-2050** | Passive | 75,000 | 100 | 75,000 |
| **2008-2050** | Active | 46,000 | 50 | 23,000 |
| | **Total:** | **121,000** | **Total:** | **98,000** |

#### 4.3.1.6.2 *South Platte Basin M&I Conservation Savings*

As summarized in Table 4-8, by 2050 the South Platte Basin is estimated to further reduce per capita M&I demand to 146 gpcd. If this goal is achieved, an additional 90,000 AF of overall M&I conservation savings would be realized between 2010 (or current) and 2050. Of this total, 30,000 AF is considered passive conservation savings with the assumption that 100 percent would be applied to the future M&I gap. The remaining 60,000 AF is considered active conservation savings and 50 percent would be applied to meeting the M&I gap. In total, 60,000 AF of future M&I conservation savings within the South Platte Basin would be applied to meeting the M&I gap. The other 50 percent of conservation savings will be applied towards maintaining system reliability.

**Table 4-8. South Platte Basin Conservation Savings Applied to the Gap**

| Timeframe | Type of Conservation | Conservation Savings (AF) | Percent Applied to the Gap | Amount Applied to Gap (AF) |
|---|---|---|---|---|
| **2010-2050** | Passive | 30,000 | 100 | 30,000 |
| **2010-2050** | Active | 60,000 | 50 | 30,000 |
| | **Total:** | **90,000** | **Total:** | **60,000** |

### 4.3.1.7 Conservation Summary

As summarized below in Table 4-9, 92 percent (265,000AF/293,000AF) of the overall (passive and active) conservation savings from 2000 to 2050 would be applied to the gap in the Metro Basin. Similarly, 81 percent (128,000AF/158,000AF) of the overall conservation savings from 2000 through 2050 would be applied to the gap within the South Platte Basin.

**Table 4-9. Summary of Conservation Savings in the South Platte and Metro from 2000-2050 and the Percent Applied to the M&I Water Supply Gap**

| Timeframe | Type of Conservation | Conservation Savings (AF) | Percent Applied to the Gap | Amount Applied to Gap (AF) |
|---|---|---|---|---|
| *Metro Basin* | | | | |
| **2000-2010** | Total | 167,000 | 100 | 167,000 |
| **2010-2050** | Passive | 80,000 | 100 | 75,000 |
| **2010-2050** | Active | 46,000 | 50 | 23,000 |
| | *Basin Total:* | *293,000* | *Basin Total:* | *265,000* |
| *South Platte Basin* | | | | |
| **2000-2010** | Total | 68,000 | 100 | 68,000 |
| **2010-2050** | Passive | 30,000 | 100 | 30,000 |
| **2010-2050** | Active | 60,000 | 50 | 30,000 |
| | *Basin Total:* | *158,000* | *Basin Total:* | *128,000* |
| | **Total**: | **415,000** | **Total:** | **355,000** |

These reductions due to conservation do not necessarily equate to the same reduction in the overall basin needs. Increased conservation reduces the amount of return flows which due to the return flow nature of the system impacts water right owners downstream, including agricultural, municipal and environmental and recreational uses. An increase in M&I conservation could reallocate water supply gaps within the basin.

Reliability, safe yield, and demand hardening are important concepts for consideration going forward. Reliability is a water supply system's ability to meet the needs of its customers during times of stress. Safe yield is the maximum volume of water that can be delivered by an entire system over a realistic hydrologic period that includes the drought of record. Reliability criteria are the allowable shortages and their respective frequencies that a water provider is willing to tolerate without failing in its service commitment to the customers. Demand hardening is the result of long-term conservation measures that make it more difficult for the water utility to promote further water use reductions during drought, which can become an issue if a portion of the conserved water has been used to serve new customers. Since long term conservation savings are achieved by existing customers, it is important that the supply reliability for these existing customers not be negatively impacted as new customers are added to the system. When considering system reliability and demand hardening, every water system in Colorado is unique and should take into consideration the interplay of demands, supply, and storage.

Providing for growth in a system, and increased reliability, can be accomplished by adding new supply to increase the safe yield of the raw water system, decreasing the demands of existing customers, or a combination of the two. Long term water conservation programs typically seek to achieve permanent reductions in demand through technical and structural improvements and behavioral changes. Some portion of conserved water can be used to serve new customers without negatively impacting reliability as long as the constrained drought demand does not increase. While this is a greatly simplified analysis with significant caveats, it suggests that conserved water is a resource that can be used to serve new customers under the right set of circumstances.

Although there are still improvements that can be made, the Metro and South Platte Basin Roundtables believe they are approaching the limit of what they can collectively accomplish. Investments in change will continue to improve efficiency but this method for reducing demand will not always be an option. Once the per capita demand has achieved the lowest consumption rate, the conservation savings should no longer be viewed as a method to reduce demand. Higher levels of conservation will require broad statewide support and political will beyond the purview of water utilities within the South Platte Basin alone.

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

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

### 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 <u>not</u> 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 as shown in Table 4-10. 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[14] 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.

[14] http://www.denverwater.org/SupplyPlanning/WaterSupplyProjects/WISE/

### Table 4-10. 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** | 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

Technical factors that may 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 demand from outdoor irrigation is minimal.

**Impacts to Downstream Water Rights:** On a local level, reuse can increase supply. However, on a larger basin scale, reuse may not increase supply. In an over appropriated system such as the South Platte Basin, downstream users, including agricultural, municipal and environmental and recreational 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.[15]

**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.

**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

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

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). IPR 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. Water Environment Research Foundation (WERF) and CWCB have recently conducted a study regarding the Barriers to the Implementation of Direct Potable Reuse in Colorado. The study concluded that DPR is technically feasible using RO treatment methods, but the economics of the process would be challenging without increased efficiency of RO brine disposal/ minimization technologies. It recommended that the State of Colorado should advance the potential of future DPR projects by:

- Beginning to develop an appropriate regulatory framework addressing DPR
- Continuing to promote/monitor research into new cost effective technologies for brine disposal
- Promoting and monitoring research of non-RO treatment of recycled water suitable for DPR
- Improving public understanding of advantages of potable reuse

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 4-11 provides a summary of the approved uses under Regulation 84.

**Table 4-11. Approved Uses for Reclaimed Water**

| | Category 1 | Category 2 | Category 3 | Additional Conditions |
|---|---|---|---|---|
| ***INDUSTRIAL*** | | | | |
| **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*** | | | | |
| **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
- 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 multiple 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 4-12 shows this information according to basin and provider.

**Table 4-12. 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 4-13.

### Table 4-13. 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 4-14.

### Table 4-14. ATM Grant Programs in the South Platte Basin

| | |
|---|---|
| Northeast Colorado Water 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[16]

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.

[16] Colorado’s Water Supply Future: Alternative Agricultural Water Transfer Methods

### 4.3.4 In-Basin Identified Projects and Processes

There are numerous in-basin projects identified in the South Platte as shown in Table 4-15 including:

- The Chatfield Reallocation Project will supply multiple providers in the South Platte Basin
- The Northern Integrated Supply Project (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 changed 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

**Table 4-15. 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] | |

**Table 4-15. South Platte and Metro Provider's In-Basin IPPs**

| Basin | Providers | Project | Estimated Yield (AFY) | Estimated Completion Date |
|---|---|---|---|---|
| **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 Northern Water's Municipal Subdistrict, a separate entity, operates the Windy Gap project. The Windy Gap Project consists of a diversion dam and pump plant on the Colorado River, and a six-mile pipeline to Lake Granby. From Lake Granby, the Windy Gap project uses C-BT facilities to bring additional water to the east slope for municipal users.

The Windy Gap Firming Project (WGFP) is a collaborative proposal between 12 Northeastern Colorado water providers and the Platte River Power Authority. The WGFP would improve the Windy Gap Project's reliability by constructing a new storage reservoir for Windy Gap water at Chimney Hollow near Carter Lake.

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 4-16 shows South Platte Transbasin IPPs.

**Table 4-16. 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 conservation, reuse, and permanent agricultural transfers.

Traditionally, M&I water 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 maintaining a healthy agricultural economy in Colorado: the success of IPPs, new storage and infrastructure, multipurpose projects, M&I conservation and potentially new Colorado River supply projects. ATMs are also being explored as an alternative to traditional agricultural buy and dry, but will not complicate or restrict traditional agricultural transfers.

### 4.4.1 Agricultural Specific Projects and Multipurpose Projects Benefitting Agriculture

A signification reduction in the yield from IPPs 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 surface storage projects that benefit agriculture, 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 due to stricter groundwater administration in the South Platte Basin requiring court-approved augmentation plans. 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, at times, be an effective means to maintain instream flows by replacing historical return flows, out-of-priority groundwater pumping depletions, etc. Typically recharge diversions remove water from the stream system during times when there are high flows, and re-time the recharge return flows to the river to times when there is less flow in the river. Therefore recharge projects typically provide streamflow benefits to environmental and recreational attributes.

Recharge facilities can also be specifically designed to provide environmental habitat benefits. For example, Ducks Unlimited has partnered with a variety of entities in designing recharge wetlands to serve as recharge facilities and also provide wetland habitat. Several other water supply agencies and environmental groups have also incorporated multi-benefit components in their projects and programs.

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 and framework briefly described in Sections 2 and 3 and detailed in Appendix D, focus areas that both do and 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, however the framework developed through the BIP process can be implemented in the future to begin to assess these needs. Additional work will be needed to continue 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 assess the environmental and recreational needs and 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 and framework 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 begin to be analyzed in conjunction with the attributes and focus areas. The methodology and framework used to begin to review the projects and methods is described briefly in Section 3 and in detail in Appendix D.

#### 4.5.1.1 General Basin-Wide Methodology

A general basin-wide methodology was developed in Phase I of the South Platte BIP, to generally assess the available data. At a basin-wide level, 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, where available, 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 additional information is needed. General 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. However, BIP Phase I scope and data limitations did not allow for development of a robust method for the assessments of attributes or sufficiency of projects. Additional specific analyses can determine the extent of potential habitat.

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 overall 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 4-17 shows the percent occurrence in the basin by attribute, based solely upon the data available in the GIS shapefiles regarding location of attributes. These percent occurrences do not necessarily demonstrate the vitality or lack of habitat of a species. Current habitat may be sufficient to maintain species if such habitat is not degraded, or additional habitat or connectivity may be needed. Some species are micro-habitat specific and may occur throughout the basin in appropriate areas, or may need additional habitat to thrive. Location specific studies and analyses are needed to fully determine the species habitat, potential habitat and sufficiency of protections for the species.

## Table 4-17 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% |

#### 4.5.1.2 Stream Mile Representation Framework

In order to better assess the attributes, projects and protections in place or needed within the basin, a stream mile representation framework was developed during Phase II of the South Platte BIP. The Stream Mile Representation Framework allows for a fixed spatial analysis framework and a more streamlined assessment of attributes and projects when the data needed for assessment is available.

For the general basin-wide methodology developed in Phase I of the BIP, significant time was spent attempting to utilize previous CWCB "Nonconsumptive Needs Analysis" data products, including GIS layers, NCNA Microsoft Access database, and spreadsheets. This effort identified significant limitations in the data and approach, which severely limit the effectiveness of analysis. The stream mile representation framework was developed to address these limitations, discussed in detail in Appendix D.

The Stream Mile Representation Framework represents the river in a spreadsheet format as relatively short segments that allow for a reasonable level of analysis. The segment length used in the framework was 0.1 mile long segments. The framework allows anyone with simple spreadsheet tools to be able to access the data, without the need for database and GIS tools. Along with the stream of interest, additional data layers can be represented in the framework, including focus areas, environmental attributes, projects, streamflow gages, and diversions. A detailed description of the framework is included in Appendix D.

### 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, allowing for more senior water rights to be used for instream flow purposes. 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, rafting 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 may 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[17], 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 various projects that include reintroductions of the Boreal toad, cutthroat trout, and plains fish species.

#### 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.

[17] United States Geological Survey. 2010. Southwest Regional Gap Analysis Project. http://fwsnmcfwru.nmsu.edu/swregap/Stewardship/Categorization.htm

- 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 South Platte Basin Master Plans

There are various master plans throughout the South Platte Basin. These plans often include various projects that will assist in protecting or enhancing environmental and recreational flows. These plans include mechanisms for watersheds to work together in planning efforts. A brief review of the Master Plans was done in conjunction with the BIP, and the review is included in Appendix D.

#### 4.5.2.7 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, these water rights may legally reduce flow below the specified minimum flow 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 was completed in specific reaches to the extent that data was available, using the stream mile representation framework and other data analyses. Similar analyses could be completed in various other areas with significant additional resources and additional data.

### 4.5.3 Project Examples

The proposed general basin-wide methodology and Stream Mile Representation Framework were applied in a limited manner to highlight 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. Included is a general discussion of example projects based on the basin-wide methodology from Phase I. The section also contains additional descriptions of the Stream Mile Representation Framework and associated analyses from Phase II. 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 could be analyzed in the future with specific direction from the environmental and recreational subcommittee and BRTs and additional data a funding resources.

### 4.5.3.1 Northern Colorado Region

There are various types of focus areas in the Northern Region with multiple project types in place, planned or needed to protect or enhance the environmental and recreational attributes. Nineteen of the 34 focus areas in the South Platte located in the Northern Region. The descriptions of focus areas in the region include:

- Environmental attributes including: Habitat for federal and state endangered, threatened and species of concern including plains fish, native minnow species, common shiner, stonecat, and brassy minnow, cutthroat trout and lake chub; rare or imperiled riparian plant communities; and Wild and Scenic River designation.
- Recreational attributes including: Fishing, whitewater and flatwater boating, municipal recreational corridors, RICDs, State Wildlife Areas, Wild and Scenic River designation, and additional greenway benefits.

There are various projects throughout the Northern Region addressing environmental and recreational needs. Project types in the region include stream and riparian restoration, fish passage projects, species reintroduction, instream flows, streamflow agreements, and various types of studies.

To demonstrate the types of projects within the Northern Region, specific existing projects are highlighted. In addition, the stream mile representation framework previously discussed was used to generally analyze the environmental and recreational needs and the existing and future project types within that area that may address the gap.

#### 4.5.3.1.1 *Example Projects*

An example project in the Northern Region 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 4-4 shows the environmental and recreational focus areas and locations of the rare fish habitat, and recreational boating areas in part of the Northern region 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.

Additional analyses using the Stream Mile Representation Framework could be completed in the future to evaluate these projects.

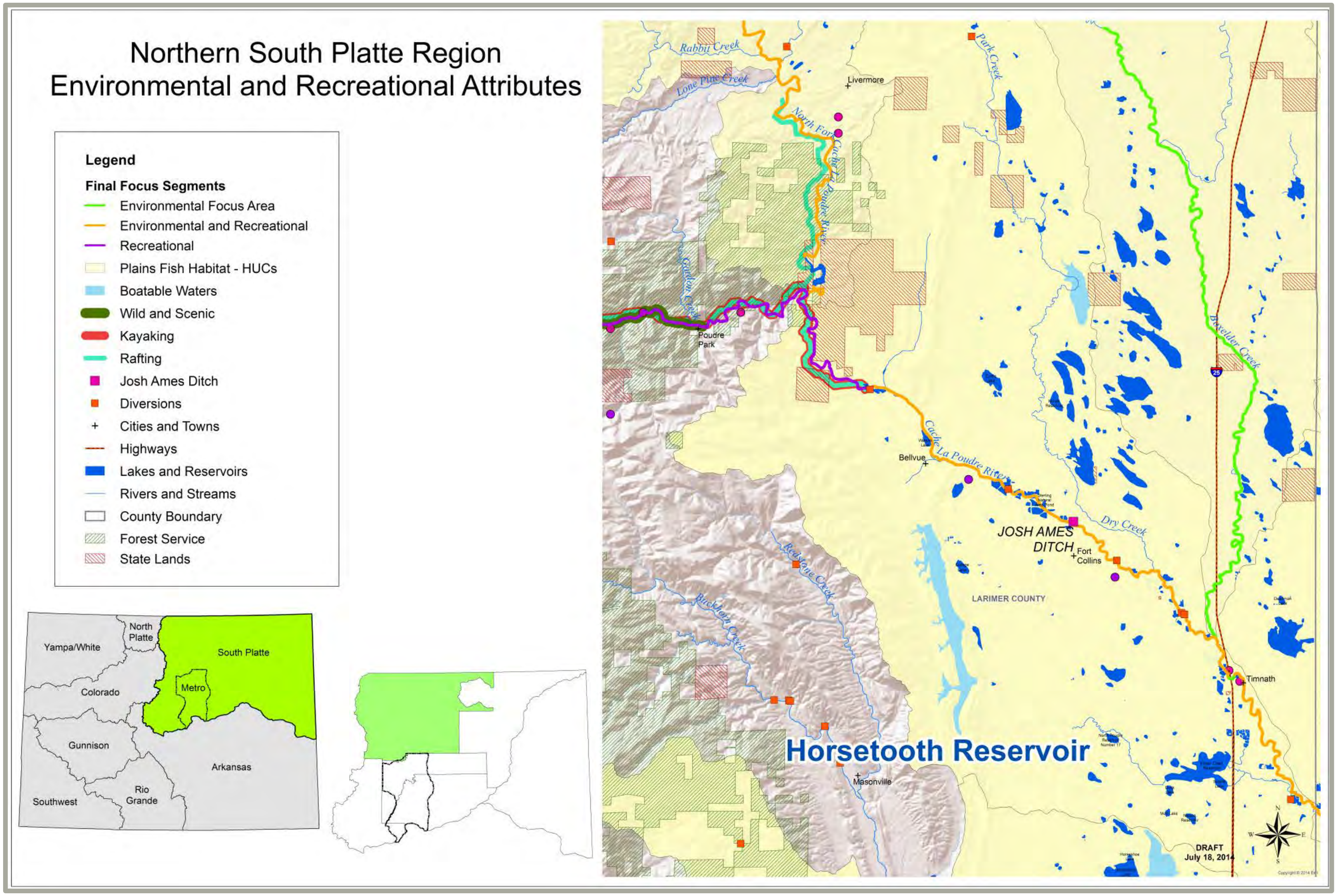


**Figure 4-4. South Platte Northern Environmental and Recreational Enhancements**

#### 4.5.3.1.2 *Example Area Analysis*

To demonstrate the stream mile representation framework described earlier in this section and in detail in Appendix D, the example area analyzed for the Northern Region is located on St. Vrain Creek near Lyons, Colorado.

*Stream Mile Representation Analysis*

The gage analyzed within this reach is the St. Vrain Creek at Lyons gage (SVCLYOCO, 06724000). The section of river analyzed includes an approximately 7 mile stretch on St. Vrain Creek from the confluence of South St. Vrain Creek and North St. Vrain Creek. It also includes approximately 6 miles on both the South and North St. Vrain Creeks. The example area is shown in the photo in the map in Figure 4-5.

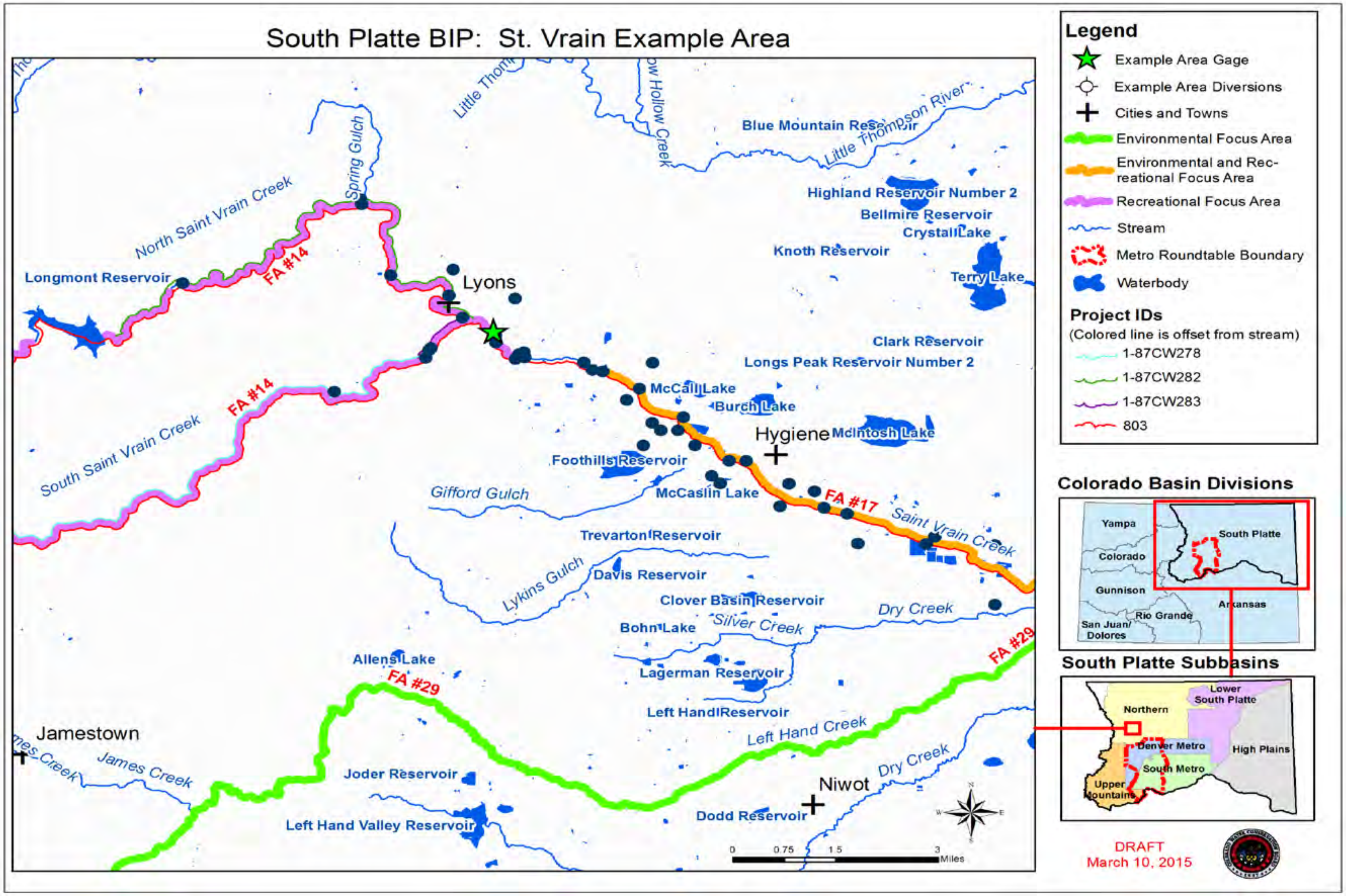


**Figure 4-5 - St. Vrain at Lyons Example Area Map**

The stream mile representation framework spreadsheet for this stretch of river is shown in Appendix D. A brief summary of the items shown in the stream mile representation follows.

The attribute categories located in the example area include:

- Environmental:
  - Plains Fish State Endangered, Threatened, Species of Special Concern
  - State Endangered, Threatened, Species of Special Concern
  - Important Riparian Habitat
- Recreational:
  - Fishing
  - Recreation (boating)

The example area includes portions of Focus Area 14, a recreational focus area which includes North Saint Vrain Creek, from Horse Creek to Highway 36 and South Saint Vrain Creek from Middle Saint Vrain Creek to the confluence with the North Saint Vrain. The streamflow gage data analyzed in this example is within Focus Area 14. The example area also includes portions of Focus Area 17, an environmental and recreational focus area which includes Saint Vrain Creek from the James Ditch to the confluence of the Saint Vrain with the South Platte River. The example area also includes a short segment that is not in a focus area between Focus Areas 14 and 17 on Saint Vrain Creek.

Based upon the stream mile representation and available project data with available spatial data, the projects upstream and downstream from the streamflow gage include:

- Streamflow Enhancement Project (803) – The St. Vrain Creek Corridor Committee releases 1000 acre-feet per year to benefit minnows.
- Decreed Minimum Instream Flows – Including Division One Case Nos. 78W9362, 78W9363, 87CW278, 87CW281, 87CW282, and 87CW283.
- Stewardship Projects – Stewardship projects include areas protected by federal or state agencies, landowner agreements, and non-governmental organizations. These projects typically provide riparian habitat protection rather than streamflow benefits.

There are various diversions in the area, as shown in the map. These diversions include diversions for the Cities of Longmont and Lyons, as well as many other diversions for agriculture and municipal and industrial uses.

*Streamflow Analysis*

To analyze the streamflow available to the various attributes at the gage location, streamflows were analyzed in various ways.

The period of record for the Lyons gage analyzed extended from 1900 until 2013. The general hydrograph over the period of record is shown in Figure 4-6.

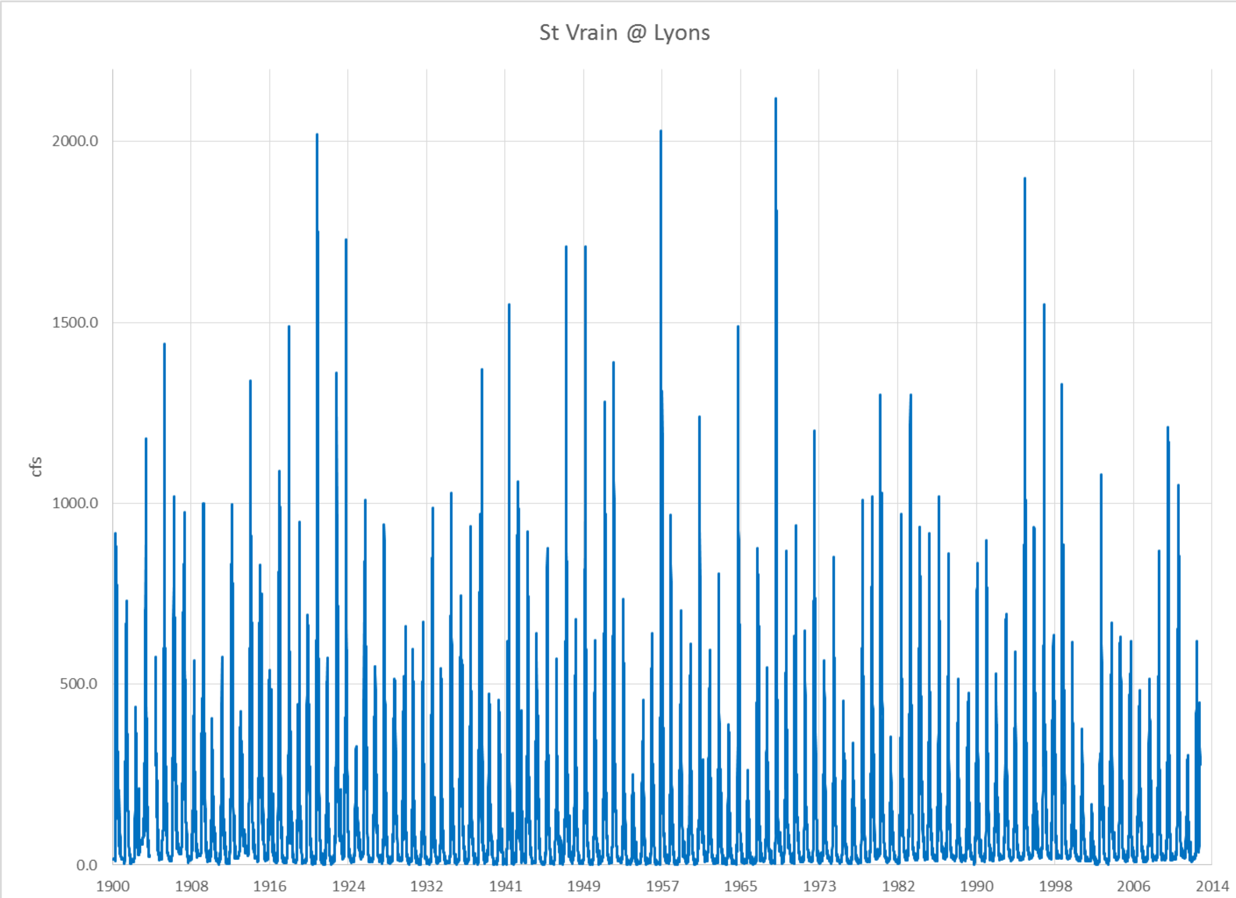


**Figure 4-6 – Time Series Hydrograph of St. Vrain Creek at Lyons (Gage: SVCLYOCO, 06724000)**

The hydrograph was disaggregated on a yearly basis to examine certain flow requirements for environmental and recreational needs.

Site and species specific studies are needed to determine the minimum flow needed to sustain the native species. Flow regimes necessary to support aquatic species are extremely site specific, and the flow regimes can change significantly with a change in channel shape and function. No studies have been completed regarding specific flow requirements within the example area since the significant channel changes resulting from the September 2013 floods,. Results from hydraulic modeling must be assessed in conjunction with biologic assessments of the study area. If such studies become available in the future, the streamflow requirements for aquatic and riparian needs can be added into the analysis.

The environmental minimum flows shown in the table below are based upon the minimum instream flows decreed in the reaches of the South and North Forks of the St. Vrain immediately above the gage. The minimum instream flows for the North and South Forks were combined to analyze the flow at the gage. The decreed instream flows should be compared to environmental flow recommendations if they become available. The minimum instream flows for the North Fork of the St. Vrain were decreed in Division 1 Case No. 87CW282. The minimum instream flows decreed in the South Fork segment closest to the confluence with the North Fork were decreed in Division 1 Case No. 87CW283.

There were also no studies specifically indicating required flushing flows in the area. Flushing flows are needed to move sediment downstream, creating diverse aquatic habitat, as well as to aid in life cycle functions of species. Therefore general recommendations based on the Tennant method for flushing flows of 200% of the annual mean flow were determined. The mean flow based solely on the gage data was 124cfs, therefore a recommended flushing flow of 248 cfs was included in the analysis.[18] The flow rate and duration of flushing flows should be determined from additional hydraulic analyses based on specific channel characteristics at the project locations.

There are no studies suggesting specific recreational flow recommendations in the South Platte basin, nor in this reach. However, there is information anecdotally available on American Whitewater's website regarding flows within specific reaches. There are anecdotal recommendations for both the North and South Forks of St. Vrain Creek above the confluence of these two forks. The recommendations were summed to estimate the range of anecdotally acceptable whitewater boating flows at the gage.

Table 4-18 below shows the general recommendations based on these sources. Refinements should be made with site-specific studies before using these values to plan or implement projects.

### Table 4-18 St Vrain at Lyons – General Flow Recommendations (in cfs)

| *Month* | **Minimum Instream Flow** | | | **Flushing Flows** | **Recreational Minimum Flow** | | | **Recreational Maximum Flow** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | S Fork | N Fork | Combined at gage | | S Fork | N Fork | Combined at | S Fork | N Fork | Combined at gage |
| *January* | 4 | 3 | 7 | | | | | | | |
| *February* | 4 | 3 | 7 | | | | | | | |
| *March* | 4 | 3 | 7 | | | | | | | |
| *April* | 20 | 8 | 28 | | | | | | | |
| *May* | 20 | 21 | 41 | ~506 | 150 | 80 | 230 | 300 | 315 | 615 |
| *June* | 20 | 21 | 41 | ~506 | 150 | 80 | 230 | 300 | 315 | 615 |
| *July* | 20 | 21 | 41 | | 150 | 80 | 230 | 300 | 315 | 615 |
| *August* | 20 | 14 | 34 | | | | | | | |
| *September* | 20 | 8 | 28 | | | | | | | |
| *October 1-14* | | 8 | 20 | | | | | | | |
| *15-24* | 12 | 6 | 18 | | | | | | | |
| *25-31* | | 4 | 16 | | | | | | | |
| *November* | 12 | 3 | 15 | | | | | | | |
| *December* | 4 | 3 | 7 | | | | | | | |

These general recommendations were compared to specific annual hydrographs, as well as the time series data. The decreed minimum instream flows are indicated by the red line in the following graphs. The flushing flows are indicated by the yellow line in the following graphs. The recreational flows are indicated in the green and blue lines, for the minimum recreational recommended flow and maximum recreational flow, respectively. The annual hydrographs for 2002 through 2004 are shown in Figure 4-7 through Figure 4-9.

[18] Tennant method or "Montana" method was used to determine flushing flows. Additional information regarding this method can be found in Appendix D.

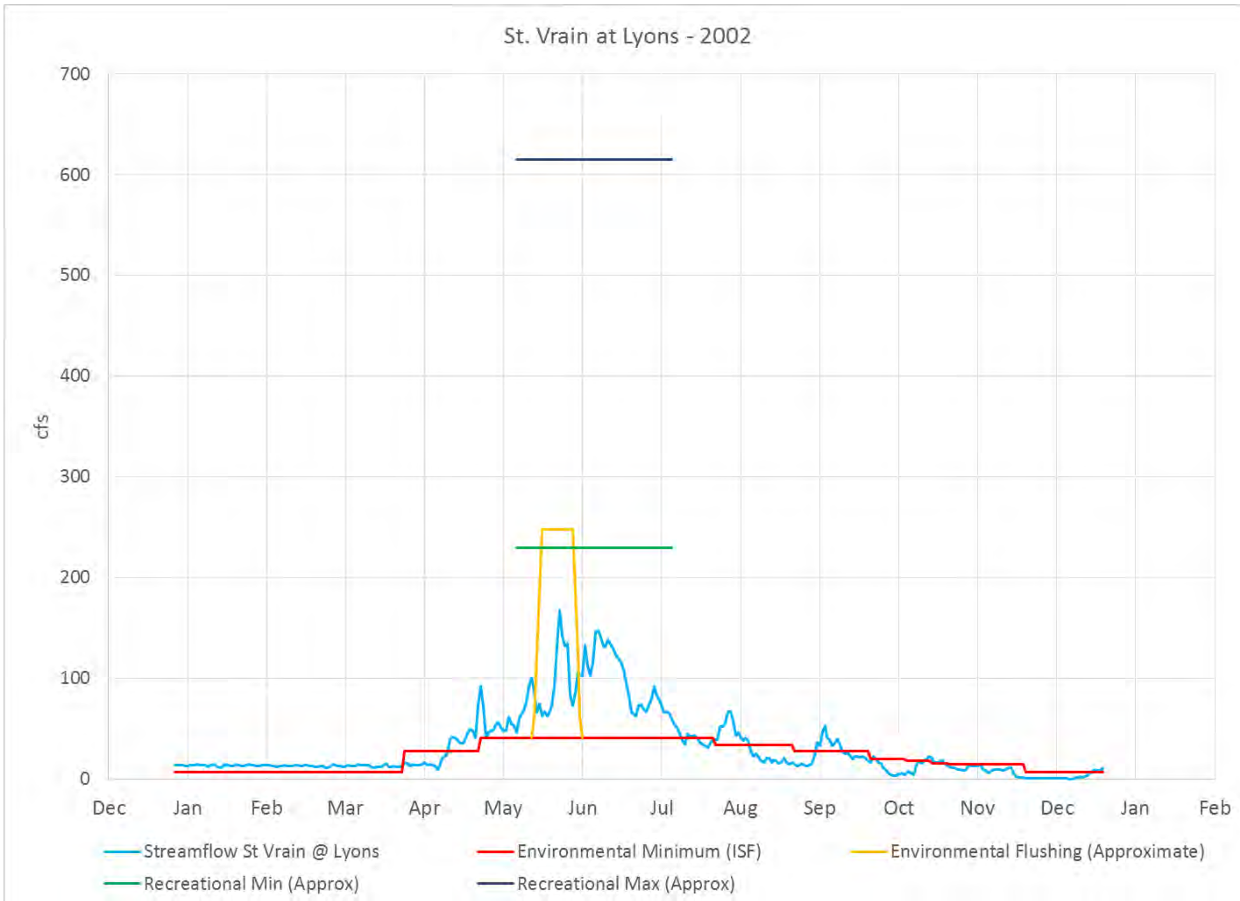


**Figure 4-7 - Hydrograph comparison to available environmental and recreational flow information - 2002**

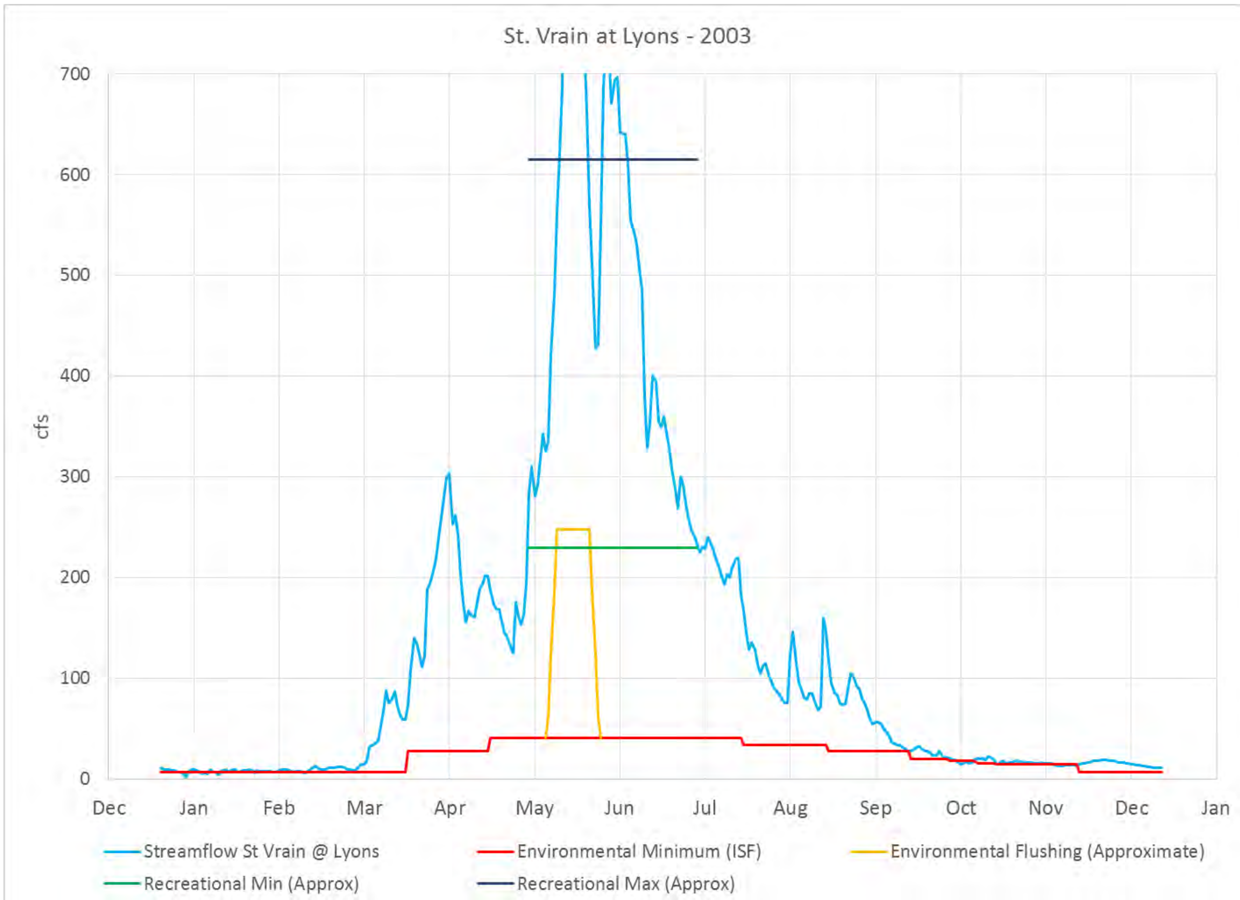


**Figure 4-8 - Hydrograph comparison to available environmental and recreational flow information - 2003**

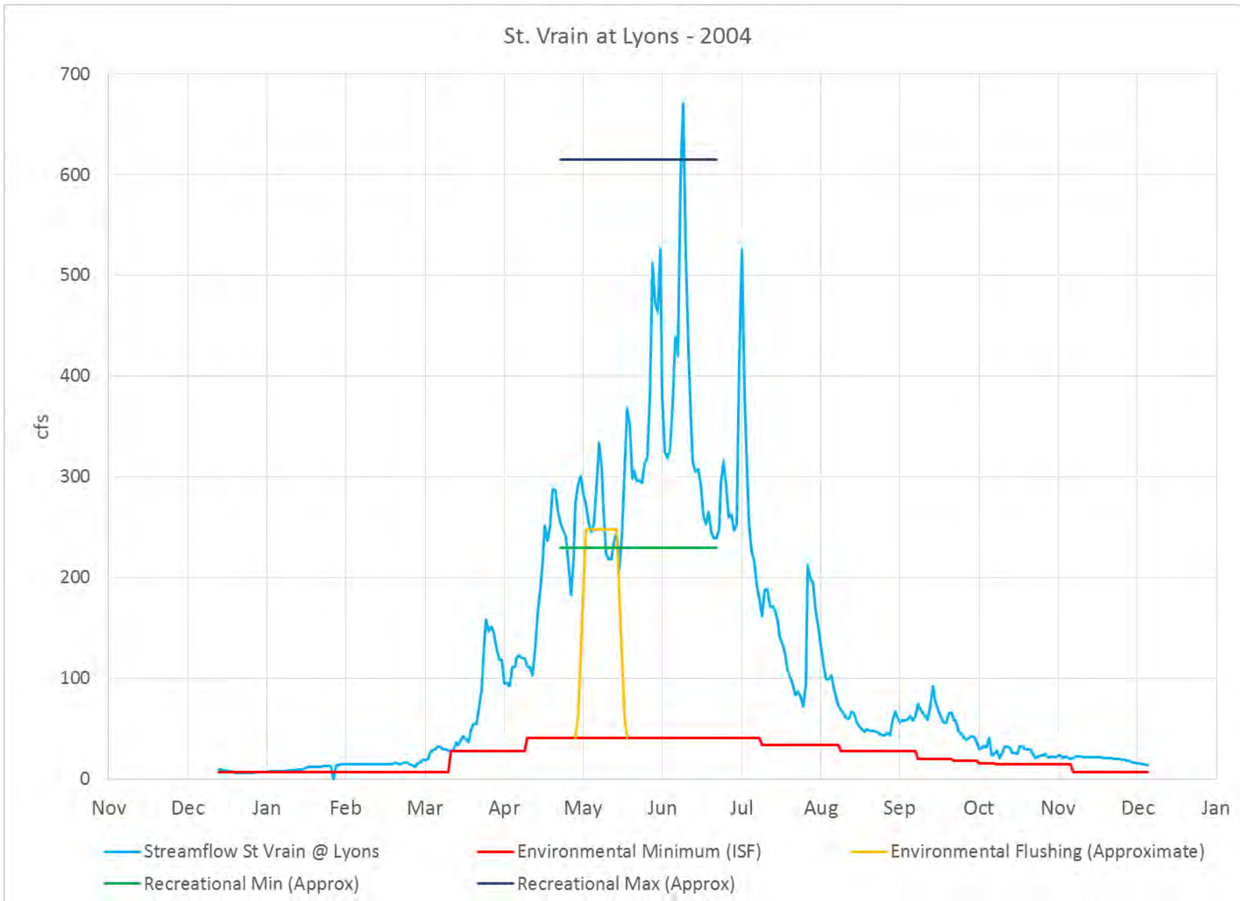


**Figure 4-9 - Hydrograph comparison to available environmental and recreational flow information - 2004**

In addition to comparing the flows in the St. Vrain in specific years, time series raster plots were developed to demonstrate the flows over the period of record. A raster plot can show flows as different colors, based on specific parameters that take the flow recommendations into consideration. A time-series raster plot can assist in giving planners a quick snapshot of flows with respect to certain environmental and recreational considerations. The time series raster plots shown below were developed to graphically demonstrate how the various general flow recommendations described above are met based on the time series data for the gage.

To demonstrate the times when the minimum instream flows from the CWCB decrees are met or not met by the available streamflows, a time-series raster plot was developed, as shown in Figure 4-10. The days when the minimum decreed instream flow rates were not met are indicated in red on the raster plot. The flows above the minimum instream flow rates are indicated in yellow on days on which streamflows were greater than the minimum instream flow rate. The minimum instream flows were decreed in 1988. Accordingly, the time series generally shows fewer days that the minimum flows were not met as compared to earlier in the period. This plot shows times when there are opportunities to potentially increase the flows in the river to meet the instream flow requirements. If additional required flow studies and information become available, similar plots could be used to compare the actual streamflows to the more specific needs of aquatic and riparian habitat determined by such studies. These types of studies are recommended in areas where this methodology is intended to be used to assess the aquatic and riparian environment.

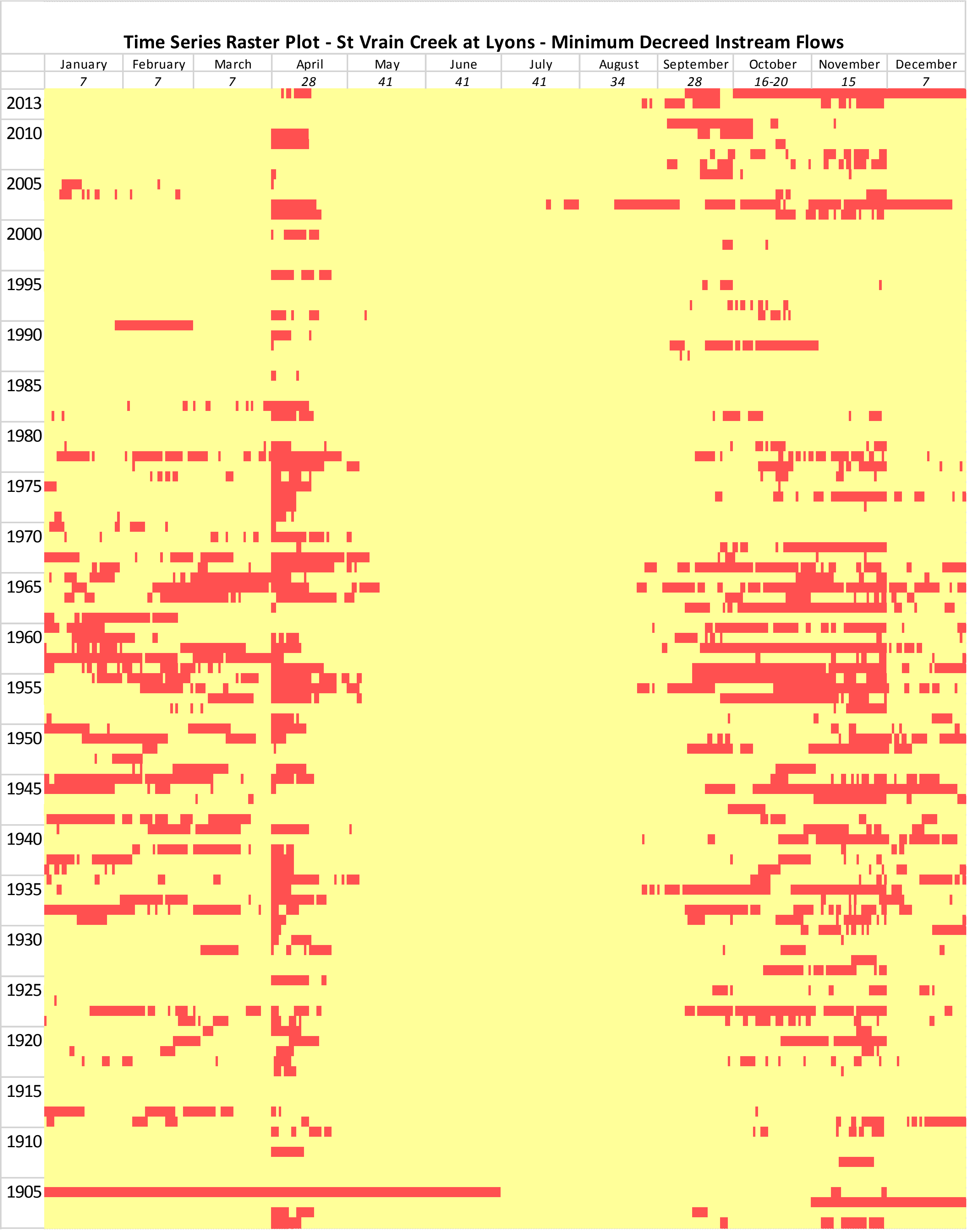


**Figure 4-10 - Time Series Raster Plot - St Vrain Creek at Lyons - Minimum Decreed Instream Flows**

To demonstrate the times when the flushing flows recommendations are met or not met, a time-series raster plot was developed, as shown in Figure 4-11. The yellow on the plot shows times when the flow is greater than the generally recommended flushing flows. The red in the plot shows times when the flow is less than the generally recommended flushing flows. In general, in most years there appears to be flushing flows available in this area, based on the Tennant method. If additional required flow studies and information become available, similar plots could be used to compare the actual streamflows to the more specific needs of aquatic and riparian habitat determined by such studies. These types of studies are recommended in areas where this methodology is intended to be used to assess the aquatic and riparian environment.

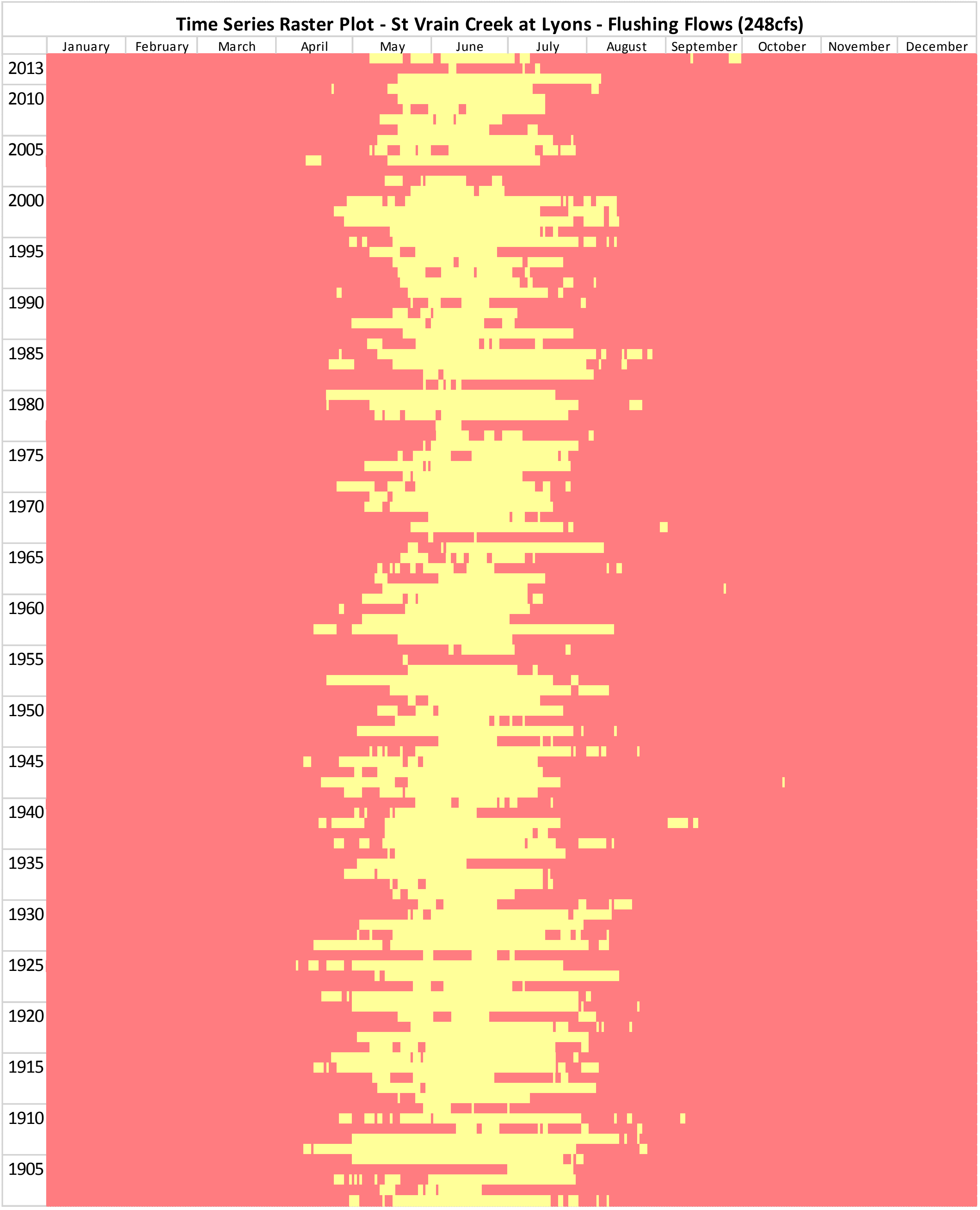


Figure 4-11 - Time Series Raster Plot - St Vrain Creek at Lyons - Flushing Flows (248cfs)

To demonstrate the times when the anecdotal recreational flows are met or exceeded, a time-series raster plot was developed, as shown in Figure 4-12. The green through light blue colors shows times when the flow is between the generally recommended recreational flows of 230 cfs to 615 cfs from April through October. The degree to which the flows are greater than the minimum recommended recreational flow are shown in a scale from green to light blue, with green being closest to the minimum recommended value and light blue being the maximum recommended recreational flows for the gage. The red in the plot shows times when the flow is less than the generally recommended minimum recreational flows. The dark blue in the plot shows times when the flow is greater than the generally recommended maximum recreational flows This plot shows times when there are opportunities to potentially increase the flows in the river to meet recreational needs. If additional required flow studies and information become available, similar plots could be used to compare the actual streamflows to the more specific needs of recreational uses determined by such studies. These types of studies are recommended in areas where this methodology is intended to be used to assess recreational flows of the stream.

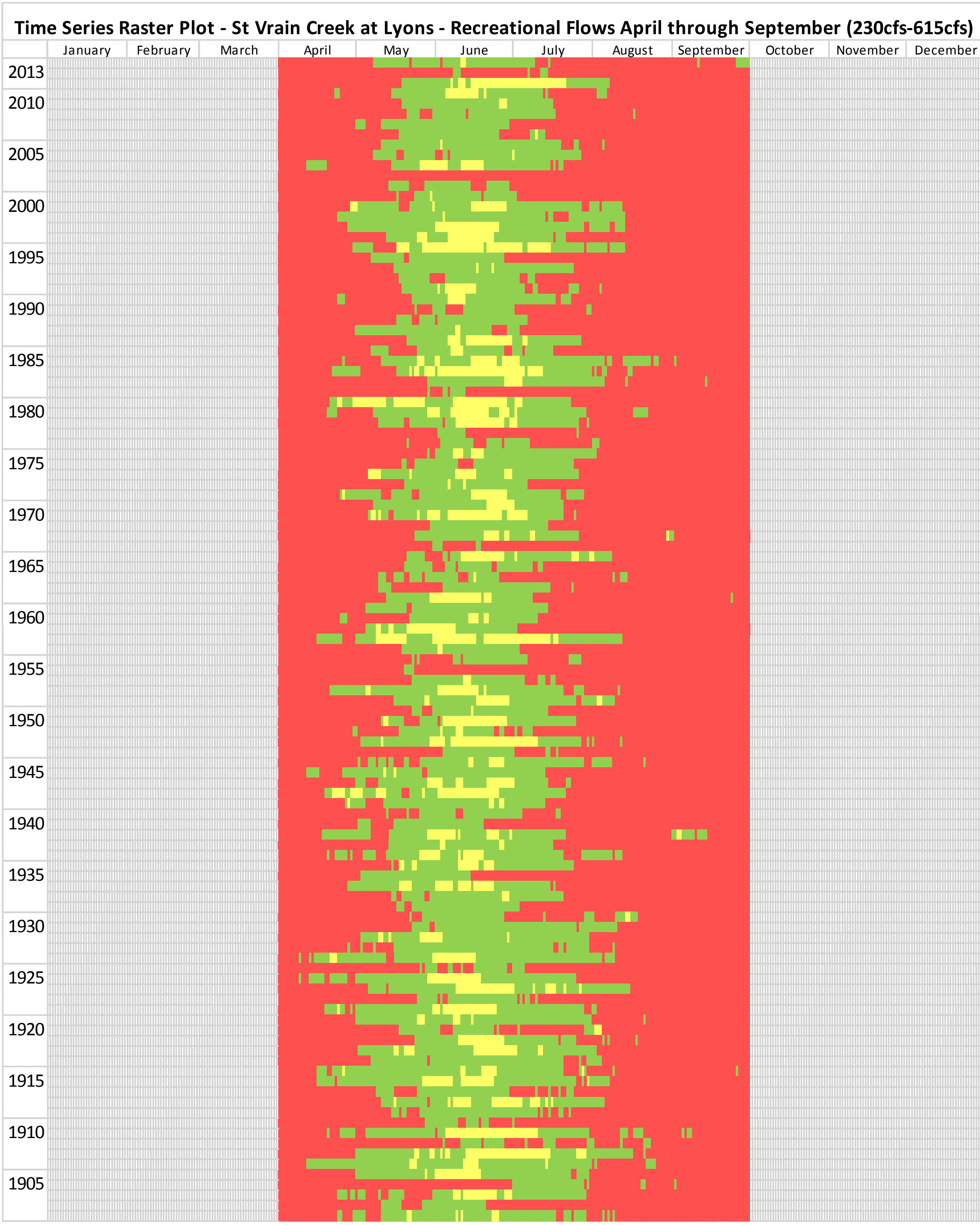


**Figure 4-12 - Time Series Raster Plot - St Vrain Creek at Lyons - Recreational Flows April through September (230cfs-615cfs)**

*General Discussion and Recommendations*

In general, the analysis of streamflows on the St. Vrain at Lyons indicates the streamflows may be present in this area to meet the very general flow recommendations presented above. However, significant additional flow study information is necessary to determine if these recommendations are adequate for environmental and recreational protection.

There is a great amount of additional data needed to fully assess the environmental and recreational protections that exist and may be needed in the example area on the St. Vrain. Studies that relate the channel form and function to the streamflows can make assessment of flows in the area more robust. With the significant changes in the channel after the September 2013 floods, assessments should be made regarding the requirements of aquatic and riparian ecosystems in the area. In addition, streamflows necessary for recreational needs should be assessed.

The time-series raster plots are also helpful in assessing what flows may be needed or available for additional municipal and industrial projects. The Surface Water Availability Analysis (detailed in Appendix G) shows that there is potentially availability for surface water development at times in the St. Vrain at Lyons. Comparing to the raster plots once additional work has been done to fully assess the flows required for environmental and recreational needs can show times when additional diversions may not negatively impact the minimum flows, flushing flows or recreational flows. It appears that times of lengthy flushing flows, greater than preferred recreational flows and adequate minimum instream flows may coincide with times of legal and physical availability. Additional daily analysis and comparison should be done to ensure the times generally shown in the raster plot and the summarized annual availability coincide, before determination is made that additional diversions may not impact environmental and recreational flows.

Specific types of projects that may help to protect or enhance the environmental and recreational flows in the area include:

- Stream channel modifications – Particularly following the September 2013 floods on the St. Vrain, channel restoration could significantly benefit the aquatic and riparian habitat in the example area. The St. Vrain Master Plan indicated various types and locations of specific stream channel modifications that may benefit environmental and recreational needs as well as assist in future flood mitigation.
- Fish Passage – There are various examples of fish passageways near the example area. Additional diversion structures could be modified in the future to assist with stream channel connectivity in the area.
- Operational Flow Agreements - There are some examples of operational flow agreements in the example area. The St. Vrain Creek Corridor Committee releases 1000 acre-feet per year to benefit minnows. Additional operational agreements could be pursued in the future to assist with minimum flows, flushing flows and recreational flows. Studies to determine the amount of beneficial flow should be conducted to assist with determining how these operational agreements could benefit the environmental and recreational attributes.

Additional projects should be added into the stream mile representation for analysis of the effect of projects within the area. Specific spatial data, as well as specific flow data and completion date would be beneficial in determining when and to what degree these projects have benefited the example area.

The minimum instream flows shown in this analysis are specifically from settled upon decreed CWCB instream flows. The actual needs of the aquatic and riparian habitat should be specifically studied in this area if additional project recommendations are to be made to protect and enhance the environmental attributes in this reach. In addition, the minimum instream flows are located on two tributaries upstream of the subject gage. Aggregating the instream flows to compare against the gage data may not reliably show if the instream flows were met previously, as there are diversion structures upstream of the gage, but downstream of the minimum instream flow reaches. These diversions could be taken into account in future work to fully assess the flows at the gage location.

### 4.5.3.2 Upper Mountain Region (Headwaters Areas)

There are various types of focus areas in the Upper Mountain Region with multiple project types in place, planned or needed to protect or enhance the environmental and recreational attributes. Fourteen of the 34 focus areas in the South Platte located in the Upper Mountain Region. The types of focus areas in the region include:

- Environmental attributes including: Significant, imperiled and rare wetland and riparian plant species and plant communities, habitat for federal and state endangered, threatened and species of concern including native minnow species, trout, cutthroat trout and lake chub;.
- Recreational attributes including: Fishing including Gold Medal Fisheries, whitewater boating, State Wildlife Areas, Eleven Mile Canyon National Forest Recreation Area, and waterfowl hunting and viewing.

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 various projects throughout the Upper Mountain Region addressing environmental and recreational needs. Project types in the region include stream and riparian restoration, stewardship projects, instream flows, streamflow agreements, and various types of studies.

To demonstrate the types of projects within the Upper Mountain Region, specific existing projects are highlighted. In addition, the stream mile representation framework previously discussed was used to generally analyze the environmental and recreational needs and the existing and future projects within that area that may address the gap.

#### 4.5.3.2.1 *Example Projects*

Examples of projects in the Upper Mountain Region addressing rare plant communities include CPW, CWCB, NCNA interviewed, stewardship, and ISF in Park County are present in most of the Park County Focus Areas. 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. 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 4-13 shows the environmental and recreational focus areas and locations of the rare aquatic-dependent plants in Park County.

#### 4.5.3.2.2 *Example Area Analysis*

To demonstrate the stream mile representation methodology described earlier in this section and in Appendix D, the example area analyzed for the Upper Mountain Region is located on the South Platte River, above Elevenmile Reservoir. The example area analysis for the Upper Mountain Region is included in Appendix D, similar to the analysis that was done above for the Northern Region. The gage upon which the example area detailed analysis is based is the South Platte gage, above Elevenmile Reservoir.

In general, the analysis of streamflows on the South Platte River above Elevenmile Reservoir shown in Appendix D indicates that at times, streamflows may be present in this area to meet the general flow recommendations. However, significant additional flow study information is necessary to determine if these recommendations are adequate for environmental and recreational protection.

There is a great amount of additional data needed to fully assess the environmental and recreational protections that exist and may be needed in the example area on the South Platte above Elevenmile. Studies that relate the channel form and function to the streamflows can make assessment of flows in the area more robust. In addition, streamflows necessary for recreational needs should be more fully assessed.

Specific types of projects that may help to protect or enhance the environmental and recreational flows in the area include stream channel modifications, fish passage structures, and operational flow agreements. Additional discussion of the recommendations for the Upper Mountain Region example area are included in Appendix D.

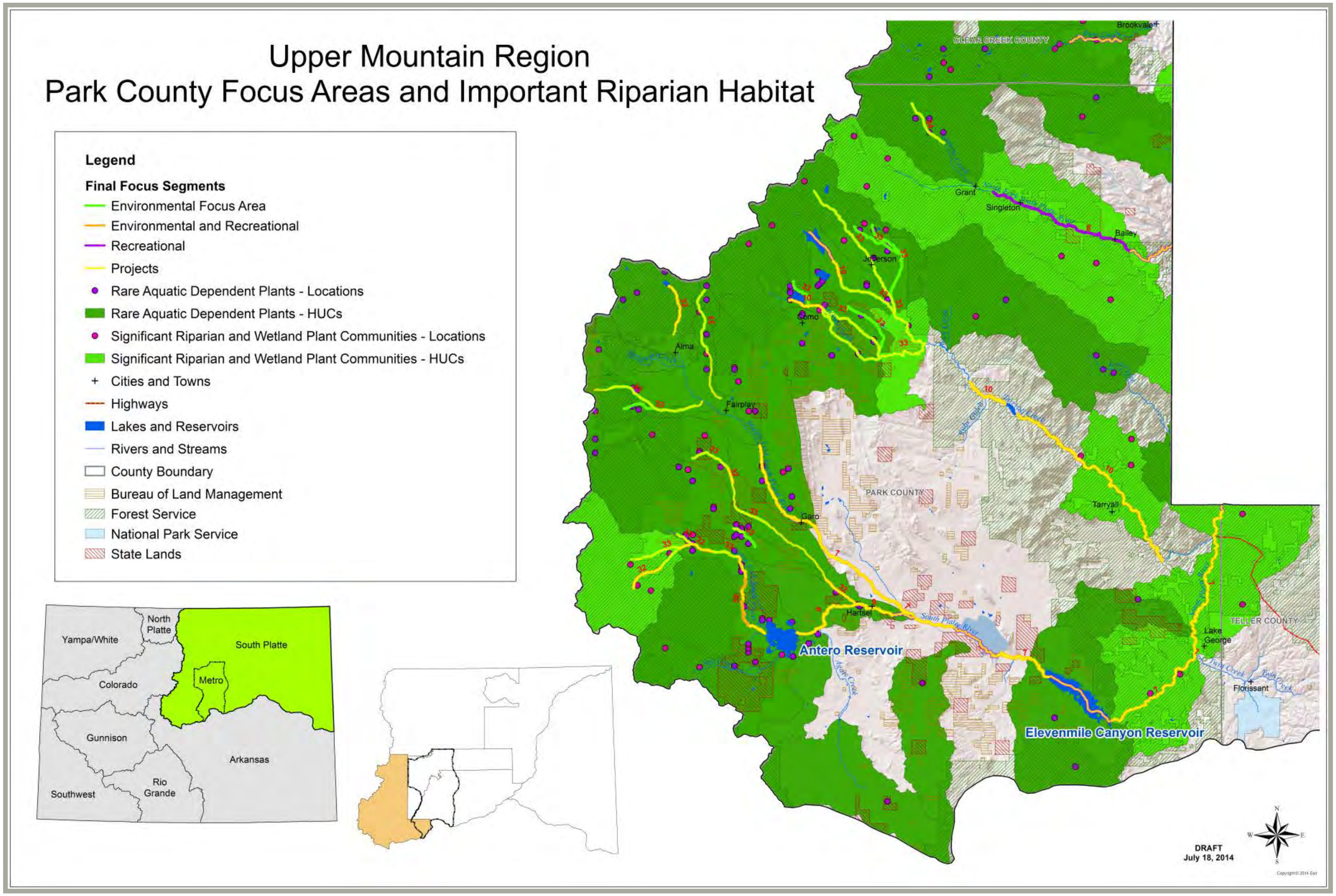


Figure 4-13. Park County Important Riparian Habitat

### 4.5.3.3 Metro Region

There are various types of focus areas in the Metro Region with multiple project types in place, planned or needed to protect or enhance the environmental and recreational attributes. Five of the 34 focus areas in the South Platte located in the Metro Region. The types of focus areas in the region include:

- Environmental attributes including: Habitat for federal and state endangered, threatened and species of concern, and rare or imperiled riparian plant communities.
- Recreational attributes including: Fishing, whitewater boating, municipal recreational corridor, and State Wildlife Areas.

There are various projects throughout the Metro Region addressing environmental and recreational needs. Project types in the region include stream and riparian restoration, streamflow agreements, and various types of studies.

To demonstrate the types of projects within the Metro Region, specific existing projects are highlighted. In addition, the stream mile representation framework previously discussed was used to generally analyze the environmental and recreational needs and the existing and future projects within that area that may address the gap.

#### 4.5.3.3.1 *Example Projects*

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 4-14 shows the environmental and recreational focus areas and locations of the rare aquatic-dependent plant, fishing and recreational corridors in the Metro Corridor.

#### 4.5.3.3.2 *Example Area Analysis*

To demonstrate the stream mile representation methodology described earlier in this section and in Appendix D, the example area analyzed for the Metro Region is located on the South Platte River, below Chatfield Reservoir. The example area analysis for the Metro Region is included in Appendix D, similar to the analysis that was done above for the Northern Region. The gage upon which the example area detailed analysis is based is the South Platte gage, below Chatfield Reservoir.

In general, the analysis of streamflows on the South Platte below Chatfield indicates the streamflows may be present in this area to meet the very general flow recommendations presented above. However, significant additional flow study information is necessary to determine if these recommendations are adequate for environmental and recreational protection.

There is a great amount of additional data needed to fully assess the environmental and recreational protections that exist and may be needed in the example area on the South Platte. Studies that relate the channel form and function to the streamflows can make assessment of flows in the area more robust. In addition, streamflows necessary for recreational needs should be assessed.

Specific types of projects that may help to protect or enhance the environmental and recreational flows in the area include stream channel modifications and operational flow agreements. Additional discussion of the recommendations for the Metro Region example area are included in Appendix D.

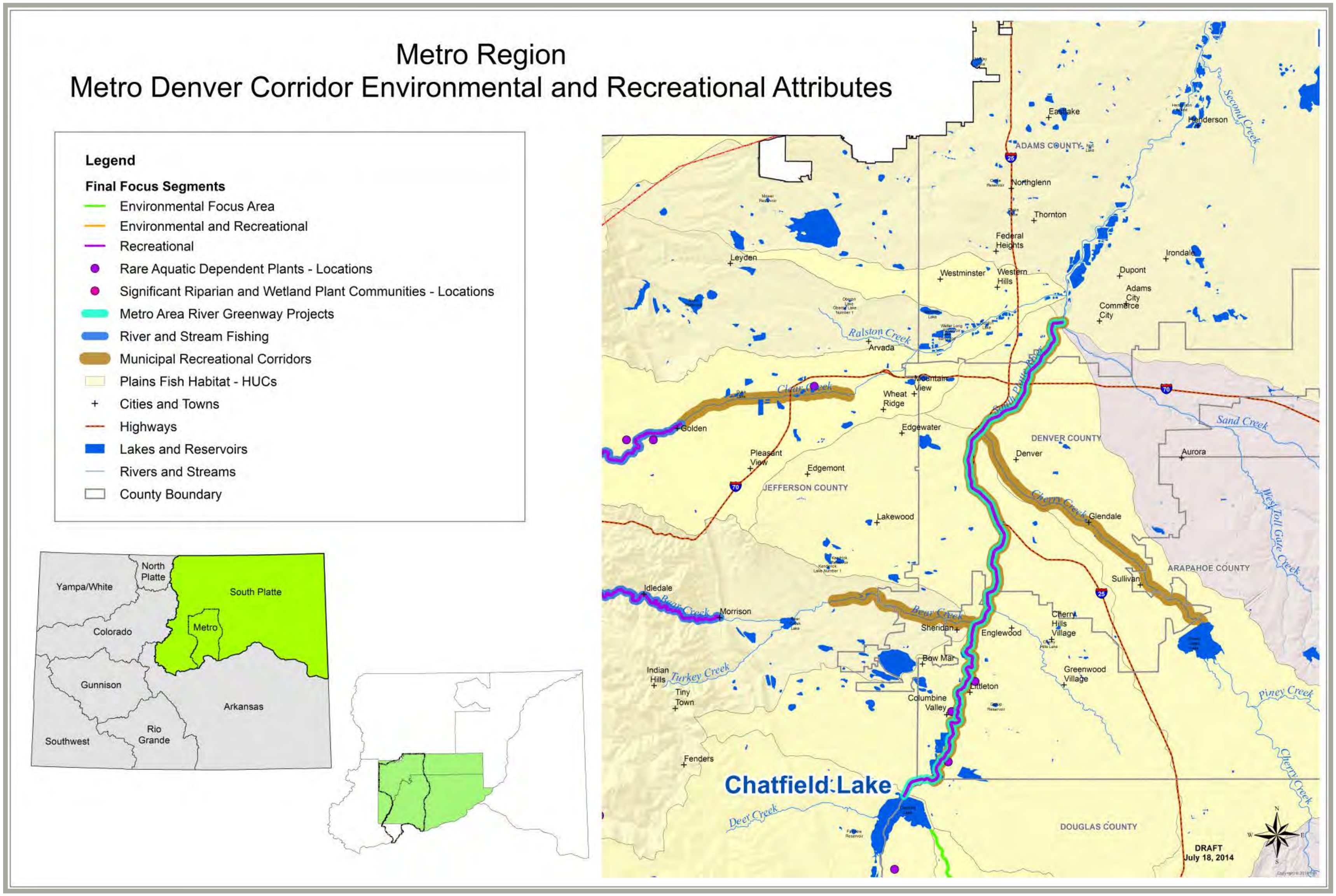


Figure 4-14. South Platte Metro Corridor Environmental and Recreational Enhancements

#### 4.5.3.4 Lower South Platte Region (Plains Region)

There are various types of focus areas in the Lower South Platte Region with multiple project types in place, planned or needed to protect or enhance the environmental and recreational attributes. Two of the 34 focus areas in the South Platte located in the Lower South Platte Region. The types of focus areas in the region include:

- Environmental attributes including: Habitat for federal and state endangered, threatened and species of concern including plains fish; and Rare or imperiled riparian plant communities.
- Recreational attributes including: Wildlife viewing and hunting.

There are various projects throughout the Lower South Platte Region addressing environmental and recreational needs. Project types in the region include species reintroduction, and various types of studies.

To demonstrate the types of projects within the Lower South Platte Region, specific existing projects are highlighted. In addition, the stream mile representation framework previously discussed was used to generally analyze the environmental and recreational needs and the existing and future projects within that area that may address the gap.

##### 4.5.3.4.1 *Example Projects*

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.[19] 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

[19] 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.

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. 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 4-15 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 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 when sufficient data becomes available.

#### 4.5.3.4.2 *Example Area Analysis*

To demonstrate the stream mile representation methodology described earlier in this section and in Appendix D, the example area analyzed for the Lower South Platte Region is located on the South Platte River downstream of the town of Brush. The example area analysis for the Lower South Platte Region is included in Appendix D, similar to the analysis that was done above for the Northern Region. The gage upon which the example area detailed analysis is based is the South Platte gage at Balzac.

In general, the analysis of streamflows on the South Platte at Balzac indicates the streamflows may, at times, be present in this area to meet the very general flow recommendations presented above. However, significant additional flow study information is necessary to determine if these recommendations are adequate for environmental and recreational protection.

There is a great amount of additional data needed to fully assess the environmental and recreational protections that exist and may be needed in the example area on the South

Platte. Studies that relate the channel form and function to the streamflows can make assessment of flows in the area more robust. In addition, streamflows necessary for recreational needs should be assessed.

Specific types of projects that may help to protect or enhance the environmental and recreational flows in the area include fish passage structures, operational flow agreements, land conservation and habitat restoration. Additional discussion of the recommendations for the Lower South Platte Region example area are included in Appendix D.

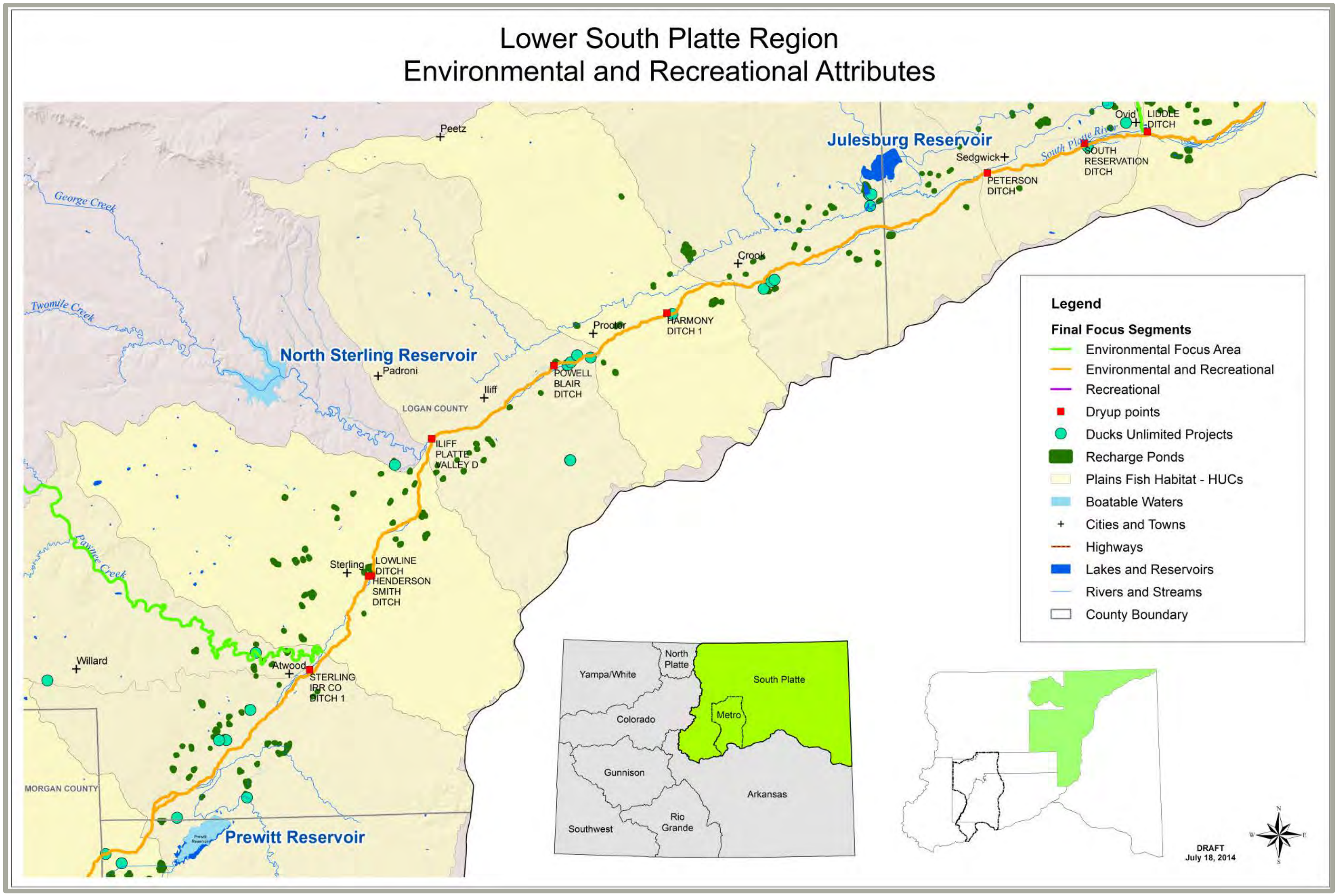


**Figure 4-15. Lower South Platte Plains Fish Habitat**

### 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 and projects 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. Changes in channel form and function can both impact and benefit 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 future.

There is significant additional information, data and analyses needed to better understand and quantify the environmental and recreational needs, the benefit from existing and planned projects, the potential impact from general trends and other projects, and the protections in place or needed to protect or enhance environmental and recreational attributes within the South Platte Basin. Appendix D discusses specific additional data needs and analysis constraints that should be addressed in the future. The additional information, data and analyses needed generally includes:

- Better data and information regarding attributes and projects.
- Better assessment of ecological habitat and streamflow requirements and preferred recreational flows.
- Integration of other existing and not yet available environmental and recreational data.
- Additional needs detailed in Appendix D.

Generally, more data, better data and better data management is needed basin-wide to adequately assess the needs of and requirements for maintaining and enhancing environmental and recreational attributes.

## 4.6 Multipurpose, Cooperative, and Regional Projects and Methods

### 4.6.1 Example of an Existing South Platte Basin Multipurpose Project

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 southwest of the Denver Metropolitan area on the South Platte River, was built by the United States Army Corps of Engineers (Corps) in response to major flooding through Denver that occurred in 1965. Denver Water is currently the only entity with rights to store water in Chatfield Reservoir, per their 1979 agreement with the Corps. 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. In 1994 fifteen water providers and other interested parties began investigating the possibility to store additional water in the reservoir. On June 1, 2014 the U.S. Army Corps of Engineers issued a record of decision (ROD) authorizing this project. This, subject to meeting environmental and recreational mitigation measures, allows 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 system. 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. The Audubon Society of Greater Denver vocalized and documented opposition to the project throughout the development of the Draft EIS and through the release of the Record of Decision. Through a federal lawsuit filed in U.S. District Court (October 2014), Audubon is challenging the evaluation of alternatives and selection of the least environmentally damaging practicable alternative as presented in the federal environmental impact statement.

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 received approval from the State of Colorado for its Fish and Wildlife Mitigation Plan and no must enter into the implementation phase. The lengthy process for permitting 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.

### 4.6.2 Conceptual Future In-Basin Multipurpose Project

Multipurpose projects have the potential to benefit many water 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 lengthen the permitting schedule

The following conceptual projects provide initial examples of how multipurpose in-basin projects could potentially expand the use of native South Platte Basin supplies for the benefit of multiple parties and needs. These projects are purely conceptual and serve to outline possible ideas for implementing projects that utilize native South Platte unappropriated supplies to meet basin water supply gaps. Much additional effort is needed by a broad and diverse stakeholder group to further evaluate these concepts. There are numerous other conceptual projects and possible future project concepts that are not listed below that should also be considered to help meet water supply gaps. The projects listed below are not meant to be an exclusive list of potential future projects. These project concepts and other in-basin project concepts could work in conjunctively together, in coordination with existing IPPs and/or in coordination with a future Colorado River projects (described later in Section 4.8.2.1) to meet basin water supply gaps.

#### 4.6.2.1 Expanded Use of Inbasin Supplies

As population in the South Platte Basin grows, the BRTs have committed to developing multi-purpose projects that take full advantage of limited remaining in-basin supplies, which help reduce traditional permanent dry-up of irrigated agriculture, that minimize the need for additional Colorado River Basin supplies, and that provide water for ecologically and economically important habitats and streamflows, as well as for recreational uses.

##### 4.6.2.1.1 *Overview*

This project concept is generally modeled after information provided to HDR by The Nature Conservancy in collaboration with Merrick & Company. Their project concept extends the City of Aurora's current infrastructure for the Prairie Waters project and utilizes existing gravel pit/river exchange operations used by Aurora Water. Currently, a pipeline conveys water from a well field in Brighton to the Peter Binney Water Purification Plant allowing the recapture of reusable effluent. This concept would expand the current conveyance pipeline to potentially three other diversion points along the South Platte River. The first phase would extend the pipeline to draw from the mainstem below the confluence of the Saint Vrain and the South Platte. The second phase would extend infrastructure downstream to below the confluence of the Cache La Poudre River and incorporate ATMs. The third phase would extend infrastructure even farther downstream on the mainstem below the Balzac gage to incorporate unappropriated flows and ATMs in this area as well. This would provide additional opportunities to facilitate ATMs within the lower part of the basin (Morgan, Logan, Washington and Sedgwick Counties).

Later phases would also require expansion of capacity in the original Prairie Waters pipeline (or a parallel pipeline), pump stations, and additional water treatment facilities (or expansion of capacity at existing water treatment plants). New water treatment plants could be constructed near Greeley to provide potential M&I supplies to northern Front Range municipalities located in Weld and Larimer counties where the largest gap in the South Platte Basin will exist.

The following sources of water would be utilized in this concept.

**Unappropriated Native South Platte Water:** As summarized in Section 3.2.1.2 and documented in the Technical Memorandum regarding Surface Water Availability included in Appendix G, unappropriated water may be available primarily within the middle and lower South Platte River mainstem in wet years.

**Reusable Supplies:** Similar to projects like Aurora's Prairie Waters Project, this concept would increase the ability for Front Range water providers to reuse their fully consumable supplies for non-potable and indirect potable beneficial uses. Expanding the ability of water providers to reuse their existing reusable supplies will increase reuse efficiency. Typically, these reusable supplies are available during the winter months when the M&I demand is lowest.

**Alternative Transfer Methods:** ATMs, as described Section 4.3.3.2, would provide an option to minimize impacts from traditional agricultural buy-and-dry. This project concept would provide the infrastructure necessary to link water providers within both the Denver metropolitan area and the north front range to Lower South Platte agricultural users (in Water Districts 2, 1, and 64) who may be interested in participating in ATM opportunities. Figure 4-16 shows the general components of the conceptual project.

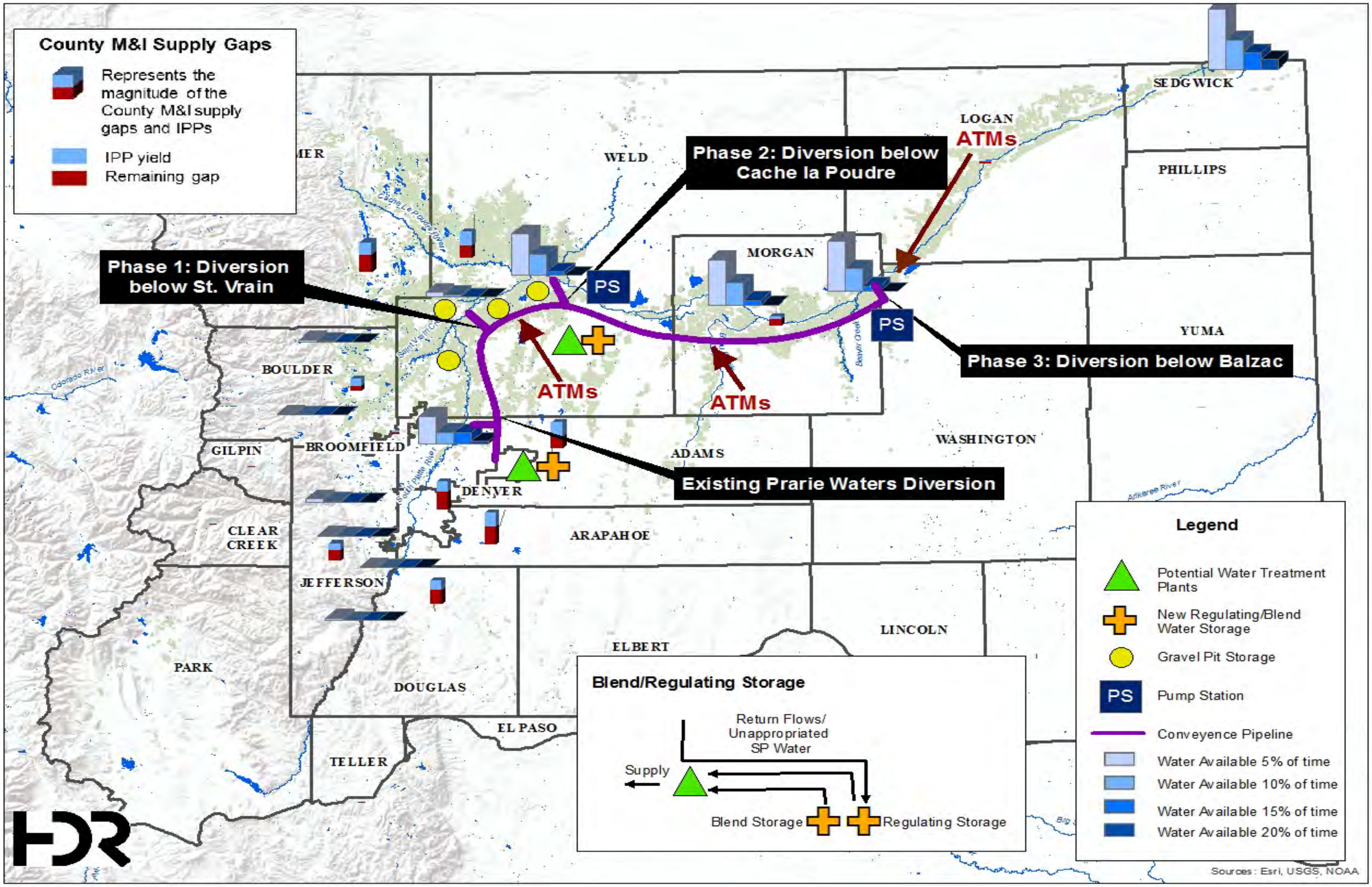


Figure 4-16 Expanded Use of In-basin Supplies

The multiple jurisdictions who may be involved in a regional South Platte River solution poses a series of institutional and governance complexities that should be addressed along with the water management alternatives. Those jurisdictions could include municipalities, special districts, state and federal agencies, non-governmental organizations and others. Because this wide range of groups have varying capacities and objectives with engaging in a multi-jurisdiction program and at different times, it will be probable that a new governance and financing structure will be developed to gain the benefits from a river basin program.

That governance structure may come from an expansion of responsibilities and service areas from an existing entity. It could also come from a newly formed organization with a specific purpose of meeting the beneficial needs of multiple entities serving many areas and jurisdictions bound together by a common purpose related to new water development and protection. These types of governance structures are have been developed around the country to meet similar objectives and to capture the economies of scale necessary to finance large infrastructure systems across multiple jurisdictions. Representative examples include the Metropolitan Water District of Southern California, Southern Nevada Water Authority and Tampa Bay Water. There is not a singular framework that has formed the basis for these regional solutions and it is expected that any new governance structures in Colorado will require customization to the specific needs of this region. Common elements of the participation agreements forming the basis of these regional water entities relate to facilities, operations, financing and governance. The structure developed for the South Metro WISE program could be also considered as one approach moving forward.

#### 4.6.2.1.2 *Opportunities and Challenges*

This conceptual multi-purpose project would provide the following opportunities:

- Development of native unappropriated South Platte supplies
- Increase ability for M&I water providers to reuse their fully consumable supplies,
- Facilitate implementation of ATMs that would benefit agricultural communities by minimizing negative socioeconomic associated with traditional agricultural buy-and-dry and
- Enhance environmental and recreational attributes in Focus Area 1, which includes habitat for state listed plains fish, critically imperiled plant communities, and wildlife hunting and viewing. The conceptual project includes off-channel storage along the South Platte River, which could be operated in such a manner as to enhance streamflows when most critical for environmental and recreational needs.

Challenges to the implementation of this conceptual project would include:

- Variations in South Platte River basin hydrology that impact surface water availability
- Water rights administration
- The timing of available reusable return flows and the rights to reuse water is tied to the owners of the first-use water rights
- Increasing the use of fully reusable supplies will affect both downstream and upstream municipal users by decreasing the amount of physical flow in the river

- The timing of water availability in relation to M&I demands and the need for regulating storage
- Exchange capacity is very limited and, therefore, it is required to pump water back to upstream locations for subsequent use
- Capacity limitations on the physical ability to deliver water through re-operating storage and pump/pipe/treatment systems
- Scheduling, financial and economic attractiveness of reuse opportunities and required advanced treatment and brine disposal when compared to alternative demand management strategies and new source water development
- The institutional and governance issues associated with the planning, construction and operation of reuse projects in the context of a river basin water management program.
- Public, political and regulatory acceptance and endorsement of the further development of reuse projects up to, and including, direct potable reuse.
- Increasing the use of fully reusable supplies will affect downstream agricultural users by decreasing the amount of physical flow in the river.
- Increasing the use of fully reusable supplies will affect downstream environmental and recreational values by decreasing the amount of physical flow in the river.

In general, water quality in the South Platte Basin tends to degrade in the downstream direction; especially between the Denver Metro Area and the Colorado/Nebraska state line (see Appendix G). This degradation is illustrated by the increasing concentrations of Total Dissolved Solids (TDS) and nitrate below the Denver Metro area. Raw waters with TDS values greater than the secondary maximum contaminant level (MCL) of 500 mg/L[20] may require additional treatment or blending with alternative sources prior to treatment. If additional treatment is needed, processes including pretreatment (i.e., flocculation, sedimentation, and particle filtration), reverse osmosis (RO) membrane filtration, and deep well injection or zero liquids discharge of membrane concentrate would likely be required. These methods of treatment will produce potable water quality, but are costly, complex, and feasibility of their implementation may be constrained by the lack of local brine residual disposal options.

Several concepts have been explored for eliminating the need for brine disposal including additional storage of low salinity sources during wet years to and supply and blending purpose. Additional reservoir storage at multiple locations could be explored including reservoirs for the use by multiple agencies and construction of new off channel storage.

#### 4.6.2.2 Groundwater Recharge and Augmentation for South Platte Agriculture

Agriculture plays a key role in the economy and water use in the South Platte Basin. Of the 831,000 irrigated acres in the South Platte, nearly 50 percent may be lost if all future

[20] EPA. Secondary Drinking Water Regulations: Guidance for Nuisance Chemicals. (2013). http://water.epa.gov/drink/contaminants/secondarystandards.cfm

M&I demands are met solely through traditional buy and dry. In 2006, a significant number of irrigated acres were taken out of production in the central South Platte Basin because of a shortage of augmentation water which led to numerous wells being shut down. The cost of acquiring augmentation water is a limiting factor for many irrigators in the South Platte Basin, however better management of current augmentation supplies could improve the efficiency of water use in the lower part of the basin.

#### 4.6.2.2.1 *Overview*

In coordination with the Northeast Colorado Water Cooperative (Water Cooperative), this project concept could improve the efficiency of augmentation supplies by maximizing the use of both South Platte native supplies and/or excess augmentation sources and could work in coordination with an organization such as the Northeast Colorado Water Cooperative (Water Cooperative) to maximize augmentation supplies. The project concept would also leverage existing infrastructure and potentially provide new infrastructure consistent with the future services mission of the Water Cooperative.

The project concept could involve storing water and make it available for augmentation purposes as an additional source of replacement water within Water Districts 2, 1, and 64. Unappropriated South Platte River water that is available during periods of free river conditions or existing augmentation sources would be diverted and stored in an off-channel reservoir and/or the north Kiowa/ Bijou Designated Basin.

## Northeast Colorado Water Cooperative

**Purpose:** Formed on January 1, 2014 to facilitate the maximum beneficial use of certain water rights along the lower South Platte River in northeastern Colorado, especially District 1 and 64

**Initial Services to Members:**

- Coordination of and market for the lease, exchange and retiming of excess augmentation supplies between cooperative members.
- Accounting models developed for the tracking and coordination of annual, monthly and daily water excesses and shortages between members, within existing decreed augmentation plans.
- Assistance with the development of real time telemetry for wells and other infrastructure that have short term impacts on the stream, and potential financial assistance for such telemetry.
- Establishment of an overall augmentation plan or assistance with members to amend their existing augmentation plans for the efficient use of excess augmentation supplies.
- Coordination and assistance in meeting accounting and notice requirements set up by the existing terms and conditions of current member augmentation plans.

**Future Services to Members:**

Research and potentially coordinate various means to lease, exchange and re-divert the transferrable portion of historic consumptive use water from both senior direct flow and reservoir water rights, while maintaining ownership of the ag water rights, and to find alternatives to the traditional “buy and dry” approach to changed uses of senior water rights.

Investigate the need for utilizing existing infrastructure and building additional infrastructure to help improve water use efficiency by its members both for the short term and long term operations of the Water Cooperative.

Research the historical timing and amount of unappropriated waters in Water Districts 1 and 64 and to utilize existing and new infrastructure to strategically divert and beneficially use such water to meet existing agricultural, municipal, industrial and non-consumptive shortages for both members and non-members.

**Governance:** The Water Cooperative’s governing board of directors is designed to be representative of multiple geographic areas within Districts 1 and 64 as well as representative of various water uses throughout the service area. Members are made up of two classes, voting and non-voting, and each member must own a decreed or pending application for a water right or augmentation plan or water recharge facility.

**Financing:** based on various sources such as grants, loans, membership dues, and water transaction fees

Additional storage in the Kiowa/ Bijou designated basin or in an off-channel reservoir such as Empire Reservoir could provide a mechanism for the Water Cooperative to store excess water during free river that would otherwise flow out of the state. Kiowa/ Bijou designated basin is a non-tributary groundwater source that under natural conditions would not be used to recharge or supplement continuously flowing surface streams, and would therefore provide storage that has a high rate of return. Additional reservoir storage could be achieved by increasing the capacity of a local reservoir such as McCarthy Reservoir or construction of a new off-channel reservoir near Wiggins. Stored water would be delivered for use from storage by either pumping back to the South Platte River or to local canals, thus increasing the efficiency of use due to limited seepage back to the river. A stored source could be useful in augmentation plans to provide a source of water available to replace long-term depletions, which could allow other sources to be available for near-term augmentation. This could provide significant benefits to well users in water districts 2, 1, and 64, especially in District 2 where there is a lack of affordable augmentation supplies. Figure 4-17 shows the components of the conceptual project.

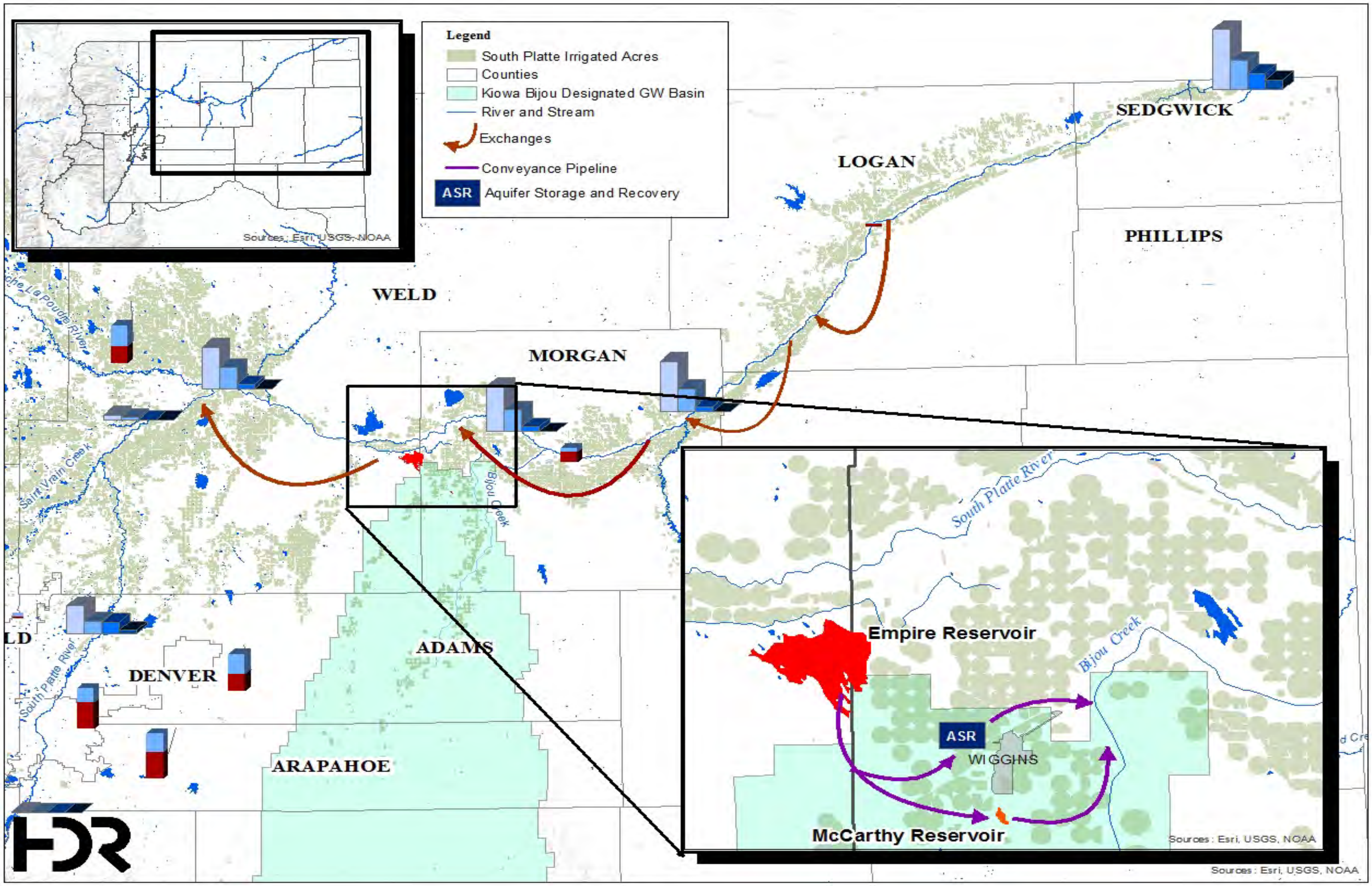


**Figure 4-17. Groundwater Recharge and Augmentation for South Platte Agriculture**

The system efficiency could be further increased through exchanges in the lower part of the South Platte River. The South Platte Water Availability analysis (See Appendix G for Technical Memorandum) explored the exchange capacity on the mainstem of the South Platte River below the Burlington Ditch. Figure 4-18 shows the median exchangeable flow in 2000-2013 for South Platte Diversion structures. The months of October through March, plotted with dashed lines, and the months of April to September, plotted with solid lines, each show similar behaviors within their groupings since October through March is a storage dominated season and the remaining months are irrigation dominated. Exchange through the Prewitt inlet diversion near the end of District 1 is very limited between October and April. However, Figure 4-18 shows moderate exchangeable flow during the summer months. That pattern is reversed downstream toward the Powell Blair Ditch. Exchanges through the Hewes Cook Ditch structure seem extremely reduced for July and August, and it is likely to act as a limiting point for other months represented by solid lines. Exchanges upstream of Fulton Ditch are likely to be controlled by low flows at Burlington and Gardeners Ditches. June is the month with higher exchange capacity, while July is among the months with the lowest capacity.

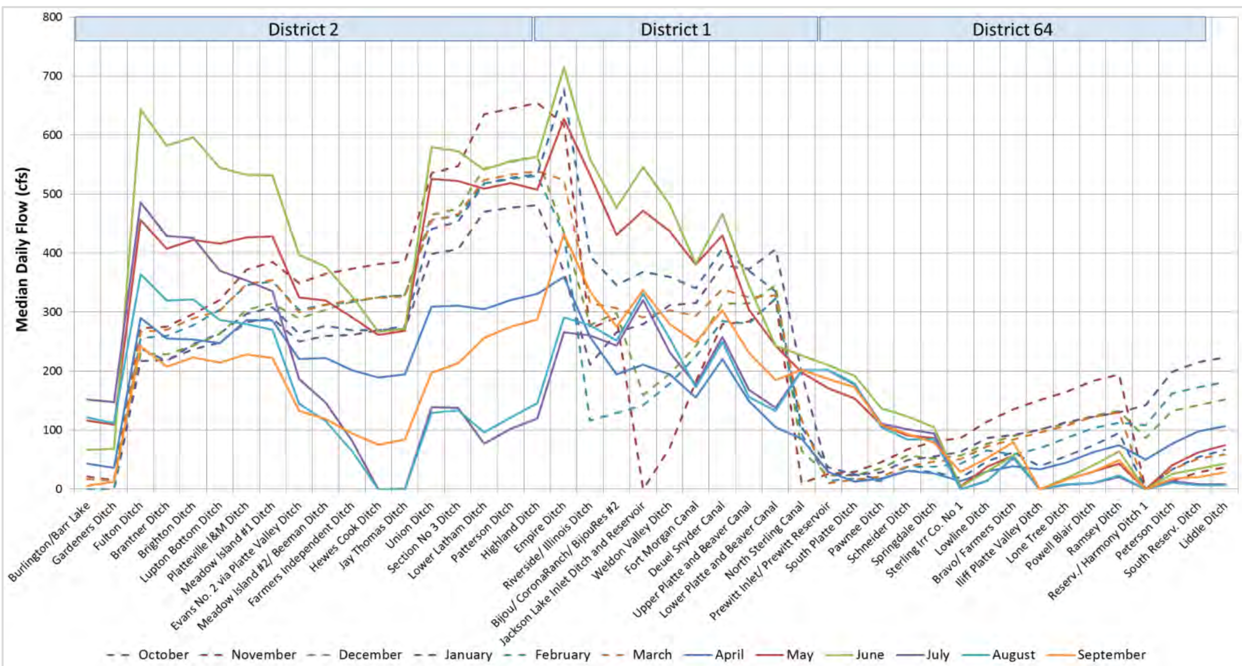


**Figure 4-18 Median Exchangeable Flow for the South Platte Diversion Structures (2000-2013)**

The Water Cooperative could act as the governing agency for this conceptual project. Currently, the Water Cooperative is made of a governing Board of Directors that is representative of multiple geographic areas and water users within Districts 1 and 64. Financing of the Water Cooperative is planned based on various funding sources such as grants, loans, membership dues, and water transaction fees based upon numerous operating scenarios such as number of members, variations in hydrology, short and long term operational plans, and types of water supplies and demands. The current list of members includes:

- Weldon Valley Ditch Company
- Riverside Irrigation District
- Bijou Irrigation Company
- Sublette
- Town of Wiggins
- Wiggins Farms, LLC
- Geisick Brothers Farms Augmentation
- Weimer Farms
- Groves Farms
- Jensen & Teague Augmentation
- Morgan County Quality Water District
- Ft. Morgan Farms, LLC
- Upper Platte and Beaver Canal Company
- Deuel and Snyder Ditch Company
- Lower Platte and Beaver Canal Company
- Pioneer Water & Irrigation, Inc.
- Logan Well Users, Inc.
- Lowline Ditch Company
- Lower Logan Well Users, Inc.
- Harmony Ditch Company
- Stromberger Land and Cattle Company
- LSPWCD WAE
- Julesburg Irrigation District
- South Platte Ditch Well Users
- Parker Water and Sanitation District

#### 4.6.2.2.2 *Opportunities and Challenges*

This conceptual project could address certain agricultural water shortages or gaps in the lower part of the Basin through capturing excess water that would otherwise flow out of the State. Current membership of the Water Cooperative largely consists of ditch companies, irrigation districts, farm and livestock companies, canal companies, and well users in Water Districts 1 and 64. Membership could be expanded to include a broader variety of members including environmental and recreational companies and municipalities, as well as agricultural users in Water District 2.

Environmental and recreational users could benefit through cooperative operation of infrastructure. Additional storage space could be allocated to environmental or recreational pools if such stakeholders are involved to help enhance the streamflows when such flows are needed or to help address concerns with endangered species downstream. Engaging environmental and recreational stakeholders early in the process may help to address some of the challenges listed below. Continued irrigation in the basin benefits aquatic, riparian and wetland habitat through several mechanisms, including streamflows when downstream agricultural rights continue to call water through stream reaches and by the return flows from irrigation practices that enhance streamflows and wetland habitat. Reservoirs could allow for recreational benefits. In addition, if diversion structures are constructed or significantly modified in the future, bypass structures could be constructed so as to allow fish passage, while still measuring bypass flows. Bypass structures allowing fish passage would help to enhance the stream habitat connectivity throughout the reach, which is in focus area 1 and includes plains fish that are listed as state endangered, threatened and species of concern.

Several risks and challenges are associated with this project concept. They could include:

- Financial costs and support
- Water rights and legal constraints
- Management performance
- Community and public support as well as acceptance by existing ditch and reservoir companies
- River flow conditions
- Water rights administration
- The capacity to exchange
- Capacity limitations on the physical ability to deliver water through re-operating storage and pump/pipe systems outside of the river system
- The Platte River Recovery Implementation Program (PRRIP)

### 4.6.3 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 provides connectivity of habitats that are important to plains fish species with fragmented habitats. The life cycles of these species includes 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 D.

# 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 gap of 428,000 AF as defined in Section 2. The remaining 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 gap between projected M&I and SSI water demands and existing supplies (428,000 AF), 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 remaining gap does not necessarily represent a future water supply shortage, but remaining gap does demonstrate where additional work is needed to identify projects and methods to meet those future needs. During the CWCB Portfolio and Tradeoff Analysis (May 2012), the Metro and South Platte roundtables identified IPP success by IPP type. Table 4-19 shows the IPP success rate for each IPP type.

**Table 4-19. IPP Success Rate by IPP Type**

| Basin | Agricultural Transfer | Reuse | Existing Supplies | In-Basin Project | Transbasin | In-Basin Firming | Total Success Rate |
|---|---|---|---|---|---|---|---|
| **Metro Basin** | 75% | 75% | 100% | 75% | 75% | 75% | 88% |
| **South Platte Basin** | 50% | 80% | 100% | 50% | 85% | 50% | 65% |

Source: Basin Roundtable Portfolio and Tradeoff Analysis Table 3

For this gap analysis, the Metro and South Platte BRTs chose to use a medium demand (as defined in Section 2) with an overall 88 percent success for Metro Basin IPPs and a 65 percent success for South Platte Basin IPPs. These percent successes account for future uncertainty in long range population, demand, and water supply forecasting. The gap analysis was performed on a county wide basis and organized into regional subbasins for the consistency with SWSI 2010. These regional subbasins are defined in Figure 4-19.

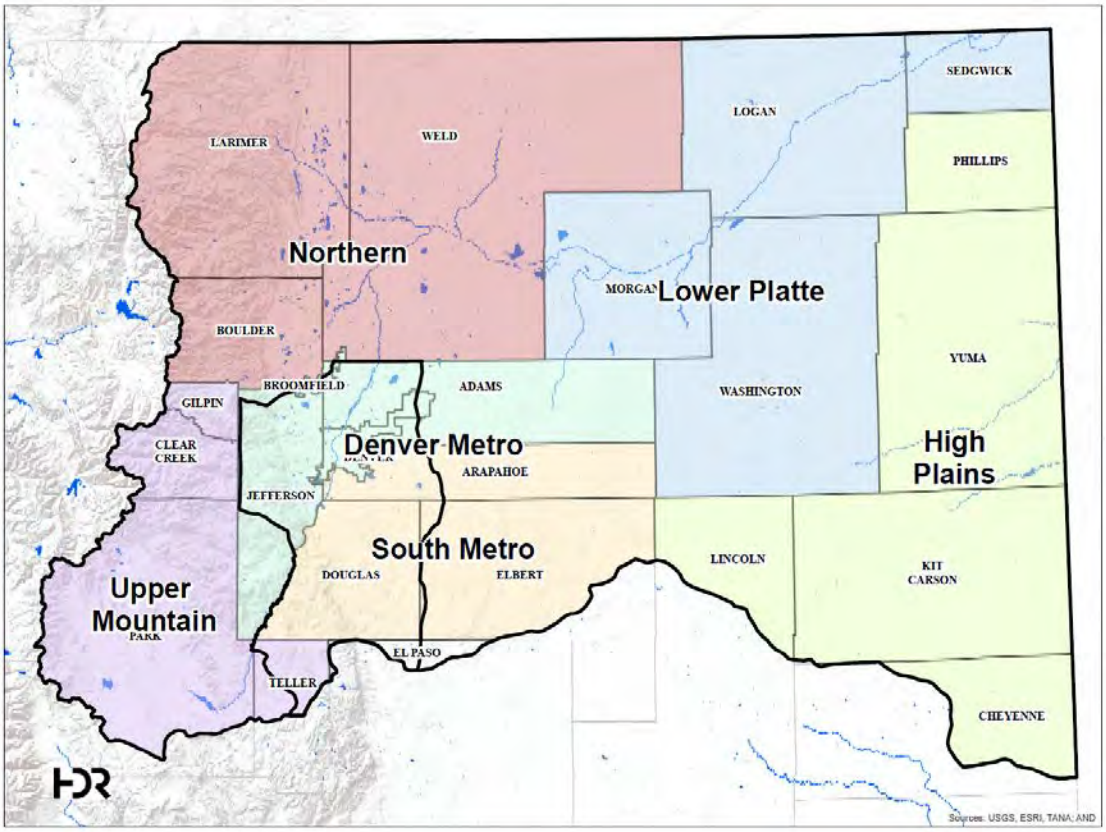


**Figure 4-19. Location of Subbasins in the South Platte and Metro Basins**

### 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 4.3.1.6.

Next, the anticipated yield from the water providers' 2050 IPPs were incorporated, assuming an 88 percent success rate for Metro Basin IPPs and a 65 percent success rate for South Platte Basin IPPs. 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.

**Reference Documents**

The following methodology was extracted from SWSI 2010 Metro & South Platte Basin Report Basinwide Consumptive and Nonconsumptive Water Supply with Needs Assessments - Section 4

*but includes changes to reflect revised IPP success rates.*

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 as outlined in Section 4.3.1.

The 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 M&I and SSI Water Supply Gap = 2050 Medium Net New Water Needs-2050 IPPs (at 88% success rate for Metro Basin IPPs and 65% success rate for South Platte Basin IPPs)

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 88% success rate for Metro Basin IPPs and 65% 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 4-19):

- 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)
- High Plains (Cheyenne, Kit Carson, Lincoln, Phillips, Yuma)

**Reference Documents**

The following methodology is extracted from:

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

*but includes changes to reflect revised IPP success rates.*

The remaining 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. Figure 4-13 on page 4-61 illustrates the M&I gap by 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 54,000 AFY from the medium IPP yields as calculated in SWSI 2010. In the South Platte Basin, the IPP yield increased by 4,000 AFY from the medium IPP yields as calculated in SWSI 2010. This increase is largely due to the increase in IPP success rate. In the Metro basin, other 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. The South Platte Basin had no major project additions, but project yields were refined based on new knowledge. Total regional IPP yields are show in Figure 4-20.

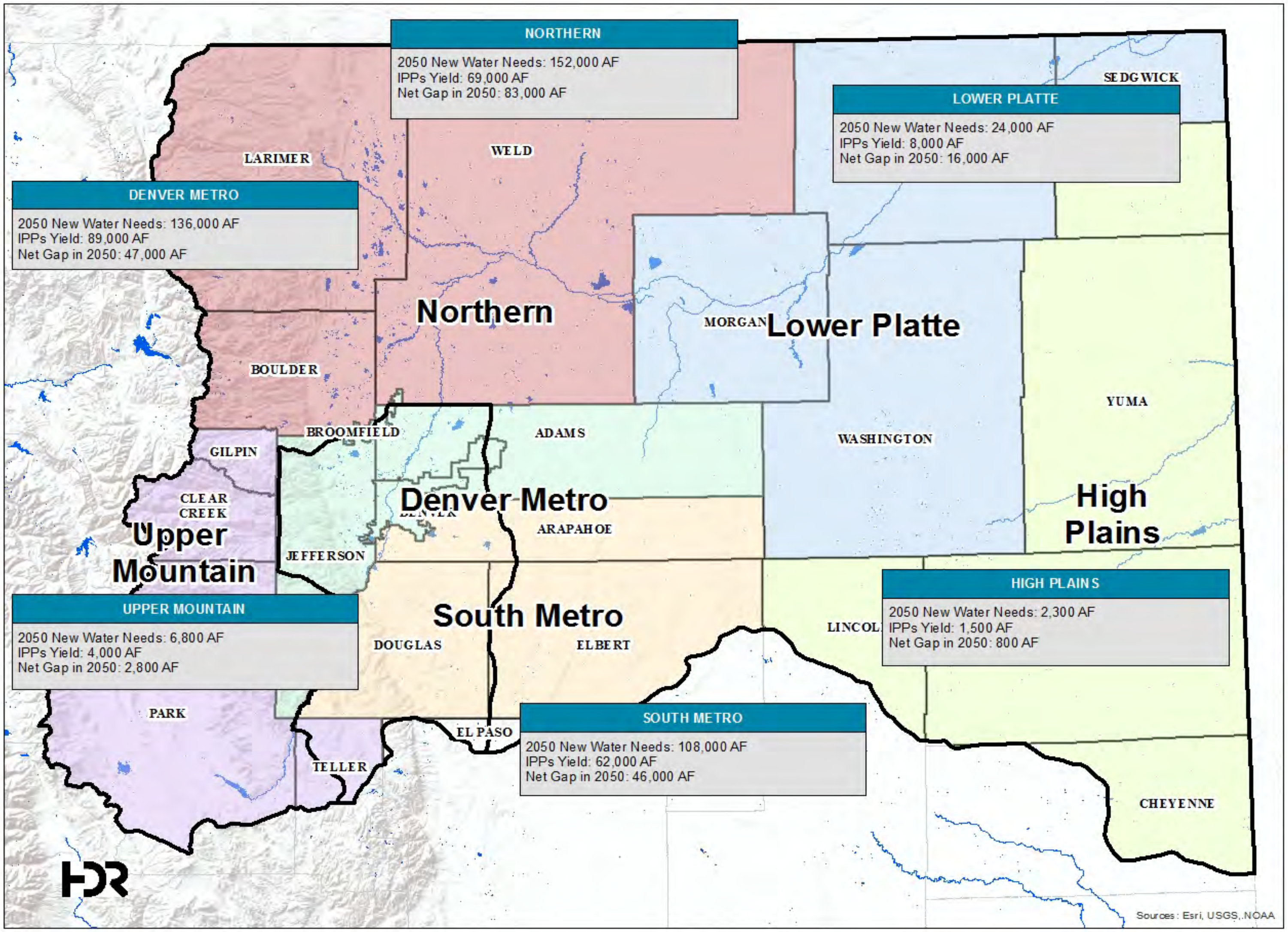


**Figure 4-20. South Platte and Metro Basin Regional IPPs Yields (88% IPP Success Rate for Metro Basin and 66% IPPs Success Rate for South Platte Basin)**

#### 4.7.1.4 Regional M&I and SSI Gap Analysis

This analysis includes 2050 medium remaining gap values for the Metro Basin, South Platte Basin, and the combined Metro and South Platte remaining gap.

The results of the remaining gap analysis presented in this report follow the methodology used in previous CDM studies and incorporate the updated IPP information gathered by HDR. 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 4-20 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 (45,500 AFY)
- Larimer (29,700 AFY)
- Denver (24,700 AFY)
- Arapahoe (21,500 AFY)

Figure 4-21 through Figure 4-23 summarize the results of the gap analysis in the Metro and South Platte Basins. Figure 4-24 illustrates the gap by region within the South Platte and Metro Basin.

**Table 4-20. Summary of Medium Scenario Gap by County**

| Region | County | Total Gap | IPPs at 88% Success for Metro and 66% Success for South Platte (AFY) | 2050 Medium Net Gap After IPPs are Implemented (AFY) |
|---|---|---|---|---|
| High Plains | Cheyenne | 0 | 0 | 0 |
| | Kit Carson | 900 | 600 | 300 |
| | Lincoln | 100 | 100 | 0 |
| | Phillips | 300 | 200 | 100 |
| | Yuma | 900 | 600 | 300 |
| ***REGIONAL TOTAL*** | | **2,300** | ***1,500*** | ***800***[21] |
| Lower Platte | Logan | 5,200 | 1,700 | 3,500 |
| | Morgan | 18,100 | 5,900 | 12,200 |
| | Sedgwick | 300 | 100 | 200 |
| | Washington | 100 | 0 | 100 |
| ***REGIONAL TOTAL*** | | **23,700** | ***7,100*** | ***16,000***[21] |
| Metro | Adams | 46,700 | 37,400[22] | 9,300 |
| | Broomfield | 6,900 | 6,100 | 800 |
| | Denver | 50,800 | 26,100[22] | 24,700 |
| | Jefferson | 31,800 | 19,500[22] | 12,300 |
| ***REGIONAL TOTAL*** | | ***136,100*** | ***89,000*** | ***47,100***[21] |
| Northern | Boulder | 21,400 | 13,900 | 7,500 |
| | Larimer | 53,200 | 23,500 | 29,700 |
| | Weld | 76,800 | 31,300 | 45,500 |
| ***REGIONAL TOTAL*** | | **151,400** | ***68,700*** | ***82,700***[21] |
| South Metro | Arapahoe | 56,800 | 35,300[22] | 21,500 |
| | Douglas | 42,500 | 26,300[22] | 16,200 |
| | Elbert | 8,600 | 0 | 8,600 |
| ***REGIONAL TOTAL*** | | **107,900** | ***61,600*** | ***46,300***[21] |
| Upper Mountain | Clear Creek | 2,000 | 1,200 | 800 |
| | Gilpin | 500 | 300 | 200 |
| | Park | 2,800 | 1,600 | 1,200 |
| | Teller | 1,500 | 900 | 600 |
| ***REGIONAL TOTAL*** | | ***6,800*** | ***4,000*** | ***2,800***[21] |
| ***BASIN TOTAL*** | | ***428,200*** | ***232,500*** | ***195,700*** |

- 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%)

[21] 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.

[22] 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.

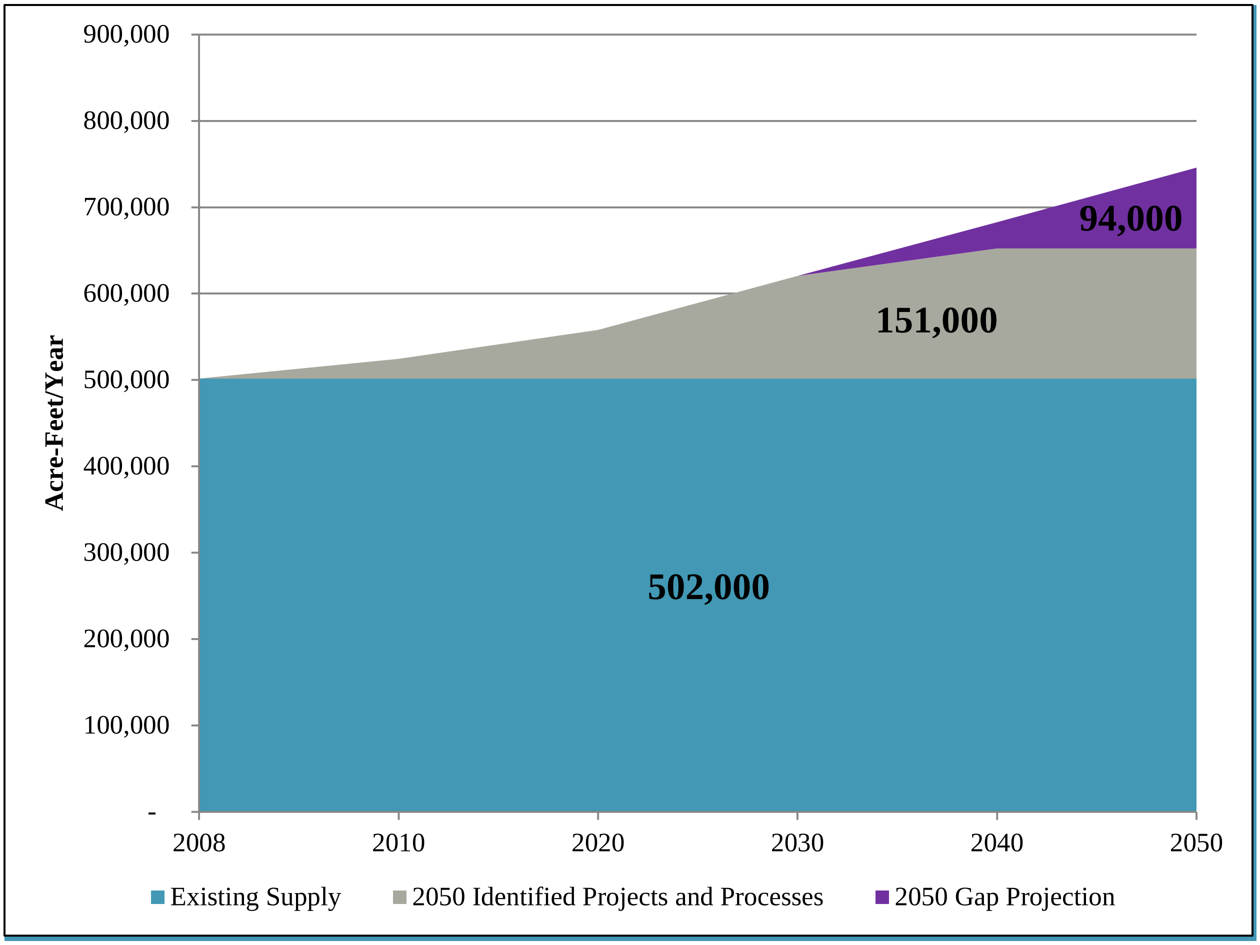


**Figure 4-21. Metro Basin M&I and SSI Gap Summary (88% IPP Success Rate)**

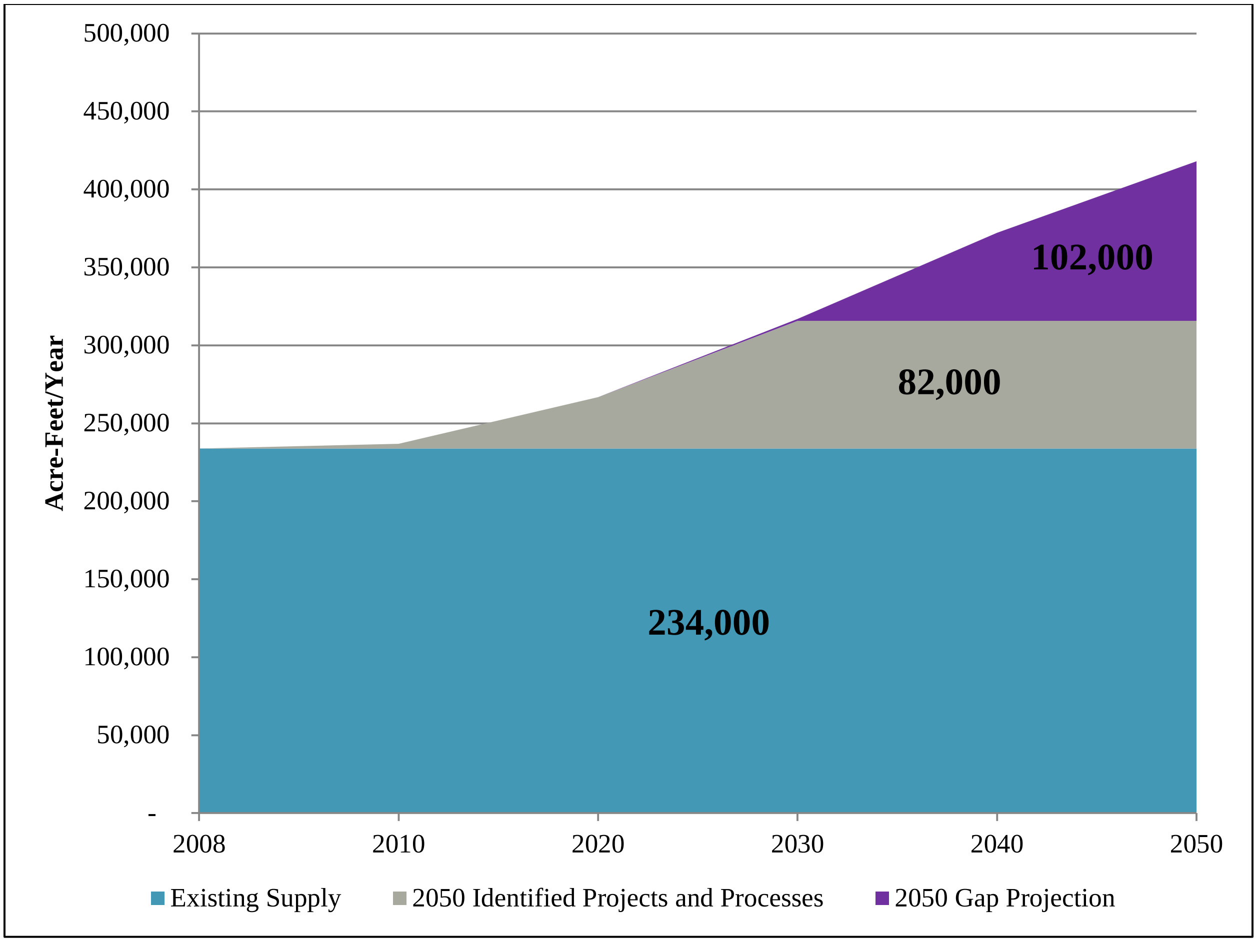


**Figure 4-22. South Platte Basin M&I and SSI Gap Summary (66% IPPs Success Rate)**

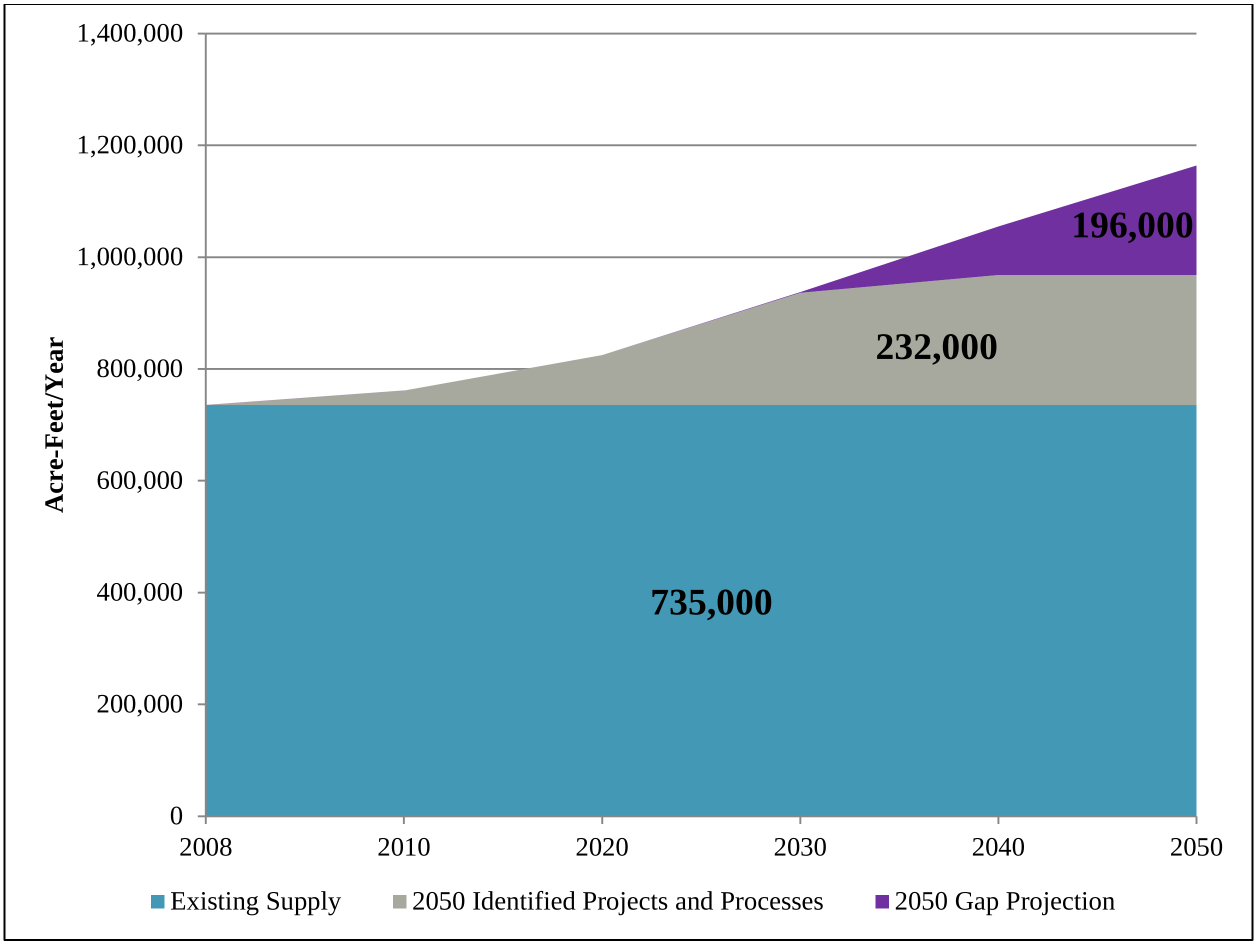


**Figure 4-23. South Platte Basin and Metro Basin M&I and SSI Gap Summary (88% IPP Success Rate for Metro Basin and 66% IPPs Success Rate for South Platte Basin)**

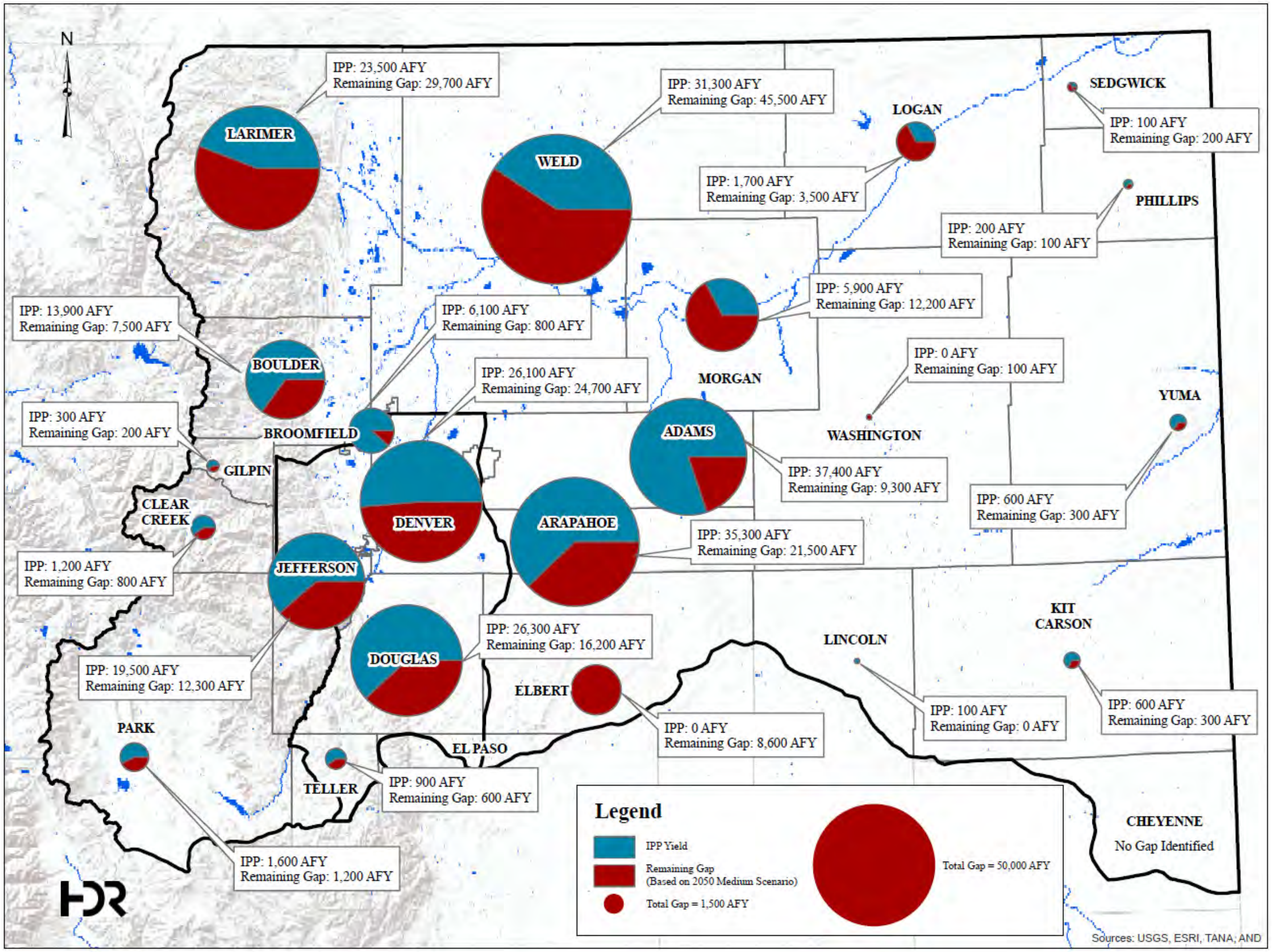


**Figure 4-24. South Platte Basin Gap Disaggregation by County**
**(88% IPP Success Rate for Metro Basin and 66% IPPs Success Rate for South Platte Basin)**

## 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. Examples of these types of analyses can be performed using the framework and methodology presented above and in Appendix D. In most locations, additional data is necessary to fully evaluate the projects that exist and that are planned, 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 that currently have no projects are not necessarily needing protection, as senior downstream calling water rights may call for water through these reaches.

As discussed above, the methodology and framework detailed in Appendix D can 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 in the future.

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 and recreational flow 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. Once these data are compiled for a location, the framework and methodology discussed above and in Appendix D can be used to better assess the level of protections that exist within an area and the additional needed protections.

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 continuing dialogue on additional Colorado River Basin supply development. This section summarizes the IBCC process and presents the perspectives of the South Platte and Metro BRTs related to previously-considered Colorado River Basin supply concepts including both large and smaller projects.

### 4.8.1 The IBCC Process

IBCC representatives assembled an “IBCC Conceptual Framework” related to the 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 and the potential for conditions to worsen over the next few years. The operations of these reservoirs have ramifications for water management, hydroelectric generation and distribution and economic impacts 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 intra-state conceptual frameworks regarding the Colorado River.

Three IBCC task groups have been set up to explore elements of the conceptual framework, which is now being termed the conceptual framework, including the topics and summary points listed in Table 4-21.

**Table 4-21. Current IBCC Discussion Topics and Conceptual Framework**

| 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.<br><br>Strategies for enhanced municipal conservation and its interplay with wastewater reuse..<br>•<br><br>The framework for what constitutes "agreed-to projects" for future West Slope needs.<br><br>Mutual benefits and advantages for Colorado's shared future, with regards to risk management strategies and maintaining compact compliance.<br><br>Near-term funding strategies to enhance environmental resiliency.<br><br>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.<br><br>2) A new TMD project would be used conjunctively with East Slope interruptible supply agreements, Denver Basin Aquifer system resources, carry-over storage, terminal storage, drought restriction savings, and other non-West Slope water sources.<br><br>3) In order to manage when a new TMD will be able to divert, triggers are needed.<br><br>4) An insurance policy is needed for existing uses, "agreed-to" projects*, and some reasonable increment of future West Slope development.<br><br>5) Future West Slope needs should be accommodated as part of a new TMD project.<br><br>6) Colorado will continue its commitment to improve conservation and reuse.<br><br>7) Environmental resiliency and recreational needs must be addressed both before and conjunctively with a new TMD |

TMD = transmountain diversion

### 4.8.2 South Platte Basin Perspectives on New Colorado River Basin 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 Basin 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.

### 4.8.2.1 Alternative Concepts for Additional Colorado River BASIN Supply Development

As past discussions of Colorado River Basin 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, including those being conducted under Water Supply Reserve Account (WSRA) programs provide important data and information useful in the consideration of new Colorado River supply projects.

#### 4.8.2.1.1 *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)[23]

This multi-party agreement begins a long-term CRCA 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:

[23] 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

- Moves forward an important project involving the enlargement of the existing Gross Reservoir (the Moffat Project), to 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.

**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.

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 4-22.

### Table 4-22. Signatories and Benefactors of the CRCA

| 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.

#### 4.8.2.1.2 *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 4-25 below shows the geographic extent for four Colorado River transbasin concepts—Blue Mesa Pumpback, Flaming Gorge Pumpback, Green Mountain Pumpback, and Yampa Pumpback.

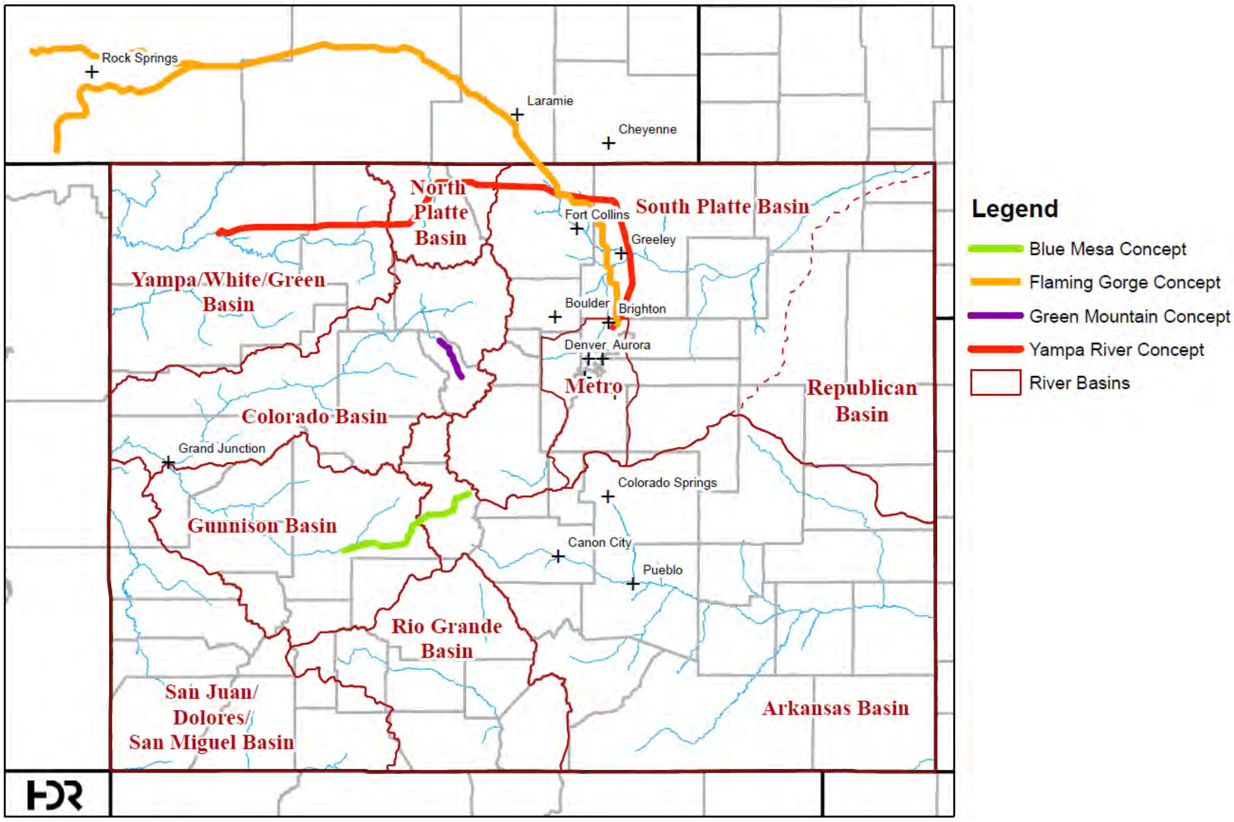


**Figure 4-25. Overview of Agricultural Transfer and New Supply Development Concepts**

The basic attributes of the four Colorado River Basin concepts as are presented in Table 4-23 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 (Reclamation) 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 4-23. Colorado River Basin 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<br>• Firming storage required | • Conventional treatment technology |
| Yampa | • New water rights appropriation | • 250 mile pipeline with static pumping requirement of 5,000 feet<br>• Firming storage required | • Conventional treatment technology |

**Table 4-23. Colorado River Basin Supply Development Concept Attributes (after SWSI Appendix N)**

| Concept | Water Source/ Water Rights | Conveyance and Storage | Water Quality and Treatment Costs |
|---|---|---|---|
| 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<br>• 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<br>• 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.

#### 4.8.2.1.3 *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 identified over the years by a variety of parties for a wide range 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 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 4-24 presents an 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. Summaries of these projects are presented following Table 4-22.

**Table 4-24. Potential Smaller-Scale Transbasin Water Projects**

| West Slope Supplies | |
|---|---|
| ***Colorado Basin*** | |
| Enhanced Green Mountain Pumpback | • Grand Valley System Improvements<br>• Increased yield for existing systems<br>• Shoshone |
| Wolcott Pumpback "Little Straw" | • Wolcott Reservoir to Vail Pass 90 – 100K AF yield (Eagle Piney) |
| Webster Hill Reservoir | • Regulating reservoir 30,000 AF Capacity |
| ***Yampa Basin*** | |
| Middle Yampa Pumpback | • Elk River to tributary storage in the South Platte |
| Mini Yampa | • Four counties project. Diversion from Morrison and Service Creek into Northern's system |
| ***Gunnison Basin*** | |
| Taylor Reservoir | • Tunnel to Arkansas Basin with pumpback to enhance Taylor River flows |

### Colorado River Basin System Improvements – Green Mountain and Grand Valley

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 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 River, 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 could 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 and other water rights. 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.

### 4.8.2.2 SMWSA Concept for Discussion

The South Metro Water Supply Authority (SMWSA) put forward for in-basin and statewide discussion a collaborative multi-purpose project concept based on a potential Flaming Gorge Pipeline project and conjunctive use with the Denver Basin Aquifer that could also be combined with temporary South Platte River Basin agricultural water transfers and additional M&I water conservation and reuse opportunities. SMWSA assembled this concept for others to react to so that it could be evaluated and built upon through the Basin Roundtable processes and be considered in on-going IBCC discussions. Although this "straw-man" is conceptualized around a Flaming Gorge Pipeline project, many of the concepts presented by SMWSA 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.

The SMWSA concept submitted to the South Platte Basin and Metro Roundtables prior to issuing the Draft SPBIP on July 31, 2014 was presented in that document as Appendix F. It is again presented in Appendix F in its entirety and with no changes. Presented below are: 1) a comparison of the SMWSA Concept in relation to the seven IBCC summary points presented in Table 4-18 above and 2) a summary of the benefits, challenges and statewide policy considerations as defined by the SMWSA.

#### Comparisons to the IBCC Conceptual Framework

1. **The East Slope is not looking for firm yield from a new TMD project and would accept hydrologic risk for that project.**

The source of water for the project would likely 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 at Flaming Gorge Reservoir. Diversions would likely vary significantly from year-to-year depending on many factors potentially including hydrologic conditions, current storage levels in federal reservoirs (Colorado River Storage Project and Lake Mead), status of compact compliance monitoring, environmental and recreational needs and management strategies as well as Front Range water demands and storage levels. Per the SMWSA, 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." Risk would be managed through the use of triggers and Dry-Period Sources including Denver Basin Aquifer conjunctive use, ASR, and East Slope temporary agricultural transfers. These are described under summary points 2 and 3 below. Additionally, to assure the critical needs of all Colorado's post-1922 users would be met if a curtailment cannot be avoided, an emergency west slope water bank would be in place. This is described further under summary point 4.

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.**

The end users of the project would also need other 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 from the WISE Project, they will continue to rely on Denver Basin well pumping as well as existing and expanding M&I conservation and reuse programs. Similar strategies could be used to deal with the variability of a Flaming Gorge project and associated triggers.

   a. **Denver Basin Aquifer System 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 System from a base supply to a drought supply, the aquifers can be managed to assure long-term reliability. This concept has been investigated and described for over 15 years (if not longer) by key parties who would potentially be involved. The SMWSA stressed that the concept is now worthy of serious consideration by the IBCC and the CWCB through Colorado's Water Plan. It recommends further investigation as a practical and viable means to manage Colorado's statewide water resources and that the concept be vigorously pursued in subsequent stages of developing Colorado's Water Plan.

b. **East Slope Temporary Agricultural Water 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 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.

3. **In order to manage when a new TMD will be able to divert, triggers are needed.**

As noted above, hydrologic triggers could include Lake Powell levels, overall storage in the CRSP system, the 10-year rolling average of upper basin deliveries, environmental and recreational needs, Front Range water demand levels, Front Range water storage levels, combinations of these triggers and potentially other types of triggers.

4. **An insurance policy that protects against involuntary curtailment is needed for existing uses and some reasonable increment of future development in the Colorado River system, but it will not cover a new TMD.**

*Emergency West Slope Water Bank for pre-1922 Water Rights:* The triggers and dry-year sources above could 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."

5. **Future West Slope needs should be accommodated as part of a new TMD project.**

*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. The SMWSA listed discussion points for each of the Yampa/White, Colorado, Gunnison and Southwest basin.

6. **Colorado will continue its commitment to improve conservation and reuse.**

Although the SMWSA concept present in Appendix F did not concentrate on conservation and reuse due to its focus on presenting a specific infrastructure concept for discussion, it concluded that the conceptualized project could also include elements to require or encourage different types of conservation measures and that the project could be configured to maximize utilization of fully consumable water either through M&I reuse or "second use" by east slope agriculture. In addition, with this concept Front

Range municipalities would get a large increment of high quality reusable water as an overall benefit of the project.

7. **Environmental resiliency and recreational needs must be addressed both before and conjunctively with a new TMD.**

The SMWSA indicates that the concept they present for a multi-purpose project for discussion purposes could include environmental and recreational benefits and suggests that the State consider policies and funding to help support a project that would have broad benefits for both consumptive and non-consumptive water needs. The SMWSA concept as presented in Appendix F also raised the possibility of benefits to the headwaters of the Colorado River system. They indicate that 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. Informal comments received to date on the Draft SPBIP and other BRT input received to date indicate this could be a highly sensitive topic. SMWSA acknowledges that “Front Range water providers have invested enormous capital” in these project and that their concept would need to be explored with current transbasin diverters.

#### Summary of Benefits, Challenges and Statewide Policy Considerations

The SMWSA offered the following summary of the concept they presented for discussion:

*Overall Benefits of the Project*

- Front-range municipalities get an increment of high quality reusable water.
- New water supply development minimizes loss of irrigated acres and reduce competition for in-basin supplies 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

### 4.8.3 Potential Future Actions[24]

The vision of the South Platte and Metro Roundtables for future Colorado River Basin 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 Basin supply 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, multipurpose 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 Basin water supply may be available for use, thereby reducing the

[24] 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

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 Basin 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 or 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 Basin supply options should be preserved for future generations on both the west and east slopes. There are many challenges to development of Colorado River Basin supply such as 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 Basin 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 Basin supply are systematically being closed, and a concerted effort is needed to preserve future options to develop Colorado River Basin 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 Basin 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 Basin 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 Basin supply project(s) would be multi-purpose, with associated recreational and environmental benefits. Colorado River Basin 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 Basin 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 system 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 Basin 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 Basin supply and Agricultural Transfers – instead of building a project that has a single source, from either Colorado River Basin supply or Agricultural Transfer. Because the required facilities essentially double with dual source projects, the cost would be 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 Basin 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 Basin supply options.
- Investigate the viability of obtaining 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 take action to reduce the need to list new species.

### 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.

# 5

# Implementation Strategies for Projects and Methods

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# 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.
  - o Portfolio A: In-basin portfolio with only traditional buy-and-dry agricultural transfers
  - o Portfolio B: In-basin portfolio assuming an 88 percent IPP success rate for the Metro Basin and a 65 percent success rate for the South Platte Basin, ATMs and multipurpose/cooperative water supply projects including additional East Slope storage and conveyance infrastructure
  - o Portfolio C: A balanced portfolio with the in-basin methods of Portfolio B combined with new Colorado River supplies
- **Eleven Key Elements of the 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. Promote multi-purpose storage projects that enhance other South Platte Basin Solutions
9. Facilitate effective South Platte communications and outreach programs that complement the State’s overall program
10. Research new technologies and strategies (especially those that could enhance use of lower quality water sources)
11. 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:

### 5.1.1 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 Basin Options

### 5.1.2 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 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 Aquifer system 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 Basin options that could benefit multiple basins using transparent processes involving IBCC representatives and BRT Chairpersons
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 processes with no definite end in sight
- Options to develop new Colorado River Basin 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 in Section 4.3.1.2) 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.

[1] https://www.keystone.org/about-us-the-keystone-center.html

#### 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, as discussed in Section 4.3.1.6.

### 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.

### 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. To fully address the environmental and recreational needs, the impact or benefit of projects requires good data; therefore baseline streamflows; aquatic, riparian and wetland species needs;

recreational needs; and other quantifiable indicators should be assessed, measured and monitored. Additional information that is important to acquire includes a better understanding of the funding pipeline and opportunities for local organizations to cooperate.

### 5.2.4 Effects of Extreme Hydrologic Variability and Climate Change

The projected and potential impacts of climate change on water resource availability in Colorado were summarized in Section 2.1.4. For planning purposes, the Metro Roundtable included in its Portfolio and Tradeoff Analysis 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 Supplies

The cost of developing additional water supplies for M&I and agriculture is continually 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 South Platte River, lower Yampa River, Green River at Flaming Gorge, the Gunnison at Blue Mesa and the lower Arkansas 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 Pumpbacks cost about $40,000 per acre-foot but would only meet a portion of the South Platte and Metro gap. For comparison, a study completed in June 2011 by the Colorado Water Institute 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 Basin 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 instead focus on additional agricultural transfers.

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.

In addition to helping fund the permitting and capital costs for new water supply projects, the State of Colorado needs to also support the continual improvement and development of water management tools. This support is important for each of the Basin Implementation Plans. As technology continues to advance, the State should provide funding to support updating technical programs and activities which will help in the understanding of the timing, magnitude and location of M&I water supply gaps, agricultural shortages and environmental and recreational needs using shared base data and well-vetted and consistent assessment methodologies. Better management tools will optimize projects to meet multiple needs, minimize cost, and protect public health and safety.

In summary, to meet the future water supply needs of the South Platte Basin, continued and additional funding for projects and for assessment technologies will be necessary. The state should maintain current funding sources for water supply projects including current or enhanced levels of funding for programs such as the CWCB Water Project Loan Program, CWCB’s WSRA Fund, the Species Conservation Trust Fund, the Water Resources and Power Development Authority’s Water Revenue Bond Program and CWCB grant program. These programs are vital for the continued development of water projects and activities to meet environmental, agricultural, and M&I needs. Additionally, the roundtables support active exploration of other, sources of funding including federal and private sector sources. It is likely that the larger, more comprehensive water supply solutions that will be considered going forward will be multipurpose projects with potential M&I, agriculture, environmental and recreational components. Therefore, it is likely that funding for these projects will come from multiple sources with complex financial arrangements. For example, environmental and recreational components of projects, especially any elements that go beyond the direct impacts of water diversions and infrastructure construction, might be more likely to be eligible for government and private sector grants. Other components tied to relatively secure revenue streams that would start to be generated soon after project construction might be attractive for private financing or public-private partnerships to get better terms or manage levels of public agency debt. Therefore, the State should form a broad-based task force to explore

[2] Kenney, Douglas. Colorado Water Institute. *Relative Costs of New Water Supply Options for Front Range Cities*. Completion Report No. 224. June 2011.

opportunities to increase funding resources. This task force should evaluate the pros and cons of a wide range of possibilities including those cited in the Draft CWP including a state-based loan guarantee program, the Container Fee Ballot measure, the use of Conservation Tax Credit revenues for stream and watershed restoration, loans for municipal conservation practices, federal programs including WIFIA and the Rural Infrastructure Fund, and other strategies that could generate new funding for environmental, agricultural, and M&I water projects in Colorado. The Roundtables also recommend additional evaluation of funding strategies being implemented on large water supply projects across the country, comparing them with current and potential State of Colorado programs and applying them conceptually to a range of future South Platte water supply projects.

### 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.

### 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, 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 Basin 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 Basin 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 Basin 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 system 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 Basin 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 system. 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 Basin supply and agricultural transfer options for future generations to determine whether they should be developed such as:

- New Colorado River Basin 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 Basin 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 US 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)
- To enhance efficiency of project development, encourage early State involvement in 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 Basin 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 continue to 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 Basin 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 Basin 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 Basin 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 Basin 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 IPPs
- 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, improvements to, or replacements of structures which help provide protections. The South Platte Basin will continue working to quantify the environmental and recreational "gap" and to assess projects that protect or enhance environmental and recreational attributes. 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 this section. The three portfolios below offer strategies that the SP BIP may use to meet 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

#### 5.4.1.1 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

#### 5.4.2.1 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 of IPPs at an 88 percent success rate for the Metro Basin and a 65 percent success rate for the South Platte Basin resulting in an estimated yield of 233,000 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 Portfolio B, the remaining anticipated demand gap of approximately 165,000 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 such as the in-basin project concepts discussed in Section 4.6.2.1, and; (2) traditional agricultural transfers. Given the lack of unappropriated water available and that in-basin project concepts are highly conceptual and much additional effort and further evaluation into project yields are needed, 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 155,000 AFY) would have to be met through traditional agricultural transfers. This equates to a loss of more than 158,000 irrigated acres (approximately 20 percent of existing irrigated acreage). This is slightly less than the estimated 235,000 acres or 28 percent loss estimated in SWSI 2010 (see Section 2.2.1.2).

Under Portfolio B, the South Platte Basin expands the use of 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, unappropriated native South Platte water, and fully consumable supplies would be done through additional storage, conveyance pipelines, and diversions in the lower part of the South Platte Basin where water may be available as illustrated by the conceptual project in Section 4.6.2.1. 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 158,000 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

### 5.4.3.1 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 88 percent IPP success rate in the Metro Basin and 65 percent IPP success rate in the South Platte) with an additional 75,000 AFY of new Colorado River basin supplies through a collaborative multi-purpose interbasin project used in conjunction with the Denver Basin Aquifer and/or temporary South Platte River Basin agricultural water transfers such as the SMWSA Concept for Discussion (Section 4.8.2.2 and available in full text in Appendix F). This portfolio reduces the loss of irrigated acreage to approximately 82,000 acres.

Under Portfolio C, new Colorado River supplies (75,000 acre feet) diversions would likely vary significantly from year-to-year depending on many factors potentially including hydrologic conditions, current storage levels in federal reservoirs (Colorado River Storage Project and Lake Mead), status of compact compliance monitoring, environmental and recreational needs and management strategies as well as Front Range water demands and storage levels. Additional Colorado River supplies 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 82,000 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.

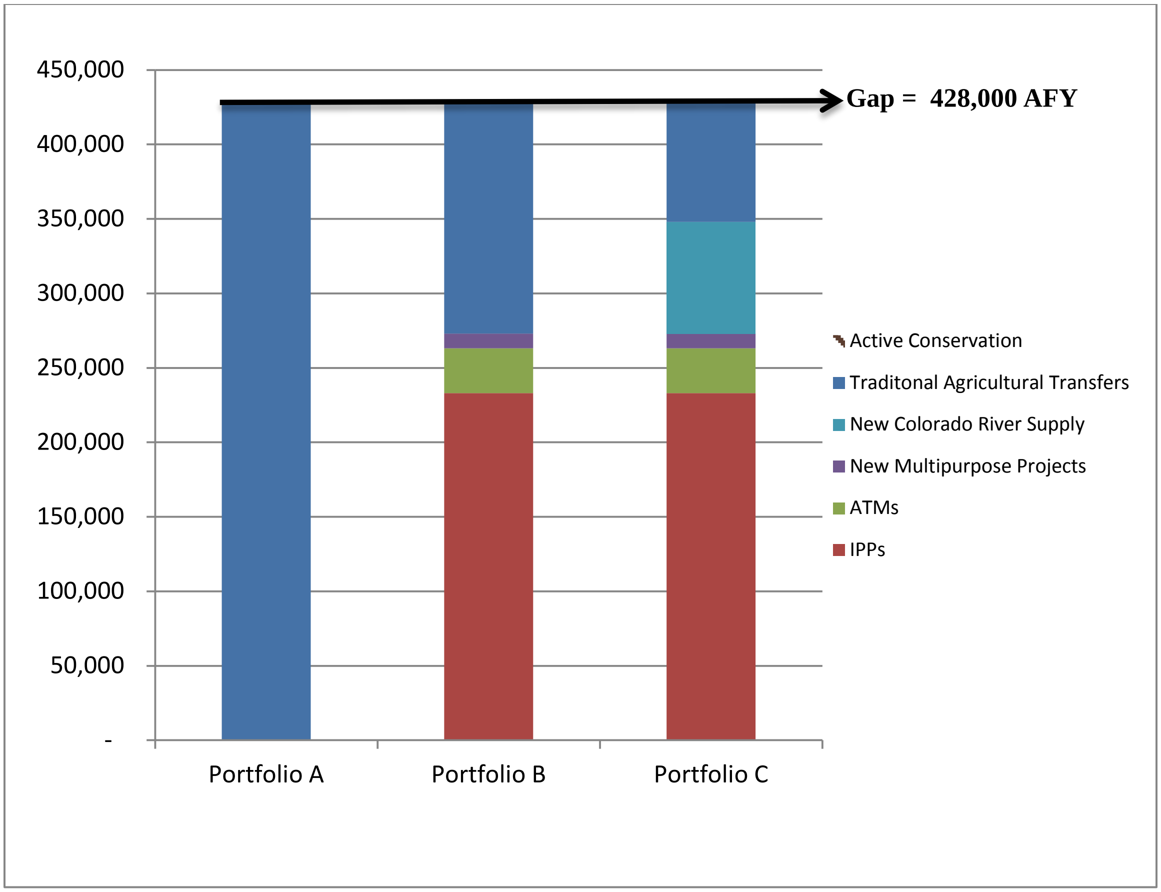


**Figure 5-1. Portfolio Scenarios to Meet 2050 M&I and SSI Gap without Active Conservation applied to the Gap**

### 5.4.4 Portfolios Evaluated Under Additional Conservation

As outlined in Section 4.3.1.6, up to 211,000 AFY of additional 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. The Metro and South Platte Basin Roundtables have indicated that 50% of future active conservation will be applied toward the gap. This percentage of savings applied toward the gap will result in a total reduction of approximately 53,000 AF. The potential effects of this strategy are illustrated in Figure 5-2.

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 meeting future conservation goals.

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. Due to the basin being highly dependent on return flows, this could impact agricultural environmental recreational, and potentially other municipal and industrial water users. Conservation may contribute to reducing local M&I demands, however, on a larger basin scale, additional conservation may simply reallocate the supply gap to another location within the basin.

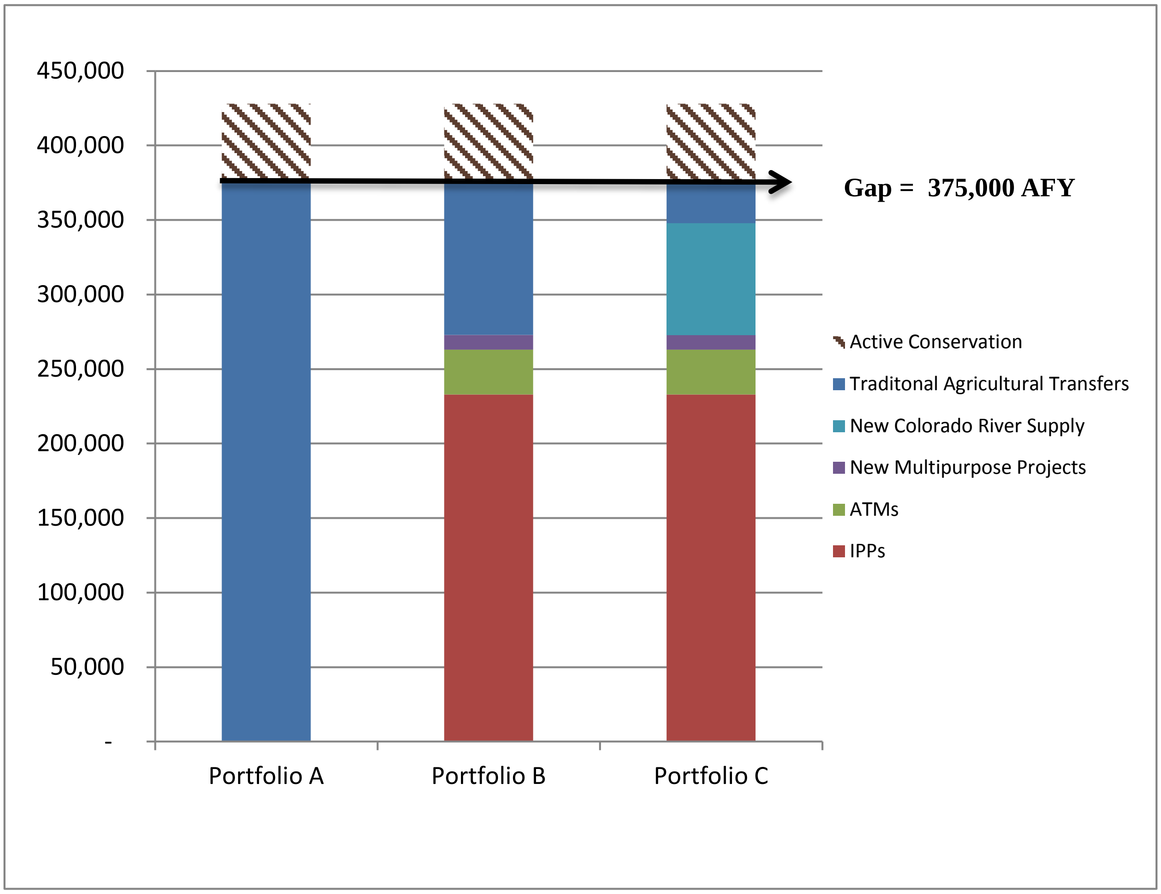


**Figure 5-2. Portfolio Scenarios to Meet 2050 M&I and SSI Gap with 50 percent of Active Conservation applied to the Gap**

## 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 638,000 AFY, and under Portfolio C, approximately 297,000 acres of irrigated land would be dried up to meet the M&I demands.

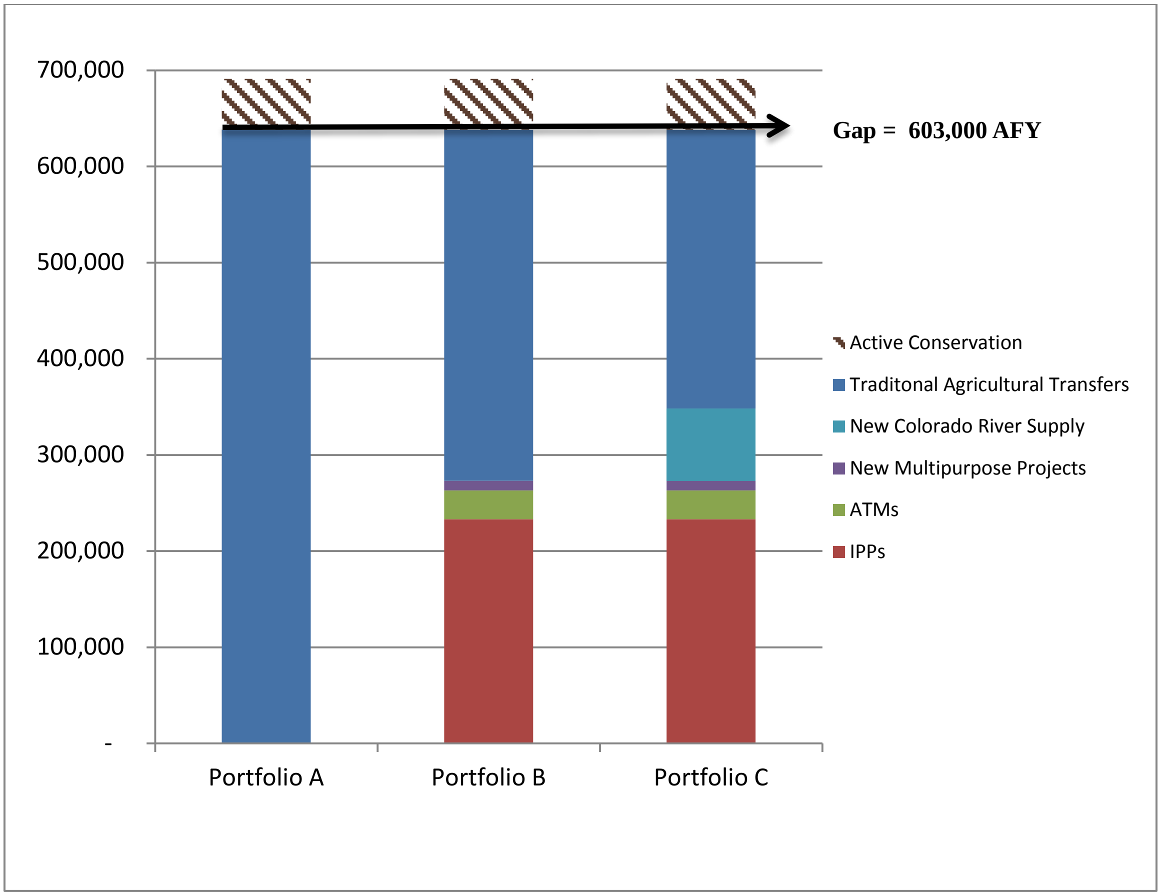


**Figure 5-3. Climate Change Portfolio Scenarios to Meet 2050 M&I and SSI Gap with 50 percent of Active Conservation applied to the Gap**

## 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) continuing and enhancing M&I conservation and reuse; 2) greater use of in-basin supplies along with East Slope storage; and 3) conjunctive use of Denver Basin aquifer system, foothills and mountain aquifers and South Platte alluvial aquifers to the extent permitted by Colorado Water administration; 4) utilize ATMs to the extent they can provide reliable long-term supplies; and 5) preservation of options to develop new Colorado River Basin supplies in the future;. 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 Basin 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 Basin 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 11 primary implementation strategies or Plan Elements. These 11 Plan Elements are explained in the 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**

## 11 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 Basin supply options
7. Promote multi-purpose storage projects that enhance other South Platte Basin solutions
8. Manage the risk of increased demands and reduced supplies due to climate change
9. Facilitate effective South Platte communications and outreach programs that complement the State's overall program
10. Research new technologies and strategies
11. 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 to 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

***Limited supplies drive an extreme overall efficiency in the Basin. Already, the South Platte Basin has achieved 15% reduction since 2000. The Metro 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.

The South Platte also relies heavily on return flows and reuse. It is generally understood that a drop of water is used multiple times before it leaves Colorado at the Nebraska state line. Metro providers are also actively pursuing ways to expand their use of reusable supplies. 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.

The next major steps in water conservation include enact ordinances and legislation to require more efficient plumbing fixtures, appliances and landscaping falls outside the purview of water providers. Recently passed legislation, Senate Bill 103 “Phase-In-Efficiency Water Fixtures Options”, requires the sale of more efficient water plumbing fixtures and strives to save water by phasing out the sale of less water efficient faucets, showerheads, toilets and urinals by replacing on shelf options with WaterSense-certified fixtures. The success of SB 14-103 exemplifies support 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 Coordinated Water and Land Use Planning

Coordinated planning efforts between water agencies and land use planners 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, implement water efficient landscaping codes, subdivision regulations, zoning requirements and master plans. Coordination with land use planning and water development provides an opportunity for these objectives to be achieved. A detailed discussion of where opportunities exist in the basin is given in Section 5.2.1.2.

#### 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 5.5.10.2 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 Basin 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.

#### 5.5.3.2 Develop Methods to More Effectively Utilize Tributary and Nontributary 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 nontributary 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 system 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 and framework 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 or recreational 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 as discussed in Appendix D.

### 5.5.6 Simultaneously Advance the Investigation, Preservation, and Development of New Colorado River Basin 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 Promote Multi-Purpose Storage Projects that Enhance other South Platte Basin Solutions

Additional storage would provide greater water supply security for municipal, industrial, agricultural, recreational and environmental needs of the South Platte Basin, while also providing resiliency against extreme weather conditions including droughts and floods. ***Furthermore, additional storage is essential to implementing the above Plan Elements (Sections 5.2.1 - 5.2.7).*** Front Range Storage implementation is imperative to managing risk associated with meeting future demands. The Metro and South Platte Basin Roundtables strongly advocate for the development of additional surface and groundwater storage, further research of ASR, and the investigation into additional storage and reservoir sites in the basin. Multi-purpose and cooperative storage projects can provide water to water users, while helping to maintain environmental flows in dry years.

### 5.5.9 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.

### 5.5.10 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.

#### 5.5.10.1 Water Quality Challenges

Projects that take water from the lower reaches of rivers will require costly advanced water treatment (see discussion within Section 5 within Appendix G). 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.

#### 5.5.10.2 Indirect Potable Reuse and Direct Potable Reuse

One strategy that will make more efficient use of water in the South Platte Basin 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). Water Environment Research Foundation (WERF) and CWCB have recently conducted a study regarding the Barriers to the Implementation of Direct Potable Reuse in Colorado. The study concluded that DPR is technically feasible using RO treatment methods, but the economics of the process would be challenging without increased efficiency of RO brine disposal/ minimization technologies. It recommended that the State of Colorado advance the potential of future DPR projects by:

- Beginning to develop an appropriate regulatory framework addressing DPR
- Continuing to promote/monitor research into new cost effective technologies for brine disposal
- Promoting and monitoring research of non-RO treatment of recycled water suitable for DPR, and
- Improving public understanding of advantages of potable reuse

New technologies focused on the minimization of concentrate, and eventually zero liquid discharge (ZLD), continue to advance. The WERF is also 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.

### 5.5.11 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 reduce both public agency expenditures and water agency expenditures that must be passed on to their customers while providing the same level of rigor and due diligence in the evaluation of environmental effects and in the associated documentation. Current efforts to permit projects have taken more than ten years; this is simply too long of a time period for any rational permitting process. The Executive Order cites this issue and calls for the identification of potential areas of improvement in CWP.

#### 5.5.11.1 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.

#### 5.5.11.2 Recommendations to Improve the State Process

The Metro and South Platte Basin Roundtables believe that the federal, state and local permitting processes for water projects can be enhanced by increased State agency communication, cooperation and involvement. Specifically, the Roundtables recommend:

- The State name the Department of Natural Resources as the lead agency for water projects that trigger federal permitting requirements, thus minimizing overlapping reviews or redundant or conflicting comments to federal, other state, or local regulatory agencies. In this role, the Colorado Department of Natural Resources would have to recognize other State Agency statutory requirements for permitting.
- The State of Colorado Department of Natural Resources should become a Cooperating Agency for every major water project in Colorado requiring federal permitting. This would assure early, timely and coordinated input into the NEPA process so the appropriate NEPA studies could be conducted in a coordinated manner, eliminating duplication or redundancy, while satisfying the many and varied information and permitting needs of multiple State agencies.
- Changes be made to applicable Colorado statutes and regulations in an effort to bring efficiency to the permitting process. Regulations or guidance should specify that State input into any NEPA compliance actions associated with a water project should begin early in the process and continue throughout the process to conclusion.
- For projects that require NEPA analysis, State agencies should rely on NEPA studies and analyses to make their decisions. This coordination and involvement would eliminate the requirement for additional technical analyses by project proponents to meet State requirements.
- Crucial State input into the NEPA document should be made between the Draft and the Final Environmental Impact Statement. This would then afford the State the opportunity, as appropriate, to voice support for all or portions of the proposed project that meet State requirements. This would hopefully help to expedite the federal review, approval and permitting process.
- Consideration be given to tailoring state statutes and regulations to specifically meet the needs for permitting water supply projects. As an example, current CDPHE 401 certification regulations require an anti-degradation review associated with water projects. Such reviews are designed for, and are applicable to permitting of point source discharge, such as wastewater treatment plants. These analyses are difficult to adapt to evaluations and review of water supply projects. This inconsistency requires extensive additional analyses and studies, thus increasing time requirements for State employees to review projects.

- The State of Colorado form a task force to study and implement ways to further improve the State's involvement in the permitting processes. Members of the Task force should include all State agencies that have any involvement in the permitting process associated with water projects. The goal of the task force should be to formulate guidelines and regulations that would not only improve the efficiency and effectiveness of the State involvement in the permitting process as well as to define ways to help streamline and introduce efficiency into, the federal process through State involvement, input and advocacy. As part of the Water Plan, a date certain for formation of the task force should be set along with membership, specific goals and timeline for completion of goals.
- A task force should be formed to look at how the 1041 permitting process can be more closely coordinated with the federal and State permitting requirements while not reducing the authority of 1041 permitting local governments.

Once again, the overall intent of these recommendations is to save precious time and resources through more efficient permitting processes that still maintain existing environmental protections.

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# 6

# Performance against Goals and Measurable Outcomes

# 6 Performance against Goals and Measurable Outcomes

**Key Points**

- The SP-BIP consists of eleven key strategic elements and three alternative water supply portfolios. Each of these eleven 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 Basin 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 Basin 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 South Platte BIP including:
  - Surface Water and Groundwater Availability/Hydrologic Modeling
  - Follow up to HB1278 South Platte Basin Groundwater Study
  - Advanced Analysis of ATMs
  - Further Analysis of Planning Coordination
  - Further Geographic, Quantitative, and Temporal Disaggregation of the M&I Gap
  - Investigation of Environmental and Recreational Attributes of IPPs
  - Further Develop In Basin Conceptual Projects and Methods
  - Further Develop Colorado River Basin Supply Strategies
  - Identification of Potential East Slope Off-Channel Storage
  - Secure Sustainable Funding for Data Recording and Reporting Equipment
  - Consider Potential Criteria for a “State Water Project”
  - Consider Alternatives to State-Sponsored Water Projects
  - Public Outreach Activities

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 11 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 Basin Options -*** A balanced program to plan and preserve options to responsibly develop Colorado River Basin 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 Basin 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 eleven 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. Promote multi-purpose storage projects that enhance other South Platte Basin Solutions
9. Facilitate effective South Platte communications and outreach programs that complement the State’s overall program
10. Research new technologies and strategies
11. 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 428,000 AFY. Using the methodology from SWSI 2010 for determining the irrigated acreage needed to meet the M&I and SSI gap, approximately 440,000 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. With an IPP success rate of 88 percent for the Metro Basin and 65 percent for the South Platte Basin, the implementation of IPPs is estimated to yield 233,000 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 75,000 AFY from the Colorado River Basin, the reduction in agricultural irrigation will be approximately 82,000 acres or approximately 10 percent of current irrigated acres in the Basin.

**Table 6-1. Comparative Analysis of Portfolio Benefits and Challenges**

| 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<br>• Reliable assessments of yield can generally be made based on historic diversion and crop data<br>• Transactional costs for water right change cases can generally be made<br>• Agricultural transfers typically require little to no permitting | • Significant decrease in total irrigated acreage in the South Platte Basin (approximately 50% decrease)<br>• Change of use proceedings in water court are costly and time consuming<br>• 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<br>• Disposal of treatment waste streams (brine) may pose difficult permitting challenges<br>• 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<br>• 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<br>• Potential harm to environmental attributes of the South Platte Basin including erosion, and degradation or loss wildlife habitat, water quality and biological diversity.<br>• Potential loss of recreational opportunities due to loss of wildlife habitat and biological diversity |
| B | • Storing water during high runoff or free river conditions would increase firm yield and allow greater operational flexibility in droughts.<br>• Flood reduction benefits if projects can be configured to skim high water levels.<br>• 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<br>• 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<br>• 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<br>• Potential changes in stream flow peak flows could impact the environmental flows needed to sustain aquatic, riparian and wetland species and could impact recreational flows.<br>• Treatment of supplies taken from the South Platte River could challenge municipal and industrial water providers. More advanced treatment would be necessary such as reverse osmosis, which requires significant costs for planning, development, and disposal of brine or other by products from these facilities |

| Portfolio | Benefits | Challenges |
|---|---|---|
| | | • 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<br>• Partnerships for large scale projects would provide greater economy of scale and overall benefit<br>• 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<br>• Conjunctive use of groundwater and surface water would allow for a more secure water supply when Colorado River Basin supplies are not available<br>• The State of Colorado could better utilize its allocation of the Colorado River Basin water<br>• 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 Basin project would take many years<br>• 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.<br>• Though development of Colorado River Basin 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 6-2 rates the degree to which the 11 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 released a report in August of 2014 titled "Climate Change in Colorado" (summarized in Section 2.1.4) that provides a detailed description of potential water resources management changes and impacts. The G&MOs currently do not address climate change, however, climate change was considered in the alternative portfolios.

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## Table 6-2. Performance of Plan Elements and Alternatives Portfolios

| Overarching Theme, Goal and Measurable Outcome | The Eleven Elements of the SP-BIP | | | | | | | | | | | Alternative Portfolios: Medium Demand Scenario | | | Alternative Portfolios: With Additional Conservation | | | Alternative Portfolios: With Climate Change | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 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 Basin supply Options* | *Climate Change Impacts (1)* | *Multi-purpose Storage* | *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 Basin Options*** | | | | | | | | | | | | ↓ | ↓ | ↑ | ↓ | ↓ | ↑ | ↓ | ↓ | ↑ |
| ***1. Agricultural G&MOs*** Measurable Outcomes: | ***Goal***: Fully recognize the importance of agriculture to Colorado's future well-being and support its continued success | | | | | | | | | | | | | | | | | | | |
| 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*** Measurable Outcomes: | ***Goal***: Continue the South Platte River Basin's leadership in wise water use | | | | | | | | | | | | | | | | | | | |
| Quantify past successes & establish baseline | | ↑ | ↑ | | — | | | | ↑ | | | ↓ | ↓ | ↑ | ↓ | ↑ | ↑ | ↓ | ↑ | ↑ |
| Encourage adoption of "best management practices" as "guidelines" | ↑ | ↑ | ↑ | ↑ | — | | | | ↑ | ↑ | | ↓ | ↑ | ↑ | ↓ | ↑ | ↑ | ↓ | ↑ | ↑ |
| 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*** Measurable Outcomes: | ***Goal:*** Bring a high percentage of updated IPPs on-line | | | | | | | | | | | | | | | | | | | |
| Maximize implementation of the updated IPP list. | ↑ | — | ↑ | ↑ | — | ↑ | | ↑ | | ↑ | ↑ | ↓ | — | ↑ | ↓ | — | ↑ | ↓ | — | ↑ |
| Encourage multi-purpose projects that also provide environmental and recreational considerations | — | | | — | ↑ | | | ↑ | | | | — | — | — | — | — | — | — | — | — |
| Take into consideration environmental and recreational attributes when incorporating IPPs | — | | | — | ↑ | | | ↑ | | | | — | — | — | — | — | — | — | — | — |

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| Overarching Theme, Goal and Measurable Outcome | The Eleven 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 | 11 | 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 Basin supply Options* | *Climate Change Impacts (1)* | *Multi-purpose Storage* | *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*** Measurable Outcomes: | ***Goal:*** To the extent possible, develop multipurpose storage, conveyance, system interconnections and other infrastructure projects | | | | | | | | | | | | | | | | | | | |
| 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*** Measurable Outcomes: | ***Goal:*** Maintain, enhance and proactively manage water quality for all use classifications | | | | | | | | | | | | | | | | | | | |
| Maintain or improve the delivery of safe water supplies throughout the basin | ↑ | | | | | ↑ | | ↑ | | ↑ | ↑ | ↓ | ↑ | ↑ | ↓ | ↑ | ↑ | ↓ | ↑ | ↑ |
| Monitor, protect and improve watershed water quality and identify and document progress and improvements | | | | | ↑ | | | ↑ | | | | ↓ | ↓ | ▬ | ↓ | ↓ | ▬ | ↓ | ↓ | ▬ |
| Improve areas where water quality may be limiting the suitability of focus areas identified by BRTs through environmental and recreational mapping efforts | | | | | ↑ | | | ↑ | | | | ↓ | ▬ | ▬ | ↓ | ↓ | ▬ | ↓ | ↓ | ▬ |
| ***6. New Colorado River Basin Supply G&MOs*** Measurable Outcomes: | ***Goal:*** Develop processes and/or agreements governing additional transbasin water imports | | | | | | | | | | | | | | | | | | | |
| 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*** Measurable Outcomes: | ***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) | | | | | | | | | | | | | | | | | | | |
| 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 | ▬ | | | ▬ | ↑ | ▬ | | ↑ | ▬ | ▬ | ▬ | ↓ | ↓ | ▬ | ↓ | ↓ | ▬ | ↓ | ↓ | ▬ |

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| Overarching Theme, Goal and Measurable Outcome | The Eleven 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 | 11 | 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 Basin supply Options* | *Climate Change Impacts (1)* | *Multi-purpose Storage* | *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.*

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## 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 and framework presented in Appendix D can be used to further refine the GMOs to assist in determining whether the plan meets the measurable outcomes. The projects go toward meeting the goal or measurable outcome that is specified within the discussion on each project. The development of the framework which will be further refined and used in the future to better assess the attributes, projects and streamflow in specific reaches as described in Section 4 and Appendix D directly goes toward the goals of developing tools and methodologies to better assess the environmental and recreational gap and determine the protections that exist or are needed.

## 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 eleven 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 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 Basin 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 Basin 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 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:

- ***Surface Water and Groundwater Availability/Hydrologic Modeling*** — A comprehensive Decision Support System is currently being developed for the South Platte River Basin (SPDSS) by the CWCB. This integrated system of hydrologic data, water allocation and crop consumptive use modeling and other related tools can be used to develop much more detailed and reliable estimates of water availability under a wider range of potential future hydrologic conditions and a much broader range of current and future water management procedures and scenarios. The CWCB estimates that the SPDSS (excluding the Cache la Poudre River Basin) might be available for initial use in early 2016. Once this system is available, it is recommended that the surface water availability analysis presented herein be updated and further refined. In addition, the SPDSS should be used to evaluate groundwater resources within the Basin and perhaps support HB 1278 activities.
- ***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 Roundtables formed a "Technical Committee" to investigate all of the HB 1278 recommendations and develop specific direction, where appropriate, for those recommendations. The current focus of this Technical Committee has been the development of a Basin-wide groundwater monitoring network and the mitigation of localized high groundwater conditions in the LaSalle/Gilcrest and Sterling areas. The Roundtables should continue to support the Technical Committee's efforts to address the remaining recommendations/issues identified in the HB 1278 Study.
- ***Advanced Analysis of ATMs***—The South Platte and Metro Roundtables' 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 Roundtables 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 and Metro Roundtables recommend further investigation into options for increased coordination between water utilities and land use planners to better plan for water efficient growth.
- ***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 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 refine 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). The Roundtables recommend incorporating SWSI 2016 information when available.

- ***Assessment of Environmental and Recreational Attributes and projects***— The South Platte and Metro Roundtables 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. Additional recommendations are included in Appendix D.
- ***Further Develop In-Basin Conceptual Projects and Methods***—The Roundtables recommend additional development and analysis associated with the conceptual in-basin projects and methods presented in Section 4.6.2.
- ***Further Develop New Colorado River Basin Supply Strategies***—The South Platte and Metro Roundtables recommend continued consideration of new Colorado River Basin supply strategies through IBCC representatives. The Roundtables also recommend additional conceptualization analysis of shared development of additional Colorado River Basin supplies and the projects and methods presented in Section 4.8.2.
- ***Identification of Potential East Slope Off-Channel Storage***— The ability to store water when 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-channel storage opportunities including potential ASR projects. Portfolios B and C could both benefit from additional East Slope storage.
- ***Further Analysis of the Potential for Backup Supply –*** The South Platte and Metro Roundtables recommend continued analysis of the potential for back-up supply, such as for east slope interruptible supply agreements, DBA storage, and other in-basin storage, to deal with the variability of both native South Platte River Supplies and new Colorado River supply options.
- ***Greater Efficiency in Permitting Process-*** The South Platte and Metro Roundtables recommend the State of Colorado work towards greater efficiency in permitting water projects through taking a more active role in the NEPA process, utilizing data and studies produced during NEPA process for State required permitting, without reducing existing environmental protections. Additionally, Roundtables support the State of Colorado forming a task force to study and implement ways to further improve the State's involvement in the permitting processes. Other specific recommendations are found in Section 5.5.10 of this report.
- ***Secure Sustainable Funding for Data Recording and Reporting Equipment***—In 2005, DWR and several cooperators *(*Northern Colorado Water Conservancy District, St. Vrain and Left Hand Water Conservancy District, Lower South Platte Water Conservancy District) secured WSRA grants to fund the installation of electronic data loggers on many water diversion structures within the South Platte basin with near real time remote reporting capabilities (cellular modem). Accurate diversion

information (1) allows the maximum use of the available water supply by distributing the water as effectively and efficiently as possible within the existing regulatory framework; (2) reduces the misunderstandings and conflicts between parties competing for a limited available water supply by allowing them to know what other parties are diverting rather than assuming or guessing; and (3) allows collaboration among parties with diverse interests to stretch the limited water supply as far as possible to meet their different needs. A source of sustainable funding is needed to pay for maintenance and replacement of electronic data loggers and cellular modems installed with state funds that fail over time. Additionally, plan to transition most water diversion structures with the South Platte basin to electronic data loggers should be considered. It is estimated an initial funding stream of $125,000 increased annually for inflation would allow replacement on a 5 year basis (1/5 annually) of the approximately 250 installations expected to be funded by WSRA grants and installed by the end of calendar year 2015.

- ***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.
- ***Public Outreach Activities***—The South Platte Basin needs an intensive education, participation and outreach program designed to generate a lasting baseline of public awareness and support. The focus of a 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 are provided in Section 4.1.3.