Basin Report Objectives

This report is designed to provide a local perspective on the Statewide Water Supply Initiative 2010 (SWSI 2010) report. This basin report was prepared in consultation with the local Basin Roundtable established by House Bill 05-1177 and some sections of the report were directly produced by basin roundtable members. As such, the report not only summarizes basin-specific data from SWSI 2010, but also seeks to document progress, problems, and a path forward from the basin's perspective. The State of Colorado fully supports the basin roundtable process, yet the substantive conclusions of this report are those of the basin roundtable and are not necessarily endorsed by the State of Colorado.

This report is intended to provide reconnaissance-level data that employs consistency in data collection and forecast methodology across the state while maximizing available data. The methods utilized in this approach are for the purpose of general statewide and basinwide planning and are not intended to replace the efforts of local entities for project-specific purposes.

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South Platte Basin

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Tables

Acronyms

ACWWA	Arapahoe County Water and Wastewater Authority
AF	acre-feet
AFY	acre-feet per year
ATM	alternative agricultural transfer method
AwwaRF	American Water Works Association Research Foundation
CBEF	Center for Business and Economic Forecasting
CBT	Colorado-Big Thompson Project
CCC	Colorado Climate Center
CCGA	Colorado Corn Growers Association
CCWCD	Central Colorado Water Conservancy District
CDOW	Colorado Division of Wildlife
CDPHE	Colorado Department of Public Health and Environment
CDSS	Colorado Decision Support System
cfs	cubic feet per second
CFWE	Colorado Foundation for Water Education
CRWAS	Colorado River Water Availability Study
CSPWP	Central South Platte Wetland Partnership
CSU	Colorado State University
CU	consumptive use
CU&L	Consumptive Uses and Losses
CWCB	Colorado Water Conservation Board
DMRP	Drought Mitigation and Response Plan
DSS	Decision Support System
DU	Ducks Unlimited, Inc.
DWR	Division of Water Resources
ECCV	East Cherry Creek Valley Water and Sanitation District
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ET	evapotranspiration
FR	Feasibility Report
FRICO	Farmers Reservoir & Irrigation Company
FS	Feasibility Study
GIS	geographic information system
gpcd	gallons per capita per day
HB	House Bill
IBCC	Interbasin Compact Committee
IPPs	identified projects and processes
ISAs	interruptible supply agreements
ISF	instream flow
IWR	Irrigation Water Requirement
LAVWCD	Lower Arkansas Valley Water Conservancy District
LIRF	lawn irrigation return flows
LSPIRDP	Lower South Platte Irrigation Research and Demonstration Project
M&I	municipal and industrial
NCNAs	Nonconsumptive Needs Assessments
NCWCD	Northern Colorado Water Conservancy District
NEPA	National Environmental Protection Act
NHD	National Hydrography Dataset
NISP	Northern Integrated Supply Project
NPIC	North Poudre Irrigation Company
POR	period of record
PRRIP	Platte River Recovery Implementation Program

PWP	Prairie Waters Project
PWSD	Parker Water & Sanitation District
RICDs	recreational in-channel diversions
SB	Senate Bill
SDO	State Demographer's Office
SEO	State Engineer's Office
SMSWA	South Metro Water Supply Authority
SPDSS	South Platte Decision Support System
SRGAP	Southwest Regional Gap Analysis Project
SSI	self-supplied industrial
SVP	Shared Vision Planning
SWSI	Statewide Water Supply Initiative
USGS	U.S. Geological Survey
USSC	
UWSD	United Water and Sanitation District
WCSD	Weld County School District
WGFP	Windy Gap Firming Project
WISE	Water Infrastructure and Supply Efficiency
WSL CU	Water Supply Limited Consumptive Use
WSRA	Water Supply Reserve Account
WSSC	Water Supply and Storage Company

Section 1
Introduction

1.1 South Platte Basin Roundtable

The South Platte Basin Roundtable covers approximately 22,000 square miles in northeast Colorado. The largest cities in the basin roundtable area are Boulder, Fort Collins, Longmont, and Greeley. The projected population in 2050 is estimated to almost double in size to between 1.8 and 2.1 million people.

The majority of the state's population resides within the boundaries of the Metro and South Platte Basin Roundtables. The Metro Basin is a hydrologic subset of the South Platte Basin determined by political and geographic boundaries. The South Platte and Metro Basins are projected to grow from approximately 3.5 million people in the year 2008 to 6.0 million people by the year 2050, under medium economic development assumptions. **Figure 1-1** shows the expected 2000 to 2050 population increases by region.

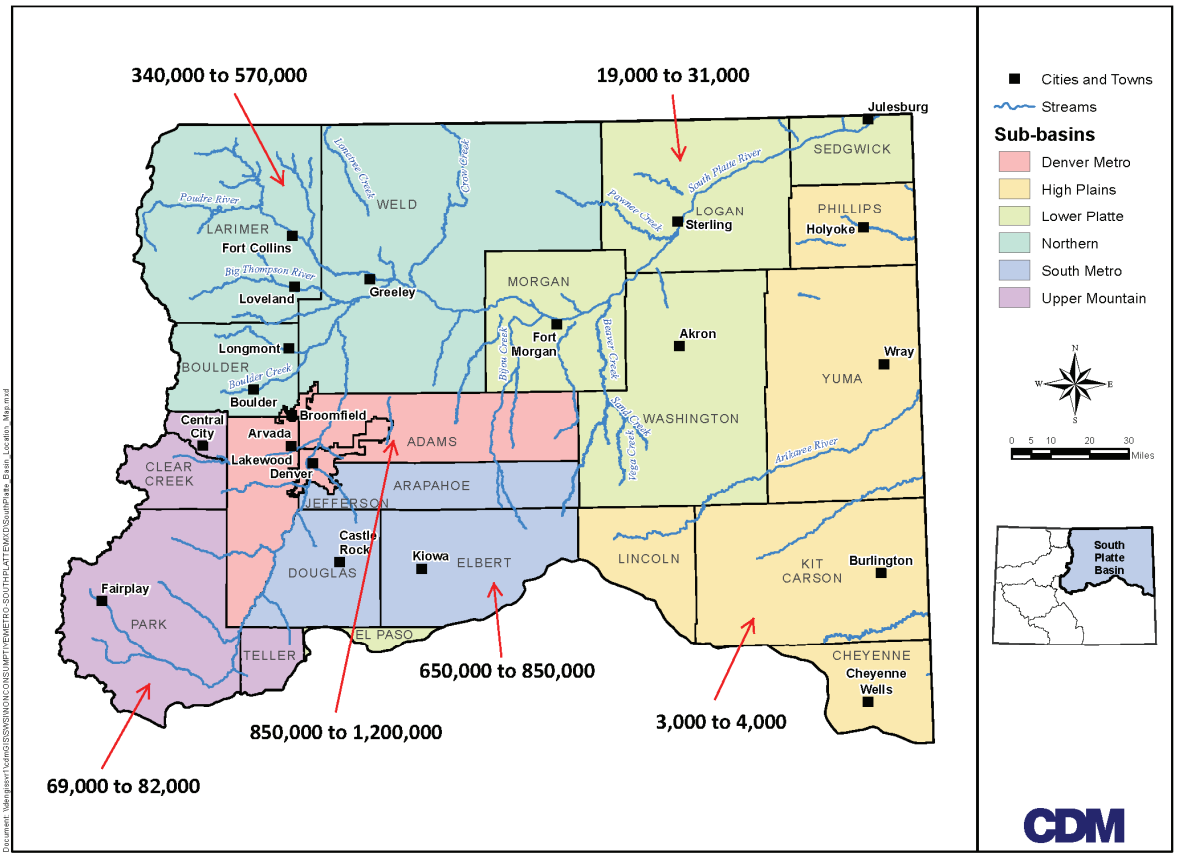

Figure 1-1 Expected Population Increase from 2000 to 2030 by Region

This amounts to an increase of about 2.5 million people, or 73 percent, during that period. About 69 percent of all Colorado residents resided in the South Platte Basin in the year 2008; by the year 2050, that proportion will decrease only slightly to about two-thirds. Economically, the Metro area and South Platte Basin collectively account for 70 percent of the state's jobs, and provide 60 percent of all revenues.

While the urban areas within the Metro area and South Platte Basin are the major contributors to the total population and economic performance, agriculture plays a key role in the economy and water use in the basins. Approximately 831,000 acres are under agricultural irrigation in the basins. If the Republican River Basin is included, another 550,000 irrigated acres are added. **Figure 1-2** shows the distribution of irrigated acres by water district within the South Platte and Metro Basins. There are less than 16,000 total irrigated acres in Water Districts 7, 8, 9, 23, and 80 upstream and within the Denver Metro area. These water districts lie partly within both the Metro and South Platte Basins.

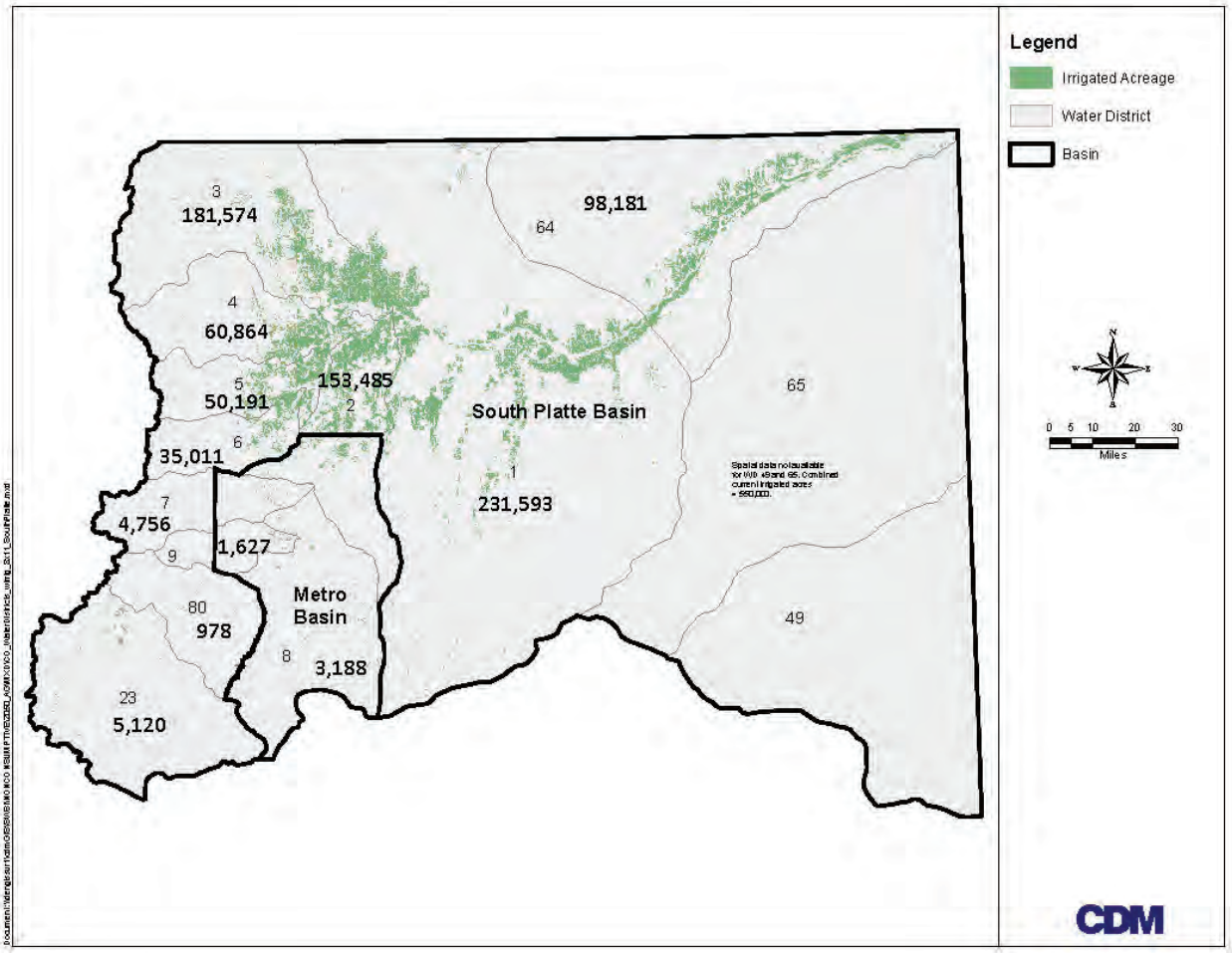

Figure 1-2 Irrigated Acres by Water District (2005)

Former Weld County Commissioner Bill Jerke has assembled a slide presentation highlighting the importance of agriculture to the overall economy of the South Platte Basin (2010). Key points from the presentation include the following:

- In 2002, seven of the top ten agricultural producing counties in Colorado were in the South Platte Basin. By 2007, this number increased to nine of the top ten agricultural producing counties, despite the curtailment of a significant number of wells in the South Platte Basin. These counties, in order, are Weld, Yuma, Morgan, Logan, Kit Carson, Adams, Phillips, Washington, and Larimer. Agricultural production by county is illustrated in **Figure 1-3**.
- Sales of agricultural products from the South Platte Basin generated nearly $3.2 billion in 2002, representing 72 percent of the statewide total. In 2007, sales increased to more than $4.4 billion, representing 73 percent of total sales of agricultural products.
- With an estimated 1.4 million irrigated acres in the combined South Platte and Republican River Basins, the gross agricultural sales from the previous bullet point translated to $2,275 per acre in 2002 and $3,163 per acre in 2007.
- In the South Platte Basin, nearly 3.2 million acre-feet (AF) are diverted annually for agriculture. Based on 2007 gross agricultural sales of more than $4.4 billion, this equates to $1,383/AF.
- Weld County, by itself, generates over 25 percent of the state's agricultural sales and produces nearly as much in sales as the rest of the state outside the South Platte Basin combined.
- Water used for irrigation in the South Platte Basin is more economically productive as water used in the Colorado River Basin ($1,383/AF versus $72/AF).
- Overall, South Platte Basin agriculture diverts 26 percent of the state's water and produces 73 percent of statewide agricultural sales.

Groundwater use along the South Platte and its tributaries is quite prevalent, estimated at 600,000 acre-feet per year (AFY), with the majority (500,000 AFY) used for irrigation, and the remaining 100,000 AFY for municipal and industrial (M&I) uses. Groundwater is pumped from the South Platte alluvial aquifer and the Denver Basin aquifers. The above figures do not include use of the Ogallala aquifer for irrigation in the eastern counties of the basin adjacent to the Nebraska border. There are approximately 9,000 decreed high capacity wells in the South Platte River Basin and its tributaries; however, a lesser number were actually completed or are currently in use. **Figure 1-4** shows the distribution of high capacity wells in the basins, including wells pumping from the Ogallala and locations of major aquifers and designated basins.

The South Platte Basin has completed their basinwide water needs assessments for their consumptive and nonconsumptive water supply needs and analyzed the basin's water supply availability. The basin consumptive needs assessment is divided into three separate parts. Part One of the consumptive needs assessment was completed in 2006 when the basin adopted the findings of the Statewide Water Supply Initiative (SWSI) 1. Part Two of the consumptive needs assessment examined five key areas—competition for the same water supply, identification of any unappropriated water, current and historical river administration, increasing use of fully consumable water, and water conservation plans by M&I providers. Part Three of the consumptive needs assessment updated the M&I water demands and projected forecast out to the year 2050, projected agricultural demands, and recalculated the water supply gap for the basin. The findings of Part Three have since been superseded by analyses completed for SWSI 2010. The basin has also completed the mapping of their nonconsumptive needs and has worked to identify projects and methods for their nonconsumptive needs.

Colorado Agriculture
Value of Agricultural Products Sold by County
Data from 2007 Census of Agriculture, USDA

Data for * Counties
#57-Broomfield $958,000
#60-Denver $561,000
#62-Clear Creek $127,000
#64-San Juan No Data Available

Colorado Ag Facts

- Value of all agricultural products sold in 2007 totaled $6 billion.
- Agribusiness contributes $16 billion to the state economy each year and employs more than 100,000 people.
- There are 37,054 farms in the state encompassing nearly 32 million acres.

LEGEND

County Rank and Name
Total Value of Agricultural Products Sold
Top agricultural products

Shaded areas are top ten agricultural counties in Colorado.

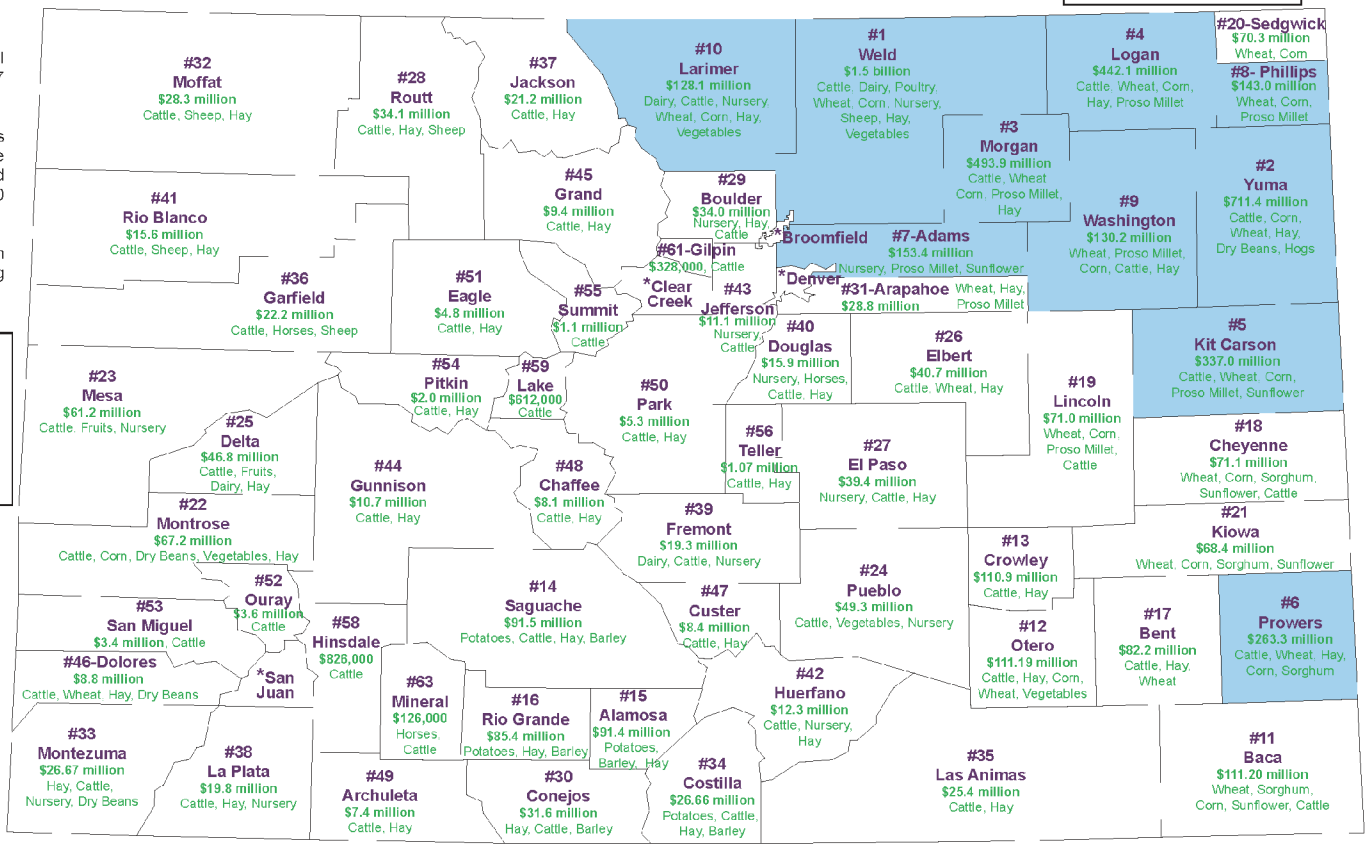

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Figure 1-3 Agricultural Sales by County

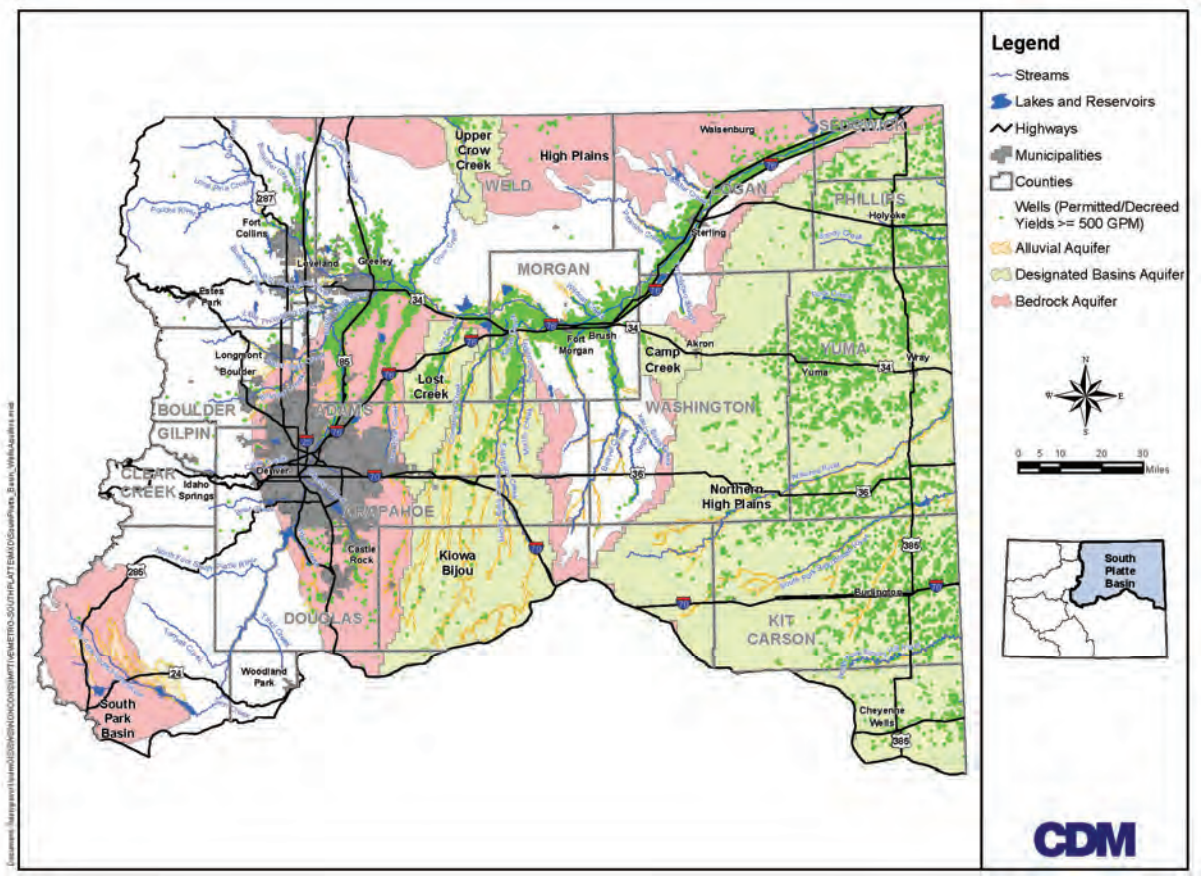

Figure 1-4 Location of Various Aquifers and High Capacity Wells (Q>50 gallons per minute)

Out of these efforts, the South Platte Basin recognizes the following:

- Large-scale dry-up of irrigated agriculture has major adverse economic impacts
- Dry-up of agricultural lands also has major environmental impacts
- Success of identified projects and processes (IPPs) is important to meeting the gap—to the extent they are not successful, other options will have to take their place (agricultural dry-up seems to be the most likely candidate)
- Additional water conservation efforts are crucial, but will not alone be enough
- In cooperation with the West Slope, additional Colorado River Basin water should be developed to meet the State of Colorado's future water demands

The South Platte Basin Roundtable is active in helping to address the basin's water supply needs and issues. Some of the basin roundtable's key priorities include:

- Ensuring adequate water for future needs for M&I, agricultural, environmental, and recreational uses
- Developing new water storage facilities
- Minimizing the dry-up of irrigated land
- Addressing agricultural supply shortages for both surface and groundwater users
- Addressing potential impacts of agricultural transfers and finding alternatives to permanent agricultural dry-up
- Successfully implementing endangered species programs to protect existing and future in-basin uses
- Identifying opportunities to optimize existing and future water supply infrastructure

The basin roundtable also recognizes the importance of their basin's major IPPs including the Northern Integrated Supply Project, Windy Gap, and Halligan-Seaman Reservoir Enlargements; without the successful implementation of these projects, the South Platte's M&I gap will be larger.

1.2 Overview of the Water for the 21st Century Act

In 2005, the Colorado General Assembly passed the Colorado Water for the 21st Century Act (House Bill [HB] 05-1177). This legislation set up a framework that provides a permanent forum for broad-based water discussions, and it created two new structures: 1) the Interbasin Compact Committee (IBCC), a statewide committee that addresses issues between basins; and 2) the basin roundtables, which were established in each of the state's eight major river basins plus the Denver Metro area. The purpose of the basin roundtables is to facilitate discussions on water issues and encourage locally-driven collaborative solutions. The broad-based, collaborative nature of this process is reflected in the basin roundtable membership.

The purpose of the basin roundtables is to facilitate discussions on water issues and encourage locally-driven collaborative solutions.

To help the basin roundtables accomplish their major responsibility of developing basinwide needs assessments, they have relied on groundwork completed during the SWSI Phase 1 study. To further develop their needs assessments, support water activities in each of the basins, and implement identified water projects and methods, it was clear that the basin roundtables needed staff support as well as technical and financial assistance. Using resources provided through HB 06-1400, the Colorado Water Conservation Board (CWCB) provides staff support and technical assistance to the basin roundtables and the IBCC for the ongoing implementation of the Colorado Water for the 21st Century Act. The basin roundtables were also provided financial resources through Senate Bill (SB) 06-179, which established the Water Supply Reserve Account (WSRA). The WSRA appropriates money to the CWCB to help implement the consumptive and nonconsumptive water supply projects and methods identified by the basin roundtables. These bills and other relevant legislation are summarized below. The purpose of this report is to summarize the results of the South Platte Basin Roundtable's needs assessment that have been completed to-date.

SB03-110 authorized SWSI 1, which implemented a collaborative approach to water resources issues by establishing SWSI roundtables. SWSI 1 focused on using a common technical basis for identifying and quantifying water needs and issues.

HB05-1177 or The Colorado Water for the 21st Century Act provides a permanent forum for broad-based water discussions. It creates two new structures: 1) the IBCC, and 2) the basin roundtables. There are nine basin roundtables based on Colorado's eight major river basins and the Denver Metro area.

SB06-179 created the WSRA. Throughout SWSI and Colorado Water for the 21st Century Act processes, there has been a clear recognition that financial assistance is needed to address the water challenges in our state. This legislation funds the WSRA, which directs the State Treasurer to annually transfer $10 million from the Operational Account of the Severance Tax Trust Fund to the WSRA. These monies are available to the basin roundtables to fund water activities.

HB06-1385 created the CWCB's Intrastate Water Management and Development Section, which implements SWSI, the WSRA, develops reconnaissance level water supply alternatives, and tracks and supports water supply projects and planning processes. This section is now called the Water Supply Planning Section.

HB06-1400 appropriated money to the CWCB to fund staffing of the Water for the 21st Century Act process and monies for a contractor to technical assistance the basin roundtables.

SB09-106 authorized the funding of the WSRA in perpetuity.

Basin roundtables are legislatively required to be made up of a diverse set of stakeholders, including representatives from counties, municipalities, water conservancy districts, the environmental and recreational communities, agriculture, and industry. The responsibilities of the basin roundtables can be grouped into three categories—procedural, substantive, and public involvement. Each basin roundtable adopted bylaws that include the basin roundtable's goals, objectives, and operating procedures. These bylaws reflect the specific needs of the basin roundtable and reflect the uniqueness of each basin. Each basin roundtable developed procedures and selected two members of the IBCC.

The most extensive substantive responsibility assigned to each basin roundtable is to develop a basinwide water needs assessment. This is performed in cooperation with local governments, area water providers, and other stakeholders. The Colorado Water for the 21st Century Act states "Using data from the Statewide Water Supply Initiative and other appropriate sources and in cooperation with the ongoing Statewide Water Supply Initiative, develop:"

- An assessment of consumptive water needs (municipal, industrial, and agricultural)
- An assessment of nonconsumptive water needs (environmental and recreational)
- An assessment of available water supplies (surface and groundwater) and an analysis of any unappropriated waters
- Proposed projects or methods to meet any identified water needs and achieve water supply sustainability over time

Equally important to selecting members of the IBCC and developing a basinwide water needs assessment, the basin roundtables serve as a forum for public involvement. The basin roundtable activities are required by law to be open, public meetings. The basin roundtable process creates an expanded foundation for public involvement.

This SWSI 2010 Report was largely based on basin roundtables' water needs assessments. This report is a summary of the South Platte Basin Roundtable's needs assessment results that were utilized in the SWSI 2010 Report and that were chosen by the basin roundtable to be included in this South Platte Basin Roundtable Needs Assessment Report.

1.3 Overview of the SWSI 2010 Report

The last decade brought many changes to the State of Colorado's water supply outlook. Despite the recent economic recession, the state has experienced significant population growth, and Colorado's population is expected to nearly double within the next 40 years. Colorado needs to provide an adequate water supply for its citizens and the environment, yet Colorado is transitioning from an era of undeveloped resources to an era of managing a more developed resource. Meeting the state's municipal, industrial, agricultural, environmental, and recreational water needs will involve implementing a mix of local water projects and processes, conservation, reuse, agricultural transfers, and the development of new water supplies, all of which should be pursued concurrently. Ultimately, the future of Colorado—both its vibrancy and its beauty—is dependent on how our water resources are sustained, used, and developed.

To help understand and address these trends, the CWCB undertook a number of important initiatives. The CWCB is statutorily charged to conserve, protect, manage, and develop Colorado's water resources for current and future generations. In advancing this mission, the CWCB helps ensure that water is utilized to meet the needs of Colorado's citizens while protecting the environment.

In the last few years, state leaders and resource management agencies have increasingly focused on helping ensure that Colorado has an adequate water supply for its citizens, agriculture, and the environment. In 2003, the Colorado General Assembly recognized the critical need to understand and better prepare for our long-term water needs and authorized the CWCB to implement the SWSI. SWSI 1, approved by the CWCB Board in 2004, was a comprehensive identification of Colorado's current and future water needs, and it examined a variety of approaches Colorado could take to meet those needs. SWSI 1 implemented a collaborative approach to water resource issues by establishing "basin roundtables"—diverse groups of individuals representing water interests who provide input on water issues.

This was followed by SWSI 2, which established four technical roundtables—Conservation, Alternative Agricultural Water Transfers, Environmental and Recreational Needs, and Addressing the Water Supply Gap. The overall goal of SWSI 2 was to develop a range of potential solutions that would help water providers, policymakers, and stakeholders gain a deeper understanding of the relative role that water efficiency, agricultural transfers, and new water development can play in meeting future needs and the trade-offs associated with these solutions.

In 2005, the legislature reaffirmed the need to prepare for a future in which water resources are increasingly limited by passing the Colorado Water for the 21st Century Act. This legislation institutionalized nine basin roundtables and created a voluntary, collaborative process to help the state address its water challenges. This process is based on the premise that Coloradoans can work together to address the water needs within the state.

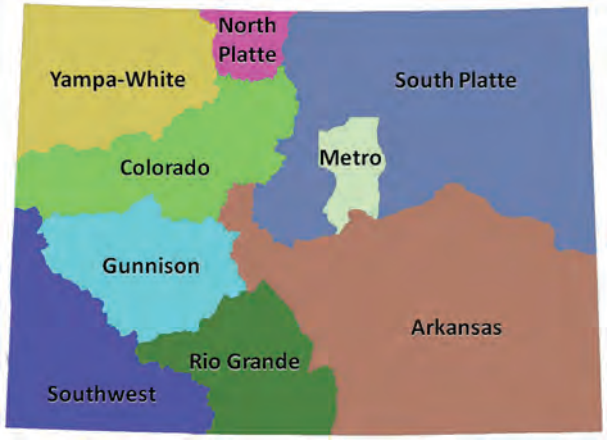

Figure 1-5 Colorado's nine basin roundtables provide a voluntary and collaborative process to help the state address its water challenges

Figure 1-5 illustrates the nine basin roundtables, which were organized to represent Colorado's eight major river basins and a separate basin roundtable for the Denver Metro area. The Yampa-White, Colorado, Gunnison, and Southwest Basin Roundtables are all based on tributaries to the Colorado River. The North Platte, Metro, and South Platte Basin Roundtables

represent watersheds tributary to the Platte River. The Arkansas and Rio Grande Basin Roundtables are the headwaters of these river systems.

In addition to the nine basin roundtables, the Colorado Water for the 21st Century Act established the 27-member IBCC to facilitate conversations between basins and to address statewide issues. The IBCC established its charter in 2006, which was soon ratified by Colorado's General Assembly. The charter outlines the roles of the IBCC—to provide a "framework that creates incentives for successful deliberations, agreements, and their implementation." To help advance this role, the IBCC embarked on a visioning process, through which the IBCC, CWCB, and basin roundtables agreed to evaluate water demand and supply strategies that could help address Colorado's water supply future.

The IBCC embarked on a visioning process, through which the IBCC, CWCB, and basin roundtables agreed to evaluate water demand and supply strategies that could help address Colorado's water supply future.

1.4 SWSI 2010 Report Recommendations

With the completion of the SWSI 2010, CWCB has updated its analysis of the state's water supply needs and recommends Colorado's water community enter an implementation phase to determine and pursue solutions to meeting the state's consumptive and nonconsumptive water supply needs. This will be accomplished through the following recommendations.

These recommendations do not necessarily represent a statewide consensus. The CWCB has deliberated on the information contained in SWSI 2010 and has put forth its view of how to move forward.

1. Actively encourage projects to address multiple purposes, including municipal, industrial, environmental, recreational, agricultural, risk management, and compact compliance needs.

2. Identify and utilize existing and new funding opportunities to assist in implementing projects and methods to meet Colorado's consumptive and nonconsumptive water supply needs.

3. Continue to lead the dialogue and foster cooperation among water interests in every basin and between basins for the purpose of implementing solutions to Colorado's water supply challenges.

4. Support water project proponents and opponents in resolving conflict and addressing concerns associated with implementing IPPs that will reduce the M&I water supply gap. Identify IPPs that could be implemented by 2020.

5. Support meeting Colorado's nonconsumptive water needs by working with Colorado's water stakeholders to help:

   - Promote recovery and sustainability of endangered, threatened, and imperiled species in a manner that allows the state to fully use its compact and decreed entitlements.
   - Protect or enhance environmental and recreational values that benefit local and statewide economies.
   - Encourage multi-purpose projects that benefit both water users and native species.
   - Pursue projects and other strategies, including CWCB's Instream Flow Program, that benefit consumptive water users, the riparian and aquatic environments, and stream recreation.
   - Recognize the importance of environmental and recreational benefits derived from agricultural water use, storage reservoirs, and other consumptive water uses and water management.

6. Help meet Colorado's agricultural water supply needs by incorporating agricultural water needs into the development of water supply portfolios and supporting the implementation of multi-purpose agricultural water supply projects.

7. In order to determine the appropriate combination of strategies (IPPs, conservation, reuse, agricultural transfers, and the development of new water supplies) and portfolios to meet the water supply needs, CWCB will identify what it considers is achievable for each portfolio element and how those portfolio elements could be implemented.

8. Evaluate multi-purpose projects or packages of projects to develop new water supplies for use on the West Slope and the Front Range.

Corn crop in South Platte Basin

9. Develop and support risk management strategies so that Colorado can fully use its compact and decree entitlements to best balance Colorado's diverse water needs.

10. Support, encourage, and incentivize water providers in planning for and implementing M&I active conservation best management practices and other demand management strategies.

11. Work with water providers to identify opportunities where additional water could be made available by increased regional cooperation, storage, exchanges, and other creative opportunities.

12. Continue the evaluation of Colorado's water supply availability in all basins to help provide water users with viable analysis tools.

13. Help safeguard Colorado's water supply during times of drought by incorporating drought mitigation and response in statewide and local water supply planning.

14. Support local water supply planning.

15. The CWCB, in consultation with other state agencies, shall develop and implement a plan to educate and promote stewardship of water resources that recognizes water's critical role in supporting the quality of life and economic prosperity of all Coloradoans.

16. Establish a 6-year planning cycle for assessing Colorado's long-term consumptive and nonconsumptive water needs and support the implementation of projects and methods to meet those needs.

1.5 South Platte Basin Roundtable Needs Assessment Report Overview

This report presents the information utilized in the SWSI 2010 Report and needs assessment information developed by the basin roundtable that is specific to the South Platte Basin. Following is a description of the contents of this Basin Needs Assessment Report:

- **Section 2** is a summary of the **South Platte Basin Nonconsumptive Needs Assessment** that have been completed to-date. The roundtable has completed an extensive inventory of its environmental and recreational attributes and has summarized this information in focus area mapping.
- **Section 3** provides an overview of **South Platte Basin Nonconsumptive Projects and Methods** that have been gathered by the CWCB and a summary of this information as requested by the basin roundtable.
- **Section 4** summarizes the basin's M&I and agricultural water demands into a basinwide look at the **South Platte Basin's Consumptive Needs Assessment**. The consumptive demands utilize a planning horizon of 2050.
- In **Section 5**, projects and methods to meet consumptive needs are considered. As part of the summary, the **Projects and Methods to Meet South Platte Basin M&I Needs** are described at a regional level.
- The CWCB recently developed the draft Colorado River Water Availability Study (CRWAS). In **Section 6, Water Availability** is considered statewide including a summary of the analyses considered in CRWAS as well as water availability information developed by the basin roundtables as part of their basinwide needs assessments and during SWSI 1.
- **Section 7** is a summary of the **South Platte Basin Roundtable's Strategies to Address Consumptive and Nonconsumptive Needs** as well as the basin roundtable's recommended next steps.

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Section 2
South Platte Basin Nonconsumptive Needs Assessment

2.1 Overview of Nonconsumptive Needs Assessments

As discussed in Section 1, the basin roundtables are required to complete Nonconsumptive Needs Assessments (NCNAs). This effort has included an extensive inventory, analysis, and synthesized mapping effort that built upon the Statewide Water Supply Initiative (SWSI) 2 environmental and recreational attribute mapping as a common technical platform for the basin roundtables. **Figure 2-1** shows the process that was utilized by the Colorado Water Conservation Board (CWCB) and basin roundtables in completing their NCNAs. The basin roundtables have utilized environmental and recreational mapping to identify where the nonconsumptive focus areas are in their basins. The basin roundtables' nonconsumptive focus areas and further study efforts are intended to facilitate the identification of projects and methods to address environmental and recreational water needs. The South Platte Basin nonconsumptive identified projects and methods are summarized in Section 3 of this report.

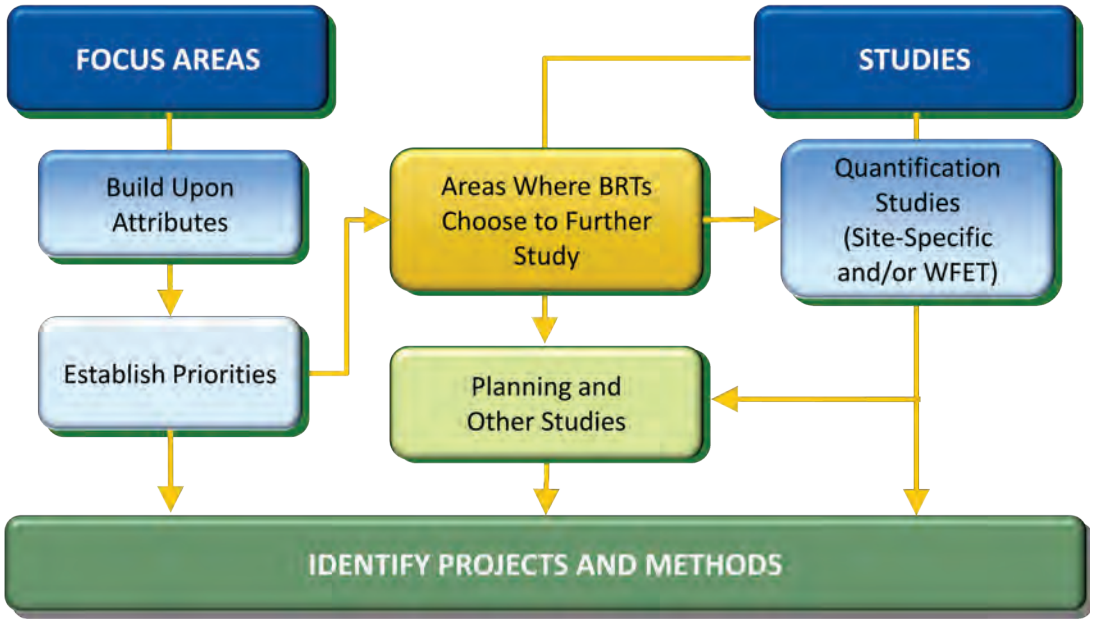


Figure 2-1 Nonconsumptive Needs Assessment Methodology

The focus area maps developed by each basin roundtable are based on a common set of environmental and recreational attributes and represent where Colorado's important water-based environmental and recreational attributes are located. The maps are reflective of stakeholder input for the focus areas and also reflect stream reaches and subwatersheds with higher concentrations of environmental and recreational qualities. These maps were generated to provide information to the basin roundtables on important environmental and recreational areas in their basins but were not intended to dictate future actions. It should be noted, and as will be shown in this section, that this effort has not identified all streams as important. The NCNAs are not intended to create a water right for the environment and will not diminish, impair, or cause injury to existing absolute or conditional water rights. The CWCB and basin roundtable developed the environmental and recreational focus area mapping for the following purposes:

The focus area maps developed by each basin roundtable are based on a common set of environmental and recreational attributes.

- The maps are intended to provide useful information for water supply planning so that future conflicts over environmental and recreational needs can be avoided.
- The maps can assist in identifying environmental and recreational water needs status, such as where needs are being met, where additional future study may need to take place, or where implementation projects in the basin are needed.
- The maps can help basins plan for the water needs of species of special concern so that they do not become federally-listed as endangered or threatened in the future.
- The maps can provide opportunity for collaborative efforts for future multi-objective projects.

2.2 Focus Area Mapping Methodology

Underlying the work done by the basin roundtables is a common technical platform, which builds off SWSI 2, as described above. This common technical platform approach recognizes the need for each basin roundtable to utilize the technical work in the most effective manner for the stakeholders and concerns within the basin. For example, some basins that were focused on wetlands or bird habitat issues used a watershed approach, while others focused on instream habitat.

Overall, the basin roundtables used three methods to identify their focus areas as shown in **Figure 2-2**. After the basin roundtables gathered additional data layers beyond existing SWSI 2 geographic information system (GIS) data layers, they each developed a summary map that highlighted environmental and recreational focus areas for their basin. The South Platte Basin Roundtable used Method 3, which reviewed all available data layers for their basin, and based on stakeholder knowledge and outreach, selected stream reaches that represented the majority of environmental and recreational activity in their basins.

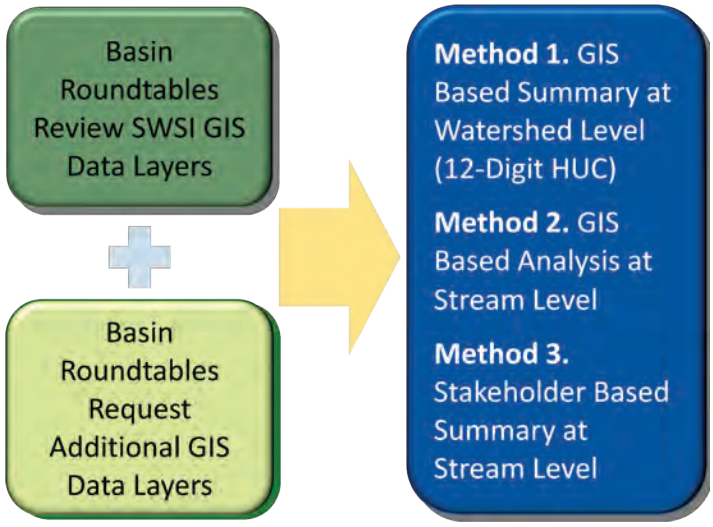


Figure 2-2 Basin Roundtable Focus Area Mapping Methodology

GIS software was used to organize the data layers for environmental and recreational attributes associated with nonconsumptive water needs for each basin. The term "data layer" refers to geographic data that represents a specific type of feature or attribute (e.g., wetlands or species habitat) and can also be referred to as a shapefile. Multiple data layers, organized collectively, are referred to as a dataset. The environmental and recreational data layers for each basin were selected using the SWSI 2 GIS data layers as a starting point. The basin roundtables reviewed the available data layers compiled during SWSI 2 and then suggested and contributed additional data layers as deemed appropriate for each basin. The SWSI 2010 Report's Appendix C contains the *Nonconsumptive Needs Assessment Focus Mapping Final Report* that provides the detailed methodology utilized by each basin roundtable in developing their focus area map.

2.2.1 SWSI 2 GIS Data Layers

The Environmental and Recreational Technical Roundtable that was formed under SWSI 2 developed a list of select environmental and recreational GIS data layers that could potentially be used by decisionmakers to determine areas of focus for environmental and recreational water needs. The complete list of SWSI 2 GIS data layers is shown in **Table 2-1**.

Table 2-1 SWSI 2 Environmental and Recreational Data Layers

Arkansas Darter	Gold Medal Trout Streams
Audubon Important Bird Areas	Greenback Cutthroat Trout
Bluehead Sucker	Greenback Cutthroat Trout
Bonytail Chub	Humpback Chub
Boreal Toad Critical Habitat	Rafting and Kayak Reaches
Colorado Department of Public Health and Environment Water Quality Control Division 303(D) Listed Segments	Rare Riparian Wetland Vascular Plants
Colorado Pikeminnow	Razorback Sucker
Colorado River Cutthroat Trout	Recreational In-Channel Diversions
CWCB Instream Flow Rights	Rio Grande Cutthroat Trout
CWCB Natural Lake Levels	Rio Grande Sucker
CWCB Water Rights Where Water Availability had a Role in Appropriation	Roundtail Chub
Flannelmouth Sucker	Significant Riparian/Wetland Communities
Gold Medal Trout Lakes	

In addition to the SWSI 2 environmental and recreational GIS data layers, the basin roundtables requested the attainment and development of other important environmental and recreational GIS data layers. Some of the additional GIS data were received directly from state and federal agencies, nongovernmental organizations and municipalities, or downloaded from their official websites. Other additional GIS data were digitized from available information, lists, or maps provided by basin roundtables, specialists (biologists, recreation guides), and other stakeholders. **Table 2-2** contains a list of additional environmental and recreational data layers that were collected based on basin input.

Table 2-2 Additional Statewide Environmental and Recreational Data Layers Based on Basin Roundtable Input

Additional Fishing	National Wetlands Inventory
Additional Greenback Cutthroat Trout Waters	Northern Leopard Frog Locations
Additional Paddling/Rafting/Kayaking/Flatwater Boating	Northern Redbelly Dace
Additional Rio Grande Sucker and Chub Streams	Osprey Nestsites and Foraging Areas
Bald Eagle Winter Concentration	Piping Plover
Bald Eagle Active Nestsites	Plains Minnow
Bald Eagle Summer Forage	Plains Orangethroat Darter
Bald Eagle Winter Forage	Preble's Meadow Jumping Mouse
Brassy Minnow	River Otter Confirmed Sightings
Colorado Birding Trails	River Otter Overall Range
Colorado Outstanding Waters	Rocky Mountain Biological Laboratory (scientific and educational reaches)
Common Garter Snake	Sandhill Crane Staging Areas
Common Shiner	Southwestern Willow Flycatcher
Ducks Unlimited Project Areas	Stonecat
Educational Segments	Waterfowl Hunting Areas
Eligible/Suitable Wild and Scenic	Wild and Scenic Study Rivers
Grand Mesa, Uncompahgre, and Gunnison Wilderness Waters/Areas	Wildlife Viewing
High Recreation Areas	Yellow Mud Turtle
Least Tern	

2.2.2 GIS Analysis of Data Layers

The South Platte Basin Roundtable examined their collected environmental and recreational data layers and utilized a stakeholder process to establish what the environmental and recreational focus areas should be for their respective basins. The basin roundtables summarized their environmental and recreational attributes on a map and created a table summarizing why the segment was included as a focus area and important attributes for each segment. This information has been summarized at the National Hydrography Dataset stream reach level. Detailed information about this approach is summarized in Appendix C of the SWSI 2010 Report.

2.3 Nonconsumptive Focus Area Mapping Results

Using the methodologies and techniques outlined above, the South Platte Basin developed a unique map showing focus areas with nonconsumptive environmental and recreational water needs. The basin map was created as a Geospatial PDF file, or GeoPDF, to allow the user the ability to "click" areas of the map and view characteristics of that portion of the map such as what attribute subcategories are present for a given Hydrological Unit Code or stream segment. In addition, the presence of specific attributes (e.g., Iowa darter, trout, kayaking, etc.) is also summarized as well as information designated by the basin roundtable through creation of tables associated with their map. **Figure 2-3** can be used as a GeoPDF in the electronic version of this report. To utilize the maps interactively, select the tools dropdown list, then select the analysis tools arrow and then click on the "object data tool." Using this tool, triple click a reach for additional information that will appear on the left side. Figure 2-3 shows the South Platte Basin's Major Environmental and Recreational Stream Segments as determined by the basin roundtable. The South Platte Basin NCNA subcommittee opted to use the term "Candidate Focus Areas" for its major segments with environmental, recreational, and environmental and recreational nonconsumptive water attributes. The South Platte Basin Roundtable also divided the basin into the following subbasins—High Plains, Lower South Platte, Northern, Denver Metro, Upper Mountain, and South Metro. Twenty-four waterbody or waterbody groups were selected by the subcommittee. The map is labeled with numbers to correspond with the data matrix.

The map is labeled with numbers to correspond with the data matrix. The matrix was linked to the spatial data layers in GIS and exported as a GeoPDF. The GeoPDF allows the viewer to select the waterbody and display the linked table, which contains the following waterbody characteristic:

- Segment description
- Environmental (is this waterbody purpose environmental?)
- Recreational (is this waterbody purpose recreational?)
- Rationale for consideration

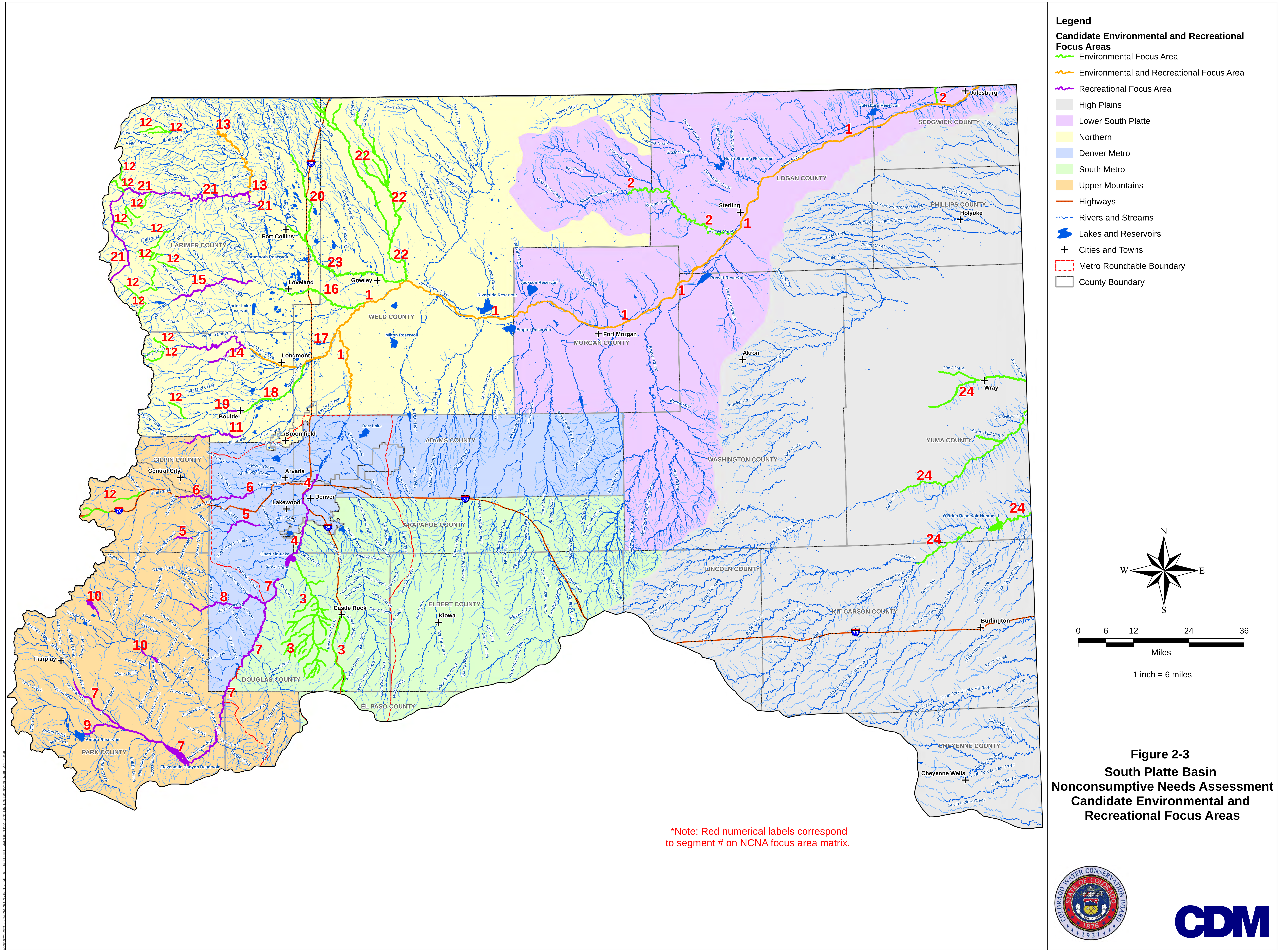


Figure 2-3
South Platte Basin Nonconsumptive Needs Assessment Candidate Environmental and Recreational Focus Areas

Section 3
South Platte Basin Nonconsumptive Projects and Methods

3.1 Nonconsumptive Projects and Methods Overview

Section 2 of this report summarizes the nonconsumptive needs in the South Platte Basin. As discussed in Section 1, the Water for the 21st Century Act requires the basin roundtables to identify projects and methods to meet their consumptive and nonconsumptive needs. For consumptive projects and methods, the Colorado Water Conservation Board (CWCB) worked with water providers and the basin roundtables to update the Statewide Water Supply Initiative (SWSI) 1 identified projects and processes (IPPs) from a planning horizon of 2030 to 2050. This effort is summarized in Section 5 of this report. For nonconsumptive needs, the CWCB has conducted an analogous outreach effort with the environmental and recreational community and the basin roundtables to identify nonconsumptive projects and methods similar to the municipal and industrial (M&I) consumptive IPPs. CWCB digitized the project information into geographical information system (GIS) and compared this information with the nonconsumptive focus areas summarized in Section 2. With this information, CWCB was able to preliminarily identify nonconsumptive focus areas with and without projects and methods. It is important to note that if a focus area does not have an associated project and method it does not mean that the area needs protective projects and methods. It is also important to note that CWCB did not judge the sufficiency of the projects and methods in each reach; rather, as with the M&I IPPs, CWCB did not judge the merits of the nonconsumptive projects and methods being pursued by local organizations. This information gathered was intended to assist the basin roundtables in addressing the following questions:

Rafting on the South Platte River

1. Are there existing protections/efforts for environmental and recreational focus areas?
2. Are there areas without protections that need further study?
3. What strategies are needed to support nonconsumptive priority areas?
4. Are there areas where new flow or water level quantification is appropriate?
5. Are there areas where a project, whether structural (e.g., river restoration) or nonstructural, can be identified and implemented?
6. Are there areas where no action is needed at this time?

Section 3.2 describes the methodology used to gather nonconsumptive projects and methods across the state. Section 3.3 summarizes the methodology used to analyze the project and method information. Section 3.4 explains the results of the analysis for the South Platte Basin Roundtable.

3.2 Nonconsumptive Projects and Methods Methodology

In January 2010, CWCB developed a survey to collect information on where there are existing or planned nonconsumptive projects, methods, and studies. Studies were included since they may recommend or inform the implementation of projects or methods that will provide protection or enhancement of environmental and recreational attributes. This survey was distributed through CWCB's basin roundtable and e-mail database. On February 10, 2010, CWCB conducted a workshop in Silverthorne, Colorado to discuss the Phase II efforts and to collect information on nonconsumptive projects, methods, and studies from the workshop attendees. At the workshop, information on 116 stream segments and 209 projects, methods, or studies was provided to CWCB. In addition, CWCB also gathered information on individuals and organizations to follow-up with the data collection effort. Since the February 2010 meeting, an additional 57 meetings have occurred to gather data on additional projects, methods, and studies. **Table 3-1** summarizes the number of individuals or organizations contacted since the February 2010 meeting; the number of follow-up meetings held; and the number of projects, methods, and studies identified to date for each basin. Table 3-1 details the number of projects, methods, and studies that are in the focus areas and the number of projects outside of the focus areas. In total, 648 projects were identified from the outreach effort. Examples of the types of projects collected during this outreach effort include:

- Habitat restoration projects such as bank stabilization projects or instream habitat restoration such as pool and riffle development. Another example of habitat restoration area projects that focus on the maintaining connectivity for fish passage such as fish ladders.
- Flow protection projects such as voluntary flow agreements, instream flow (ISF) donations, or voluntary re-operation of reservoirs for releases for environmental or recreational needs.

Table 3-1 Summary of Meetings to Collect Nonconsumptive Project and Methods Information

Basin Roundtable	No. of Individuals or Organizations Contacted	No. of Meetings	No. Projects and Methods in Focus Areas	No. Projects and Methods Outside Focus Areas	Total No. Projects and Methods
Arkansas	7	5	40	0	40
Colorado	21	12	168	35	203
Gunnison	9	4	44	15	59
Metro	See South Platte	See South Platte	See South Platte	See South Platte	See South Platte
North Platte	1	1	41	7	48
Rio Grande	10	5	59	0	59
South Platte	**17**	**14**	**54**	**53**	**107**
Southwest	17	12	84	10	94
Yampa-White	9	4	22	16	38
TOTAL	91	57	512	136	648

In addition, there is a great deal of information gathered from divisions within the Colorado Department of Natural Resources that have been integrated into the projects and methods database. For instance, **Table 3-2** summarizes CWCB's ISFs for each basin roundtable. Decreed ISFs have been confirmed by the water court. Pending ISFs have been approved by the CWCB Board and are going through the water court process. Recommended ISFs include those areas submitted to CWCB as a recommendation, but not yet approved by the CWCB Board at this time.

Table 3-2 Summary of CWCB Instream Flows and Natural Lake Levels

Basin Roundtable	Natural Lakes	ISF Decreed	Pending ISF	Recommended ISF
Arkansas	86	171	11	8
Colorado	150	404	12	6
Gunnison	82	259	15	2
Metro	0	24	0	0
North Platte	31	45	1	3
Rio Grande	49	141	0	0
South Platte	**31**	**208**	**2**	**2**
Southwest	50	151	4	6
Yampa-White	150	175	7	5
TOTAL	**494**	**1,578**	**52**	**32**

The CWCB's Watershed Protection and Flood Mitigation section oversees the agency's watershed restoration efforts. In addition, many of the Water Supply Reserve Account (WSRA) grants fully or partially address nonconsumptive needs. **Table 3-3** shows the funding programs implemented by CWCB and project type associated with each program. The table shows the status of the projects; pending in this case means that either the contract has not yet been signed, but has CWCB approval, or that applicants have applied, but are not yet approved by the CWCB.

Table 3-3 Summary of CWCB's Watershed Restoration and Nonconsumptive WSRA Projects

Funding Source	Type	Complete	On-going	Pending	Total
Colorado Healthy Rivers Fund	Report	19	9	3	31
Colorado Healthy Rivers Fund	Restoration Project	15	7	6	28
Colorado Watershed Restoration Program	Report	1	3	0	4
Colorado Watershed Restoration Program	Restoration Project	2	9	1	12
Fish and Wildlife Resources Fund	Restoration Project	2	2	0	4
Multi-Objective Watershed Protection Plan	Report	5	0	1	6
Multi-Objective Watershed Protection Plan	Restoration Project	6	0	4	10
WSRA Nonconsumptive Related Grants	Report	8	15	3	26
WSRA Nonconsumptive Related Grants	Restoration Project	13	12	4	29
TOTAL		**71**	**57**	**22**	**150**
Total Restoration Projects	**Restoration Project**	**38**	**30**	**15**	**83**
Total Reports	**Report**	**33**	**27**	**7**	**67**
TOTAL CWCB Dollars Spent/Encumbered		$14,499,625			
TOTAL Estimated Match Dollars		$34,323,697			
TOTAL Approximate Expenditures		**$ 48,823,322**			

In addition to CWCB's efforts, the Colorado Division of Wildlife (CDOW) is mandated by statute to manage the state's fishery and wildlife resources for the benefit of the citizens and visitors to the State of Colorado. The CDOW Aquatic Section takes the lead for fishery management for the agency, and to this end has mapped every waterbody, stream, or river segment in Colorado and associated a water management classification relating back to fishery objectives for that waterbody. The CDOW has participated in the basin roundtable processes throughout in order to provide data and information on basin fisheries, indicate fishery management priorities, and also to communicate where the most significant threats are currently located. CDOW recognizes that human uses of water will often conflict directly or indirectly with the ability to manage fisheries to meet these objectives. CDOW anticipates that as water resources are more intensively managed in the future, that pre-emptive coordination between water developers and conservation interests can minimize and in some cases improve their ability to meet fishery objectives in Colorado.

As has been recognized elsewhere in this document and others, the fisheries in Colorado are nationally renowned; as such, the economy of many headwater communities, including the South Platte River Basin, are substantially dependent on the health and viability of the aquatic community. Lower in the basin, the South Platte supports threatened populations of plains fish species. Managing recreational, listed, and non-listed conservation species are the primary goals for the Aquatic Section staff, and include a substantial commitment to raising fish in hatcheries for recreational and conservation purposes. Included below is a bulleted list of tasks that fishery managers and staff routinely undertake to manage fisheries:

- Monitoring of fisheries for population estimates, measures of 'quality' (e.g., Gold Medal Waters), and species composition;
- Growth and stocking of recreational and conservation cold- and warm-water species;
- Aquatic nuisance species monitoring and control (e.g., quagga and zebra mussels; virile crayfish; non-native predatory fish);
- Fishery regulatory review and implementation (i.e., establishment of and updates to fishery bag and possession limits);
- Participation in Federal Endangered Fish Recovery Programs;
- Serving as the CWCB's 'biological consultants' for instream flow appropriations;
- Aquatic pathogen and water quality contamination research, response, and spill investigation;
- Work with local communities and stakeholder groups to implement local projects, such as removing migration barriers (or in the case of native cutthroat trout, installing migration barriers to stratify native and non-native populations of trout) or stream habitat improvement projects;
- Formal regulatory processes governed by state or federal statute (county 1041 consultation, National Environmental Policy Act, U.S. Army Corps of Engineers Section 404 permitting);
- Participation as official liaisons to the basin roundtable processes.

Finally, CWCB included the Southwest Regional Gap Analysis Project (SRGAP), coordinated by U.S. Geological Survey (USGS) into the projects and methods database. The SRGAP created detailed, seamless GIS data layers of land cover, all 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. Four management status values are as described below:

- Status 4 lands are where there are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.
- Status 3 lands comprise areas having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining). It also confers protection to federally-listed endangered and threatened species throughout the area.
- Status 2 lands are areas having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.

- Status 1 lands include areas having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.

For this effort, CWCB included areas with a status between 1 and 2.5 as a project and method in the nonconsumptive projects database.

3.3 Nonconsumptive Projects and Methods GIS Mapping and Analysis Methodology and Results

The project and method information collected by CWCB, as described in Section 3.2, was spatially digitized in GIS. Each project was digitized separately using an existing stream database called National Hydrography Dataset (NHD) 12 digit segments. The average length of a NHD segment is 1.5 miles. Depending on the length of the project, multiple NHD segments could represent one project. Also, depending on the project location, multiple projects could exist on the same NHD segment. A unique Project ID and Segment ID were given to all surveyed and interviewed projects within the Nonconsumptive Needs Assessment database. In addition, the WSRA grant project locations were digitized in a similar fashion. The CWCB ISFs and natural lake levels, CWCB restoration projects, and the USGS SRGAP information had previously been summarized using GIS; therefore, this data did not have to be digitized. The USGS SRGAP information was analyzed further to calculate a weighted management status value for each NHD segment. This value was calculated in GIS for each NHD 12-digit HUC by a weighted average of each land management status within the Hydrological Unit Code.

Following are the assumptions used in digitizing the nonconsumptive projects and methods:

- No NHD segment was edited (i.e., if the project was smaller than an NHD segment, the whole NHD segment was used to represent the project location).

- Projects were digitized based on hand-drawn locations and/or brief descriptions. This information is still under review by the basin roundtables.

Following are the types of information included in the GIS geodatabase for each project:

- Project or Method Name
- Project or Method Type (i.e., study, flow protection, or restoration project)
- Project or Method Location
- Comments
- Project or Method Status (i.e., ongoing, planned, or completed)
- Project or Method Identification Number
- Project or Method Contact Name
- Project or Method Contact Identification Number

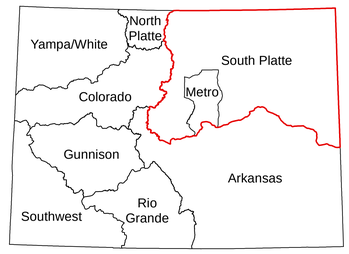
Figure 3-1 is a summary of the projects and methods developed to date by CWCB and represents the spatial information for all nonconsumptive projects and methods that are planned, ongoing, or completed in the Metro Basin (Figure 3-1 is a combination of Metro and South Platte). This map contains all nonconsumptive projects and methods including: 1) CWCB interviews and workshops, 2) CWCB watershed restoration projects, 3) WSRA grants, 4) ISFs, 5) USGS SRGAP information, and 6) CDOW projects. This map includes projects and methods inside the designated focus areas to spatially display the full extent of any project collected by CWCB.

Legend

- River and Stream
- Lake and Reservoir
- City and Town
- Road
- County Boundary
- Basin

Projects

- CDOW
- CWCB
- ISF
- Stewardship
- WSRA



Colorado Basins

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Miles

Figure 3-1

South Platte Basin Nonconsumptive Needs Assessment Focus Areas with Projects and Methods

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This information is also summarized in **Table 3-4** at the end of this section. This table summarizes the project name, location, type, and status. In addition, it summarizes the attributes located within the project boundary and also summarizes information about the type of protections the project provides as defined below.

In addition to identifying the spatial extent and status of the identified projects and methods, CWCB also examined what type of protection the project or method may provide to a given environmental or recreational attribute. CWCB has classified the projects as having direct or indirect protections based on a given environmental or recreational attribute. The definitions used for direct and indirect protections are as follows:

- **Direct Protection** – Projects and methods with components designed intentionally to improve a specific attribute. For example, ISFs have direct protection of fish attributes. Additionally, restoration of a stream channel would also provide direct protections for aquatic species.
- **Indirect Protection** – Projects and methods with components that were not designed to directly improve the specific attribute but may still provide protection. For example, flow protection for a fish species may also indirectly protect riparian vegetation that is located in the area of the flow protection. Another example includes protective land stewardship or a wetland or bank stabilization effort that could indirectly protect aquatic species.

The projects and methods identified through interviews were individually evaluated and compared to the environmental and recreational attributes gathered by the basin roundtables during their focus area mapping effort. This information is included in Table 3-4. CWCB examined the various attributes summarized by the roundtables in their focus area mapping efforts (Section 2) and indentified if these areas have projects and methods that provide direct or indirect protections. The interviewed projects and methods, ISFs, and stewardship information were assigned direct or indirect protections based on roundtable attribute. In the Metro and South Platte Basins, the basin roundtables identified 1,400 miles of water bodies as focus areas. For these focus areas, 65 percent have an associated project or method. **Table 3-5** below summarizes the project and method protections identified for the Metro and South Platte Basin. In the attribute column of Table 3-5, the environmental and recreational attributes collected by the basin roundtable are summarized. The recreation attribute category includes attributes from whitewater and flatwater boating. The Warm Water Fish State Endangered, Threatened and Species of Special Concern category includes plains fish species in the South Platte and Metro Basins. Important Riparian and Wetland Areas category includes significant riparian areas and rare plant communities. Finally, the fishing attribute category includes streams and identified lakes as fishing areas.

Table 3-5 Summary of Protections for Metro and South Platte Basins Environmental and Recreational Attributes

Attribute Category	Percent of Attribute Length with Direct Protections	Percent of Attribute Length with Indirect Protections	Percent of Attribute Length with Direct and Indirect Protections	Total Percent of Attribute Length with Protections
Fishing	32%	11%	7%	50%
Greenback Cutthroat Trout	51%	21%	12%	84%
Important Riparian and Wetland Areas	2%	40%	`%	42%
Plains Fish State Endangered, Threatened and Species of Special Concern	33%	1%	17%	51%
Recreation	0%	0%	0%	0%
Waterfowl Hunting and Viewing	0%	24%	2%	26%

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Table 3-4 South Platte Basin Nonconsumptive Identified Projects and Processes Summary

Project Location	Project Name	Project Type	Project Status	Basin Roundtable Attributes Identified	Project Protections	Reach ID
Cache La Poudre	Investigating operations change	Flow Protection	Planned	Audubon important bird areas, Brassy Minnow, Common Garter Snake, Common Shiner, Iowa Darter, Northern Leopard Frog , Preble's Meadow Jumping Mouse, Significant Riparian/Wetland Communities	Active Bald Eagle Nests-D, Brassy Minnow-D, CWCB Instream Flow Water Rights-D, Gold Metal Trout Streams-D, High Recreation Rivers -D, Iowa Darter-I, Stonecat-D	23
Black Hollow Creek	Barrier Construction	Project	Completed	Colorado Outstanding Waters, CWCB instream flow water rights, Greenback Cutthroat Trout, Rare Plants, Significant Riparian/Wetland Communities, Wilderness Area Waters	Suckermouth Minnow -D	12
Big Thompson River from Estes Park to Dillon Tunnel	Minimum flow releases from Olympus Dam - BOR and NCWCD	Flow Protection	Ongoing	CWCB instream flow water rights, Preble's Meadow Jumping Mouse, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating	Common Shiner-I, Iowa Darter-I, Rare Plants-D	15
Big Thompson River above Waltonia	Big Thompson River Instream Fish Habitat Project	Project	Completed	CWCB instream flow water rights, Preble's Meadow Jumping Mouse, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating	Ducks Unlimited Projects-D	15
Bard Creek	Bard Creek Instream Habitat Structures	Project	Completed	Boreal Toad, CWCB instream flow water rights, Greenback Cutthroat Trout, Rare Plants, Significant Riparian/Wetland Communities, Whitewater Boating	Suckermouth Minnow -D	12
Cache la Poudre (near I-25)	Cache la Poudre bank stabilization	Water Quality Protection	Completed	Audubon important bird areas, Brassy Minnow, Common Garter Snake, Common Shiner, High Recreation Lakes and Reservoirs, Iowa Darter, Northern Leopard Frog , Preble's Meadow Jumping Mouse, Rare Plants, Significant Riparian/Wetland Communities	Active Bald Eagle Nests-I, Common Shiner-I, CWCB Instream Flow Water Rights-D, Gold Metal Trout Streams-D, High Recreation Rivers -D, Iowa Darter-I, Stonecat-I	23
South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte) and North Platte (from Insmont to confluence with South Platte)	South Platte Protection Plan #8 - New operating and monitoring equipment	Information	Completed	Eligible Wild and Scenic, Flatwater Boating, Gold Metal Trout Streams, Iowa Darter, Northern Leopard Frog , Preble's Meadow Jumping Mouse, Rare Plants, Reservoir and Lake Fishing, River and stream fishing, River Otter Sightings, Significant Riparian/Wetland Communities, Whitewater Boating		7, 8
South Boulder Creek from Gross Reservoir to Mouth	Fish passage on diversion structures	Project	Completed	Common Garter Snake, Common Shiner, CWCB instream flow water rights, Northern Leopard Frog , Preble's Meadow Jumping Mouse, Rare Plants, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating	Brassy Minnow-D, Common Shiner-I, CWCB Instream Flow Water Rights-D, Ducks Unlimited Projects-D, Gold Metal Trout Streams-I, Iowa Darter-I	11
South Platte through Metro Area	Metro Area River Restoration Proposals	Project	Planned?	Audubon important bird areas, Common Garter Snake, Common Shiner, Ducks unlimited projects, Eligible Wild and Scenic, High Recreation Lakes and Reservoirs, Iowa Darter, Northern Cricket Frog, Northern Leopard Frog , Northern Redbelly Dace, Plains Leopard Frog, Preble's Meadow Jumping Mouse, Rare Plants, Reservoir and Lake Fishing, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating, Yellow Mud Turtle		4, 7
South Platte through Metro Area	Chatfield Reallocation	Project / flow Protection	Ongoing	Audubon important bird areas, Common Garter Snake, Common Shiner, Ducks unlimited projects, Eligible Wild and Scenic, High Recreation Lakes and Reservoirs, Iowa Darter, Northern Cricket Frog, Northern Leopard Frog , Northern Redbelly Dace, Plains Leopard Frog, Preble's Meadow Jumping Mouse, Rare Plants, Reservoir and Lake Fishing, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating, Yellow Mud Turtle	Active Bald Eagle Nests-D, Colorado Outstanding Waters-D, Common Garter Snake-D, Common Shiner-I, CWCB Instream Flow Water Rights-D, Gold Metal Trout Streams-I, High Recreation Rivers -D, Iowa Darter-I, River and Stream Fishing-D	4, 7

Table 3-4 South Platte Basin Nonconsumptive Identified Projects and Processes Summary, continued

Project Location	Project Name	Project Type	Project Status	Basin Roundtable Attributes Identified	Project Protections	Reach ID
South Platte River upstream of Michigan Creek	Hayman Fire Restoration	Information	Planned	Eligible Wild and Scenic, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating		7
South Platte below Horse Creek	Trumbull Trout Habitat Enhancement	Project	Completed	Eligible Wild and Scenic, Gold Metal Trout Streams, Preble's Meadow Jumping Mouse, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating	Ducks Unlimited Projects-D, Waterfowl Hunting / Viewing-D	7
South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte) and North Platte (from Insmont to confluence with South Platte)	South Platte Protection Plan #9 - Stream Channel Maintenance	Water Quality Protection	Planned	Eligible Wild and Scenic, Flatwater Boating, Gold Metal Trout Streams, Iowa Darter, Northern Leopard Frog , Preble's Meadow Jumping Mouse, Rare Plants, Reservoir and Lake Fishing, River and stream fishing, River Otter Sightings, Significant Riparian/Wetland Communities, Whitewater Boating	Active Bald Eagle Nests-I, Audubon Important Bird Areas-I, Brassy Minnow-I, Common Shiner-I, Ducks Unlimited Projects-I, Waterfowl Hunting / Viewing-I	7, 8
South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte) and North Platte (from Insmont to confluence with South Platte)	South Platte Protection Plan #7 - Planning meetings b/t Operators and fisheries and whitewater interests	Information	Completed	Eligible Wild and Scenic, Flatwater Boating, Gold Metal Trout Streams, Iowa Darter, Northern Leopard Frog , Preble's Meadow Jumping Mouse, Rare Plants, Reservoir and Lake Fishing, River and stream fishing, River Otter Sightings, Significant Riparian/Wetland Communities, Whitewater Boating		7, 8
South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte) and North Platte (from Insmont to confluence with South Platte)	South Platte Protection Plan #6 - Channel work on North Fork	Information	Completed	Eligible Wild and Scenic, Flatwater Boating, Iowa Darter, Northern Leopard Frog , Preble's Meadow Jumping Mouse, Rare Plants, Reservoir and Lake Fishing, River and stream fishing, River Otter Sightings, Significant Riparian/Wetland Communities, Whitewater Boating		7
South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte) and North Platte (from Insmont to confluence with South Platte)	South Platte Protection Plan #4 - Cheeseman Reservoir	Flow Protection	Completed	Eligible Wild and Scenic, Gold Metal Trout Streams, Preble's Meadow Jumping Mouse, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating	Audubon Important Bird Areas-D, Brassy Minnow-D, Common Shiner-I, Ducks Unlimited Projects-D, Gold Metal Trout Streams-I, Iowa Darter-I, Waterfowl Hunting / Viewing-D	7
South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte) and North Platte (from Insmont to confluence with South Platte)	South Platte Protection Plan #2 - Spinney Mountain Reservoir	Flow Protection	Completed	Eligible Wild and Scenic, Flatwater Boating, Gold Metal Trout Streams, Iowa Darter, Northern Leopard Frog , Preble's Meadow Jumping Mouse, Rare Plants, Reservoir and Lake Fishing, River and stream fishing, River Otter Sightings, Significant Riparian/Wetland Communities, Whitewater Boating	Active Bald Eagle Nests-D, Audubon Important Bird Areas-D, Brassy Minnow-D, Common Shiner-I, Ducks Unlimited Projects-D, Gold Metal Trout Streams-I, Iowa Darter-I, Waterfowl Hunting / Viewing-D	7, 8
Saint Vrain (near Longmont)	Saint Vrain stream realignment and wetland enhancement	Project	Completed	Brassy Minnow, Common Shiner, Ducks unlimited projects, Iowa Darter, Lake Chub, Northern Redbelly Dace, Preble's Meadow Jumping Mouse, Stonecat	Active Bald Eagle Nests-D, Colorado Outstanding Waters-D, Common Garter Snake-D, Gold Metal Trout Streams-D, Northern Cricket Frog-D, Stonecat-D, Yellow Mud Turtle -D	17
South Platte at Happy Meadows	Happy Meadows/ Sportsman's Paradise River Restoration	Project	Completed	Eligible Wild and Scenic, Northern Leopard Frog , River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating	Ducks Unlimited Projects-D	7
South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte) and North Platte (from Insmont to confluence with South Platte)	South Platte Protection Plan #3 - Eleven Mile Reservoir	Flow Protection	Completed	Eligible Wild and Scenic, Flatwater Boating, Iowa Darter, Northern Leopard Frog , Preble's Meadow Jumping Mouse, Rare Plants, Reservoir and Lake Fishing, River and stream fishing, River Otter Sightings, Significant Riparian/Wetland Communities, Whitewater Boating	Active Bald Eagle Nests-D, Audubon Important Bird Areas-D, Brassy Minnow-D, Common Shiner-I, Ducks Unlimited Projects-D, Gold Metal Trout Streams-I, Iowa Darter-I, Waterfowl Hunting / Viewing-D	7
Tarryall Creek	Eagle Rock Ranch Stream Stabilization	Project	Completed	CWCB instream flow water rights, River and stream fishing, Waterfowl Hunting / Viewing	Ducks Unlimited Projects-D	10
Strontia Springs Reservoir to L.C. Pump Station	Strontia Springs Reservoir to L.C. Pump Station instream flows	Flow Protection	Completed	Common Shiner, Eligible Wild and Scenic, Iowa Darter, Northern Redbelly Dace, Preble's Meadow Jumping Mouse, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating	Active Bald Eagle Nests-D, Audubon Important Bird Areas-D, Common Garter Snake-D, Ducks Unlimited Projects-D, Gold Metal Trout Streams-D, Iowa Darter-I	7

Table 3-4 South Platte Basin Nonconsumptive Identified Projects and Processes Summary, continued

Project Location	Project Name	Project Type	Project Status	Basin Roundtable Attributes Identified	Project Protections	Reach ID
Gross Reservoir	Potential Environmental Pool	Flow Protection	Planned	Common Garter Snake, Common Shiner, CWCB instream flow water rights, Northern Leopard Frog , Preble's Meadow Jumping Mouse, Rare Plants, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating		11
Metro Denver Greenways	Recreational and Riparian Improvements along the South Platte	Project	Completed	Audubon important bird areas, Common Shiner, Ducks unlimited projects, High Recreation Lakes and Reservoirs, Iowa Darter, Northern Cricket Frog, Northern Leopard Frog , Plains Leopard Frog, Preble's Meadow Jumping Mouse, Whitewater Boating, Yellow Mud Turtle		4
Metro Denver Greenways	Expansion / Enhancement to Confluence Park	Project	Completed	Audubon important bird areas, Common Shiner, Ducks unlimited projects, High Recreation Lakes and Reservoirs, Iowa Darter, Northern Cricket Frog, Northern Leopard Frog , Plains Leopard Frog, Preble's Meadow Jumping Mouse, Whitewater Boating, Yellow Mud Turtle		4
Metro Denver Greenways	Chatfield Reallocation Program	Flow Protection	Planned	Audubon important bird areas, Common Shiner, Ducks unlimited projects, High Recreation Lakes and Reservoirs, Iowa Darter, Northern Cricket Frog, Northern Leopard Frog , Plains Leopard Frog, Preble's Meadow Jumping Mouse, Whitewater Boating, Yellow Mud Turtle		4
Lower Tarryall Creek	Tarryall Reservoir Outlet Channel Reconstruction	Project	Completed	CWCB instream flow water rights, Flatwater Boating, Reservoir and Lake Fishing, River and stream fishing, Waterfowl Hunting / Viewing	Ducks Unlimited Projects-D, River Otter-D	10
Jefferson County - one mile of stream along Highway 6	Improve fish habitat and recreational opportunities	Project	Planned	Brassy Minnow, Common Shiner, Iowa Darter, Preble's Meadow Jumping Mouse, Rare Plants, River and stream fishing, Whitewater Boating		6
Metro Denver Greenways	Westerly Creek Greenway Master Plan	Information	Planned	Audubon important bird areas, Common Shiner, Ducks unlimited projects, High Recreation Lakes and Reservoirs, Iowa Darter, Northern Cricket Frog, Northern Leopard Frog , Plains Leopard Frog, Preble's Meadow Jumping Mouse, Whitewater Boating, Yellow Mud Turtle		4
Five-Mile Creek	Five-Mile Creek Channel Reconstruction	Project	Completed	CWCB instream flow water rights, Gold Metal Trout Streams, Rare Plants, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating	Ducks Unlimited Projects-D	7
Confluence of Clear Creek and Spring Gulch	General Herkimer Mill Site	Project	Completed	Rare Plants, River and stream fishing, Significant Riparian/Wetland Communities	Ducks Unlimited Projects-I	6
Como Creek	Como Creek Fishery Habitat Structures	Project	Completed	Brassy Minnow, Common Shiner, CWCB instream flow water rights, Greenback Cutthroat Trout, Iowa Darter, Northern Leopard Frog , Northern Redbelly Dace, Significant Riparian/Wetland Communities	Suckermouth Minnow -D	12
Clear Creek - Golden - just above RICD	Golden Mile habitat improvement for fisheries - focused on brown trout mainly	Project	Completed	Brassy Minnow, Common Shiner, Iowa Darter, Preble's Meadow Jumping Mouse, Rare Plants, River and stream fishing, Whitewater Boating		6
Clear Creek	Courtney-Ryley-Cooper	Project	Completed	Rare Plants, River and stream fishing, Significant Riparian/Wetland Communities	Ducks Unlimited Projects-D	6
Cache La Poudre River at Mountain Park Campground	Mountain Park Campground Fish Habitat Project	Project	Completed	CWCB instream flow water rights, Eligible Wild and Scenic, Preble's Meadow Jumping Mouse, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating	Ducks Unlimited Projects-D	21

Table 3-4 South Platte Basin Nonconsumptive Identified Projects and Processes Summary, continued

Project Location	Project Name	Project Type	Project Status	Basin Roundtable Attributes Identified	Project Protections	Reach ID
Cache La Poudre River at Kelly Flats Campground	Kelly Flats Campground Bank Stabilization	Project	Completed	CWCB instream flow water rights, Eligible Wild and Scenic, Preble's Meadow Jumping Mouse, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating	Ducks Unlimited Projects-D, Gold Metal Trout Streams-D, Iowa Darter-D	21
North Fork of the Poudre	Halligan-Seaman Shared Vision Planning	Project / flow Protection	Ongoing	Common Shiner, CWCB instream flow water rights, Eligible Wild and Scenic, Iowa Darter, Preble's Meadow Jumping Mouse, River and stream fishing, Significant Riparian/Wetland Communities, Waterfowl Hunting / Viewing, Whitewater Boating	Active Bald Eagle Nests-D, Audubon Important Bird Areas-D, CWCB Instream Flow Water Rights-D, Ducks Unlimited Projects-D, Iowa Darter-D	13
Cache La Poudre River at Dutch George	Dutch George bank Stabilization	Project	Completed	CWCB instream flow water rights, Eligible Wild and Scenic, Preble's Meadow Jumping Mouse, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating	Ducks Unlimited Projects-D, Gold Metal Trout Streams-D, Iowa Darter-D	21
Metro Denver Greenways	River North Greenway Master Plan	Information	Completed	Audubon important bird areas, Common Shiner, Ducks unlimited projects, High Recreation Lakes and Reservoirs, Iowa Darter, Northern Cricket Frog, Northern Leopard Frog , Plains Leopard Frog, Preble's Meadow Jumping Mouse, Whitewater Boating, Yellow Mud Turtle		4
Metro Denver Greenways	River South Greenway Master Plan	Information	Completed	Audubon important bird areas, Common Shiner, Ducks unlimited projects, High Recreation Lakes and Reservoirs, Iowa Darter, Northern Cricket Frog, Northern Leopard Frog , Plains Leopard Frog, Preble's Meadow Jumping Mouse, Whitewater Boating, Yellow Mud Turtle		4
North Fork of South Platte (just below Antero)	North Fork Fish Channel	Project	Completed	Flatwater Boating, Rare Plants, Reservoir and Lake Fishing, River and stream fishing, Significant Riparian/Wetland Communities	Ducks Unlimited Projects-D	9
North Fork of South Platte	Lazy River Stream Restoration	Project	Completed	Eligible Wild and Scenic, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating	Ducks Unlimited Projects-D	8
Middle Fork of South Platte	Santa Maria Ranch Riparian Restoration	Project	Completed	CWCB instream flow water rights, Gold Metal Trout Streams, River and stream fishing, Waterfowl Hunting / Viewing, Whitewater Boating	Ducks Unlimited Projects-D, Waterfowl Hunting / Viewing-D	7
Middle Fork of South Platte	Buffalo Peaks Ranch Fish Habitat	Project	Completed	CWCB instream flow water rights, Gold Metal Trout Streams, Rare Plants, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating	Ducks Unlimited Projects-D, Waterfowl Hunting / Viewing-D	7
Middle Fork at Buffalo Peaks SWA	Buffalo Peak Ranch fishery restoration - channel modification to provide better habitat restoration for brown trout	Project	Completed	CWCB instream flow water rights, CWCB natural lake level water rights, Gold Metal Trout Streams, Iowa Darter, Rare Plants, River and stream fishing, Significant Riparian/Wetland Communities, Waterfowl Hunting / Viewing, Whitewater Boating		7
S Boulder Creek	Various bank stabilization and riparian restoration projects	Restoration	0	Common Garter Snake, Common Shiner, CWCB instream flow water rights, Ducks unlimited projects, Northern Leopard Frog , Preble's Meadow Jumping Mouse, Rare Plants, River and stream fishing, Significant Riparian/Wetland Communities, Whitewater Boating		11
South Platte (from Eleven-mile reservoir outlet to confluence with the North Platte) and North Platte (from Insmont to confluence with South Platte)	South Platte Protection Plan #5 - Outflow Ramping from Eleven Mile / Cheeseman Reservoir / Roberts Tunnel	Flow Protection	Completed	Eligible Wild and Scenic, Flatwater Boating, Gold Metal Trout Streams, Iowa Darter, Northern Leopard Frog , Preble's Meadow Jumping Mouse, Rare Plants, Reservoir and Lake Fishing, River and stream fishing, River Otter Sightings, Significant Riparian/Wetland Communities, Whitewater Boating	Active Bald Eagle Nests-D, Audubon Important Bird Areas-D, Brassy Minnow-D, Common Shiner-I, Ducks Unlimited Projects-D, Gold Metal Trout Streams-I, Iowa Darter-I, Waterfowl Hunting / Viewing-D	7

Table 3-4 South Platte Basin Nonconsumptive Identified Projects and Processes Summary, continued

Project Location	Project Name	Project Type	Project Status	Basin Roundtable Attributes Identified	Project Protections	Reach ID
0	Land conservation	Project	Planned	Bald Eagle Sites, Brassy Minnow, Common Garter Snake, Common Shiner, Ducks unlimited projects, Iowa Darter, Northern Leopard Frog , Plains Minnow, Preble's Meadow Jumping Mouse, Significant Riparian/Wetland Communities, Suckermouth Minnow, Waterfowl Hunting / Viewing		1, 2
0	Tamarack Project	Project	Ongoing	Brassy Minnow, Common Garter Snake, Common Shiner, Ducks unlimited projects, Iowa Darter, Plains Minnow, Significant Riparian/Wetland Communities, Suckermouth Minnow, Waterfowl Hunting / Viewing	Colorado Outstanding Waters-D, CWCB Instream Flow Water Rights-D, Iowa Darter-I, Northern Leopard Frog -D, Preble's Meadow Jumping Mouse -D, River Otter-D, Stonecat-D	1, 2
0	St. Vrain Creek Corridor Committee releases 1000 AF/yr to benefit minnows	flow protection	0	Bald Eagle Sites, Brassy Minnow, Common Garter Snake, Common Shiner, CWCB instream flow water rights, CWCB natural lake level water rights, Ducks unlimited projects, High Recreation Lakes and Reservoirs, Iowa Darter, Lake Chub, Northern Leopard Frog , Northern Redbelly Dace, Preble's Meadow Jumping Mouse, Rare Plants, recreational in-channel diversion structures, River and stream fishing, River Otter Sightings, Significant Riparian/Wetland Communities, Stonecat, Whitewater Boating, Wood Frog	Active Bald Eagle Nests-I, Brassy Minnow-D, Colorado Outstanding Waters-I, Common Garter Snake-I, CWCB Instream Flow Water Rights-D, Gold Metal Trout Streams-D, Northern Cricket Frog-D, Stonecat-I	14, 17
0	Seasonal wetland habitat restoration	Project	Ongoing	Bald Eagle Sites, Brassy Minnow, Common Garter Snake, Common Shiner, Ducks unlimited projects, Iowa Darter, Northern Leopard Frog , Plains Minnow, Preble's Meadow Jumping Mouse, Significant Riparian/Wetland Communities, Suckermouth Minnow, Waterfowl Hunting / Viewing		1, 2
0	Riparian restoration project	0	0	Iowa Darter, Preble's Meadow Jumping Mouse	Active Bald Eagle Nests-D	22
0	Land conservation	Project	Ongoing	Bald Eagle Sites, Brassy Minnow, Common Garter Snake, Common Shiner, Ducks unlimited projects, Iowa Darter, Northern Leopard Frog , Plains Minnow, Preble's Meadow Jumping Mouse, Significant Riparian/Wetland Communities, Suckermouth Minnow, Waterfowl Hunting / Viewing	Active Bald Eagle Nests-D, Brassy Minnow-D, Colorado Outstanding Waters-D , CWCB Instream Flow Water Rights-D, Gold Metal Trout Streams-D, Iowa Darter-D, Northern Leopard Frog -D, Preble's Meadow Jumping Mouse -D, River Otter-D, Significant Plant Communities-I, Stonecat-D	1, 2
0	Riparian habitat improvement education and outreach	Project	Ongoing	Audubon important bird areas, Brassy Minnow, Common Shiner, CWCB instream flow water rights, Iowa Darter, Northern Redbelly Dace, Preble's Meadow Jumping Mouse, Rare Plants, River and stream fishing, Significant Riparian/Wetland Communities, Waterfowl Hunting / Viewing, Whitewater Boating	Active Bald Eagle Nests-I, Common Garter Snake-I, Ducks Unlimited Projects-D, Gold Metal Trout Streams-D, High Recreation Rivers -D, Iowa Darter-D, River Otter-I, Stonecat-I	3, 5

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Section 4
South Platte Basin Consumptive Needs Assessment

4.1 Overview of Consumptive Needs Assessment Process

Water in Colorado is managed to meet the needs of Colorado's citizens, agriculture, and environment. Colorado's economy, quality of life, recreational opportunities, and the environment are all dependent on water. The broad diversity of water uses in Colorado is indicative of the many ways in which we are affected by the water that is available to us and our environment, and how we choose to use it. Severe and continuing drought conditions throughout the state in the early 2000s in conjunction with rapid economic growth and concern over interstate compact obligations have brought focus to the constraints on our state's water resources and the challenges associated with meeting multiple objectives and needs.

Ranch in Fort Collins, CO

The objectives of the consumptive needs part of this South Platte Basin Needs Assessment Report is to:

- Update population projections and extend them to 2050
- Update municipal and industrial (M&I) per capita estimates including passive conservation
- Extend the Statewide Water Supply Initiative (SWSI) 1 consumptive water use projections to 2050 for the M&I sector
- Update the self-supplied industrial (SSI) sector forecast to 2050
- Update the current tally of irrigated acres throughout Colorado and forecast irrigated acres in 2050
- Update current agricultural demands and shortages
- Update the consumptive demand forecast to 2050 for the agricultural sector

The analyses summarized in this section use a water forecast horizon of 2050 for a number of reasons. The Colorado Water Conservation Board (CWCB) determined that the forecast horizon for the water demand projections needed to be extended to the year 2050 to better represent the long-term water needs that the state will face.

The following sections provide an overview of the methods used in determining reconnaissance level consumptive water use projections for 2050, and the results of those analyses. Sections 4.2.1 and 4.2.2 describe the methods and results of projecting M&I demands, including population forecasting, estimation of per capita water use, and the application of passive conservation measures. The methods used to estimate SSI demands, and the results thereof, are presented in Section 4.2.3. Section 4.2.4 summarizes the statewide results of the M&I and SSI demand projections. Section 4.3 summarizes the same for agricultural demands. Detailed descriptions of these methodologies and results are available in Appendices H and I of the SWSI 2010 Report.

4.2 M&I and SSI Consumptive Needs

Standard methods were used for projecting future M&I and SSI water demands in the South Platte Basin. 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 in this approach are for the purpose of general statewide and basinwide planning and are not intended to replace demand projections prepared by local entities for project-specific purposes.

County and statewide population projections are the most accepted predictor of future growth for the state.

The M&I water demands forecast takes on 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).

4.2.1 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.

4.2.1.1 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. To be suitable, the water demand projections would need to satisfy the following criteria:

- 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, in conjunction with 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 national and international driving forces behind Colorado's basic economic sectors were developed.

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

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, populations for counties that lie within two or more basins were allocated to the respective basins based on estimates from known population centers within each basin.

4.2.1.2 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 a 550,000 barrel per day oil shale industry, 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.

On average, statewide population projections from 2008 forward indicate an increase of about 1.4 million people every 15 years.

Table 4-1 shows how population growth will vary across the state during the next 40 years. Based on these projections, the Arkansas, Metro, and South Platte Basins will continue to have the largest population in the state. However, the West Slope will continue to grow at a faster rate than the Front Range of Colorado. **Figure 4-1** 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. About 69 percent of all Colorado residents resided in the South Platte Basin in the year 2008; by the year 2050, that proportion will decrease only slightly to about two-thirds. Consistent with predicted population trends, the South Platte and Metro Basins have the largest 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 4-1 Population Projections by River Basin

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		
Arkansas	948,000	1,451,000	53	1.6	1,581,000	1,688,000	1,841,000	67-94	1.2-1.6
Colorado	307,000	558,000	82	2.2	661,000	725,000	832,000	115-171	1.8-2.4
Gunnison	105,000	184,000	75	2.1	206,000	220,000	240,000	96-129	1.6-2.0
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
North Platte	1,500	1,800	20	0.7	2,000	2,200	2,500	33-67	0.7-1.2
Rio Grande	50,000	68,000	36	1.2	74,000	80,000	87,000	48-74	0.9-1.3
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**
Southwest	105,000	185,000	76	2.1	204,000	224,000	249,000	94-137	1.6-2.1
Yampa-White	45,000	81,000	80	2.2	94,000	117,000	153,000	109-240	1.8-3.0
TOTAL	**5,051,500**	**7,772,800**	**54**	**1.6**	**8,648,000**	**9,102,200**	**10,000,000**	**71-98**	**1.3-1.6**

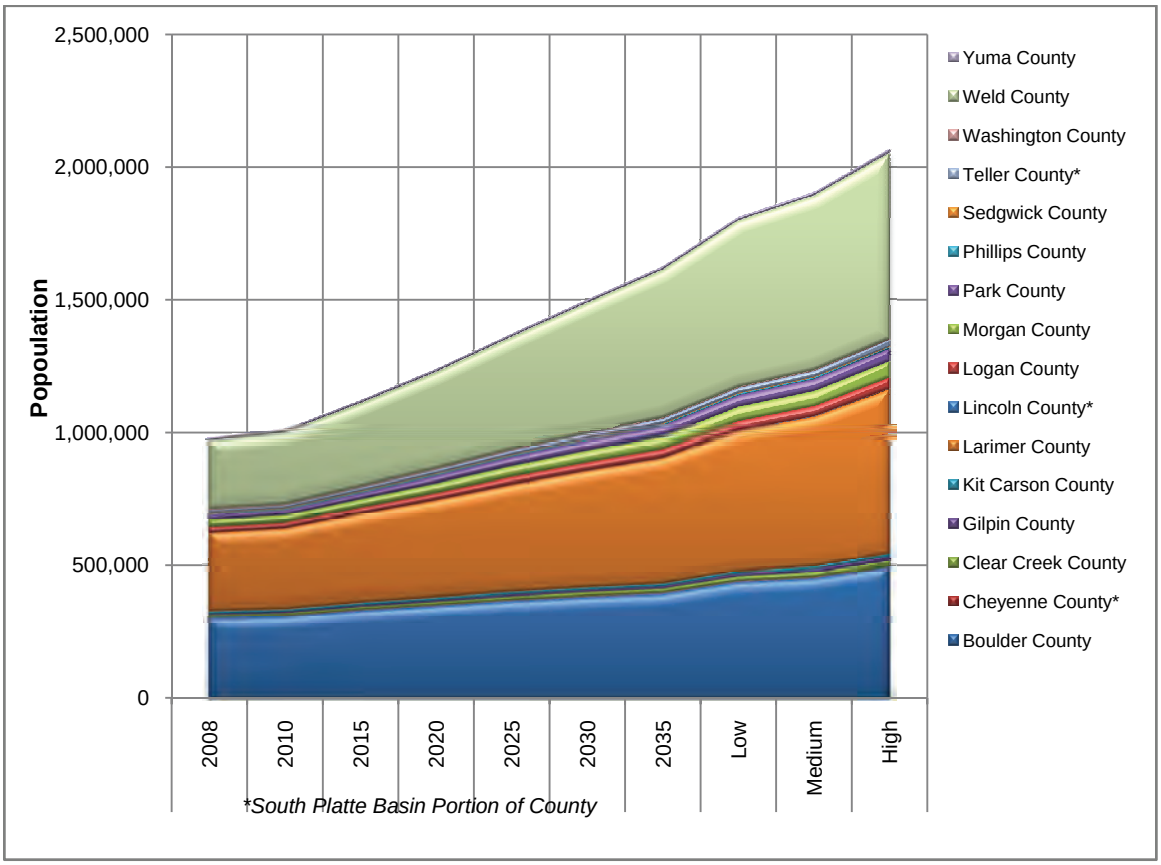


Figure 4-1 South Platte Basin Population Projections through 2050

4.2.2 Future M&I Water Demands

The M&I demand forecast is aimed at capturing the water needs of an increased population. M&I demands are the water uses typical of municipal systems, including residential, commercial, light industrial, non-agricultural related irrigation, non-revenue water, and firefighting. For the current effort, 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. **Table 4-2** contains the definitions of the M&I demand terms used throughout this report.

Table 4-2 Definition of M&I Demand Terms

Demand Terminology	Definition
M&I Demand	All the water uses of typical municipal systems, including residential, commercial, industrial, irrigation, and firefighting
SSI Demand	Large industrial water uses that have their own water supplies or lease raw water from others
M&I Demand and SSI Demand	The sum of M&I and SSI demand

The updated demands presented in this document include both baseline demands (without passive conservation) and baseline demands minus passive conservation. It is important to note 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.

4.2.2.1 2050 M&I Water Demands Methodology

The methodology used for the M&I water demands forecast in this update is nearly identical to the methodology employed in SWSI 1. The method is based on a sample of water providers throughout the state as described in this section. The estimated per capita water use rates for each county were multiplied by the projected population of each county to estimate current and future municipal water demand (i.e., the residential, commercial, and industrial water use) of each county.

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.

It is critical to note that the methods utilized in this approach are for the purpose of general basinwide and statewide planning and are not intended to replace demand projections prepared by local entities for project-specific purposes. County and statewide population projections are the most accepted predictor of future growth for the state. Therefore, it was determined the SWSI 1 methodology was most appropriate. The methodology employed is a commonly accepted forecast methodology for statewide water supply planning purposes, but is not appropriate for project-specific purposes or for direct comparisons between basins or counties.

Estimates of Per Capita M&I Water Use

The M&I water demands forecast is developed by multiplying the population projections outlined in Section 4.2.1 by a rate of use. The rate of use is systemwide gpcd. Numerous factors affect per capita water use rates, and through the course of SWSI 1 and the current SWSI 2010, differences in the water use components that are included or excluded from individual entities' per capita estimates clearly affected the resulting values.

Per capita water use rates are in large part a function of:

- Number of households
- Persons per household
- Median household income
- Mean maximum temperature
- Total precipitation
- Total employment
- Ratio of irrigated public land areas (e.g., parks) to population in service area
- Mix of residential and commercial water use and types of commercial use
- Level of tourism and/or second homes
- Ratio of employment by sector (e.g., agriculture, commercial, industrial)
- Urban/rural nature of county

Provider water use and service population data were gathered from various sources and organized to create a database. The database built upon existing information from 254 water providers gathered for SWSI 1. Efforts were made to update the data for these providers as part of analyses completed in 2009 and 2010. The CWCB also worked with water providers and basin roundtables across the state through the first part of 2010 to collect additional data. Based on these efforts, updated per capita estimates were collected for 214 water providers covering 87 percent of the population in Colorado. A systemwide gpcd estimate was calculated for each participating local water provider by dividing the total water deliveries by the service area population.

The CWCB worked with water providers and basin roundtables across the state through the first part of 2010 to collect provider water use and service population data.

Because 2050 population projects were developed at the county level, the systemwide gpcd values needed to be aggregated from the water provider level to the county level. A weighting process was applied to develop a county average systemwide gpcd based upon the portion of the county population serviced by each water provider. Once the county level M&I demand forecast was developed, basin level M&I water use rates were calculated for the nine basin roundtable areas. Basin M&I demands were aggregated from the county demands based on the portion of the county within the basin. For four counties (Cheyenne, Lake, Saguache, and San Juan), no provider-level data were obtained. For these counties, the weighted basin average was assigned.

The population estimates developed for this update and the gpcd values determined through data collection are multiplied to estimate county demands. The population estimates represent permanent populations of each county; thus the water use rates are based on total water use divided by the permanent population. The resulting gpcd water use rates incorporate water used by tourists, students, and other transient populations in that the water used by the transient population is indexed to the permanent population along with the water use of the permanent population. The resulting gpcd also incorporates commercial and light industrial water use supplied by the water provider. For statewide planning purposes, this is a consistent approach to account for water use by transient populations, commercial, and light industry. Comparisons of gpcds between counties and basins should not be made directly, since differences in the amount of industry, tourism, and outdoor water use varies significantly between geographic regions.

Passive Water Conservation Savings

The methodology for the M&I water demands projections outlined above develops baseline water demand estimates. In addition, CWCB has updated the passive conservation analysis, and these water savings are subtracted from the baseline estimates. This section provides an overview of passive water conservation savings, which chiefly relate to the water demand reductions associated with the impacts of state and

federal policy measures and do not include active conservation measures and programs sponsored by water providers. A detailed description of this analysis is provided in the *SWSI Conservation Levels Analysis Report*.

Several pieces of key federal and state legislation were considered in the development of the passive conservation savings estimates, including the 1992 National Energy Policy Act, the 2002 California Energy Commission Water Efficiency Standards, and the 2007 California Assembly Bill 715.

High efficiency front load washer/dryer

For this analysis, passive water savings were calculated to occur as a result of retrofitting housing stock and businesses that exist prior to 2016 through the replacement of washing machines, toilets, and dishwashers. Future water demand reductions associated with passive savings were calculated for each year beginning in 1996, which was when benchmark toilet flushing volume data from Denver was available. The calculations used to estimate future demand reductions from passive conservation were developed for minimum and maximum scenarios based on the assumptions related to the retrofit of existing housing and commercial construction with high-efficiency toilets, clothes washers, 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 gpcd. The upper range of these savings were applied to the county level baseline estimates described above to assess what the 2050 demands would be 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. The potential exists to realize substantial permanent water demand reductions in the future if appropriate regulations and ordinances are developed to address water use in existing and new construction.

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.

Also related to conservation savings, Part Two of the South Platte Basin Roundtable Basin Needs Assessment discussed Water Conservation Plans in the basin. The Water Conservation Act of 1991 (House Bill [HB]91-1154) created the Office of Water Conservation and required that all covered entities, which are retail water providers who provide or deliver 2,000 acre-feet (AF) or more of water annually, submit a water conservation plan to the CWCB for approval. This act was revised in 2004 under HB04-1365 referred to as the Water Conservation Act of 2004. The 2004 Act expanded the duties of the Office of Water Conservation and Drought Planning and amended the list of minimum required plan elements.

The Water Conservation Act of 2004 requires covered entities 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." A recent survey by the CWCB identified approximately 100 covered entities in Colorado. Statewide, there have been 40 approved plans submitted to-date that meet the new requirements set forth in the 2004 Act; 29 of these are in the Metro and South Platte Basins. Water providers in the Metro and South Platte Basins that have approved plans include:

The Water Conservation Act of 2004 requires covered entities to submit a Water Conservation Plan.

- Arapahoe County Water & Wastewater Authority
- City of Aurora
- City of Boulder
- City of Brighton
- Castle Pine Metropolitan District
- Castle Pines North Metro District
- Town of Castle Rock
- Centennial Water & Sanitation District
- Denver Water
- East Larimer County Water District
- Town of Erie
- City of Evans
- Town of Firestone
- City of Fort Lupton
- City of Fort Morgan
- City of Fort Collins
- Ft. Collins-Loveland Water & Sanitation District
- City of Greeley
- City of Lafayette
- Left Hand Water District
- City of Longmont
- City of Northglenn
- North Weld County Water District
- North Table Mountain Water & Sanitation District
- Town of Parker
- Pinery Water & Wastewater District
- City of Sterling
- City of Thornton
- Town of Windsor

The water conservation plans submitted by these water providers have undergone a nine step conservation planning process. The nine planning steps are:

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.

Most plans start with establishing a baseline water use for which conservation can be measured understanding the limitation of their particular system. They review current programs and incentives to identify conservation goals. Many of the programs include the following management strategies:

- Conservation Education/Outreach
- Xeriscape Education and Demonstration Gardens
- Demand Management/Water Budgets/Conservation Pricing
- Program Evaluation/Research
- Legal Remedies/Ordinances
- Financial Rebates/Incentives

Effective July 1, 2006, a covered entity seeking financial assistance from either the CWCB or the Colorado Water Resources and Power Development Authority must submit to the CWCB a new or revised plan to meet water conservation goals for the CWCB's approval prior to release of new loan proceeds.

4.2.2.2 2050 M&I Water Demands Results

Colorado's population is projected to nearly double by the year 2050. Because the major driver for water use is population growth, M&I water usage is also expected to nearly double, even with savings from passive conservation. Statewide municipal water demands are estimated to increase from 975,000 acre-feet per year (AFY) to 1.36 million AFY by 2035 requiring an additional 383,000 AFY of water to meet Colorado's municipal water needs in 2035.

City of Greeley, CO

Based on the population projections discussed in Section 4.2.1, total statewide 2050 M&I water demands with passive conservation could range from 1.5 to 1.8 million AFY. By 2050, Colorado will need between 538,000 and 812,000 AFY of additional water to meet M&I demands. Passive conservation savings will result in approximately 154,000 AFY reduction statewide or just over 8 percent decrease in M&I water demands by 2050 for the medium demand scenario.

Table 4-3 and **Figure 4-2** illustrates the M&I water demand projections with passive conservation savings for each of the counties in the South Platte Basin.

Table 4-3 M&I Forecast by River Basin

County	Water Demand (AF)	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
Boulder County	59,000	77,000	86,000	89,000	97,000	69,000	77,000	80,000	88,000
Cheyenne County-South Platte Basin Portion	58	68	72	80	90	61	64	72	82
Clear Creek County	2,400	3,800	4,300	4,700	5,300	3,600	4,000	4,400	5,000
Gilpin County	450	700	850	1,100	1,300	550	680	900	1,200
Kit Carson County	3,100	3,600	4,000	4,300	4,700	3,400	3,800	4,100	4,500
Larimer County	59,000	95,000	110,000	110,000	120,000	86,000	97,000	100,000	110,000
Lincoln County-South Platte Basin Portion	220	280	310	340	370	260	290	320	350
Logan County	7,900	12,000	13,000	14,000	15,000	11,000	12,000	13,000	14,000
Morgan County	7,800	13,000	14,000	15,000	16,000	12,000	14,000	14,000	16,000
Park County	2,200	4,900	5,300	5,500	5,900	4,400	4,700	4,900	5,200
Phillips County	2,000	2,200	2,300	2,400	2,700	2,100	2,200	2,300	2,500
Sedgwick County	950	1,100	1,200	1,300	1,300	1,000	1,100	1,200	1,300
Teller County - South Platte Basin Portion	10,000	16,000	17,000	19,000	20,000	14,000	15,000	17,000	19,000
Washington County	1,700	1,800	1,900	2,000	2,200	1,700	1,800	1,900	2,100
Weld County	53,000	120,000	130,000	140,000	150,000	110,000	120,000	130,000	140,000
Yuma County	3,200	3,800	4,000	4,300	4,700	3,500	3,700	4,000	4,500
Total	**210,000**	**360,000**	**390,000**	**410,000**	**450,000**	**320,000**	**360,000**	**380,000**	**410,000**

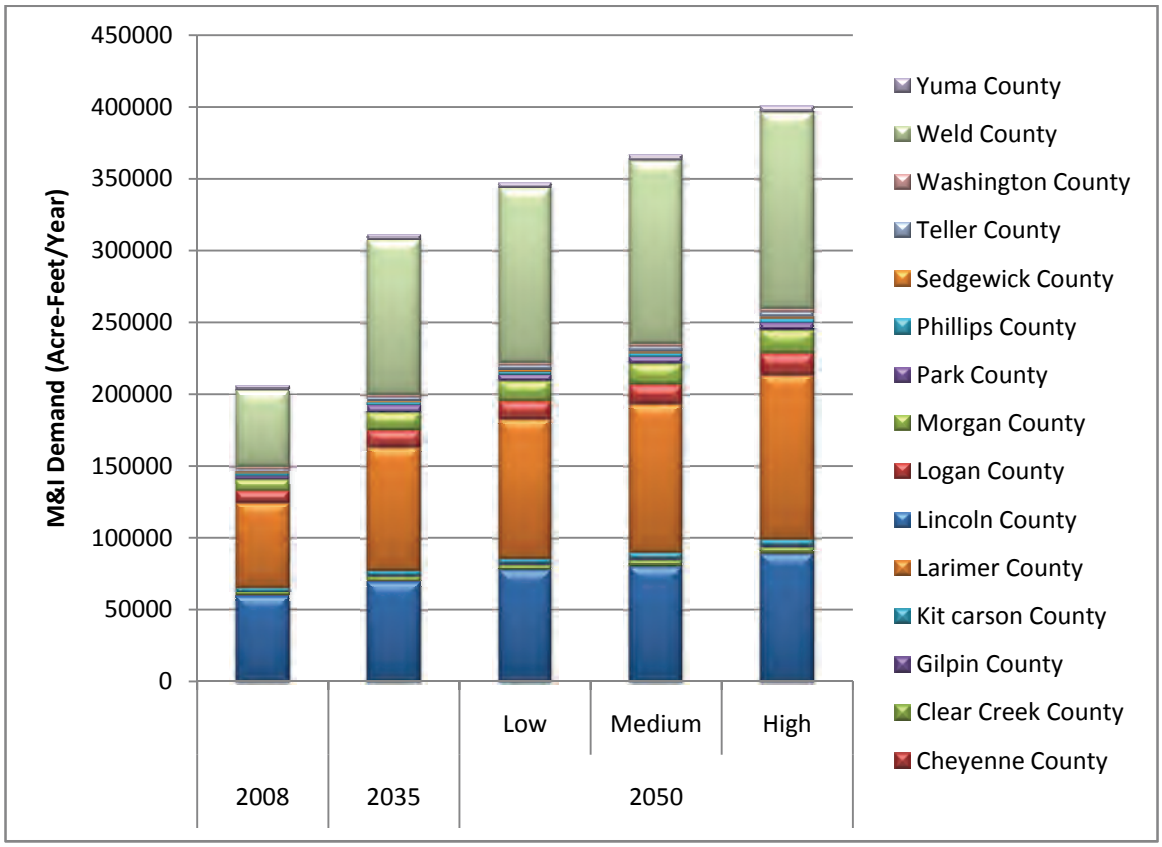


Figure 4-2 South Platte Basin M&I Water Demands

4.2.3 SSI Water Demands

Standard methods were adapted for use in SWSI 1 for estimating future SSI water demands throughout Colorado. 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
- Energy development, including the extraction and production of natural gas, coal, uranium, and oil shale

These industries represent economic growth within the state and the availability of water resources is imperative to their growth. Because of the diversity of the SSI subsectors, this section is organized to summarize each subsector separately, including data collection efforts and results. Detailed discussions of data sources, methodologies, and results are provided in Appendix H of the SWSI 2010 Report.

4.2.3.1 Large Industry

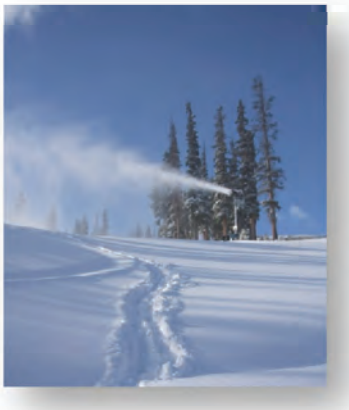
The goal of this subsector is to identify large self-supplied industries in Colorado with significant consumptive water demands. These include Cargill Inc. in Morgan County, Swift Company in Weld County, and Kodak in Weld County. The sources of information used to develop the SSI estimates for large industry are detailed in Appendix H of the SWSI 2010 Report. Results of the large industry subsector water demands forecast are provided in **Table 4-4**. No low, medium, and high growth scenarios are considered for this subsector.

Table 4-4 Large Industry Demands (AFY)

County	2008	2035/2050
Morgan	2,100	2,100
Weld	4,500	4,500
Total	**6,600**	**6,600**

4.2.3.2 Snowmaking

The ski industry in Colorado is the cornerstone of tourism and economic activity for a large region of the state. While the water used by the ski resorts does not have a high consumption rate, it is water removed from the stream system and thus important to estimate. The forecast methodology employed in this update differs from the SWSI 1 forecast methodology. Additional data were identified that proved useful in developing water use demands for snowmaking.



Snowmaking in Boulder, CO

For this effort, several pieces of information were obtained—current snowmaking acres for each ski resort, current amount of water used for snowmaking, and expected future water use for snowmaking. Water use information was not available for all ski resorts. For these resorts, the known water use data were used to estimate current and future snowmaking demand. To stay within the bounds of the known data, water use was held constant for resorts with no known future expansions. Also, for resorts with known expansions, build out was assumed to be 2050. Results of the forecast for the snowmaking industry are shown in **Table 4-5**. At this time, no low, medium, or high growth scenario is considered for 2050.

Table 4-5 Estimated Snowmaking Water Demands (AFY)

County	2008	2050
Boulder	230	230
Clear Creek	90	90
Total	**320**	**320**

4.2.3.3 Thermoelectric Power Generation

Water use at coal-fired and natural gas power facilities is included in the SSI water demands estimates. In 2006, nearly 95 percent of Colorado's electricity was produced from coal (71 percent) and natural gas (23 percent). Although Colorado's General Assembly has adopted a state renewable electricity standard that requires 20 percent of the state's electric portfolio to be from renewable resources of energy by 2020, demand for coal-fired and natural gas energy production will remain significant into the future.

For SWSI 1, estimates of current and future water use at various power generation facilities in Colorado were obtained from power producers. For this update, SWSI 1 baseline estimates were assumed to stay constant until 2035. To extend 2035 projections to 2050 for Pueblo County percent increases were assumed for the low, medium, and high scenarios, respectively, as follows—5 percent, 25 percent, and 50 percent. These percentages were based on expected population increases throughout the state. **Table 4-6** provides the estimates of thermoelectric water demands with 2050 low, medium, and high scenarios.

Table 4-6 Estimated Thermoelectric Power Generation Water Demands (AFY)

County	2008	2035	2050		
			Low	Med	High
Boulder	2,900	2,900	3,100	3,700	4,400
Larimer	5,200	11,200	11,700	14,000	16,700
Morgan	5,900	13,900	14,600	17,400	20,900
Total	**14,000**	**28,000**	**29,400**	**35,100**	**42,000**

4.2.3.4 South Platte Basin SSI Summary

Figure 4-3 displays SSI water demands in the South Platte Basin.

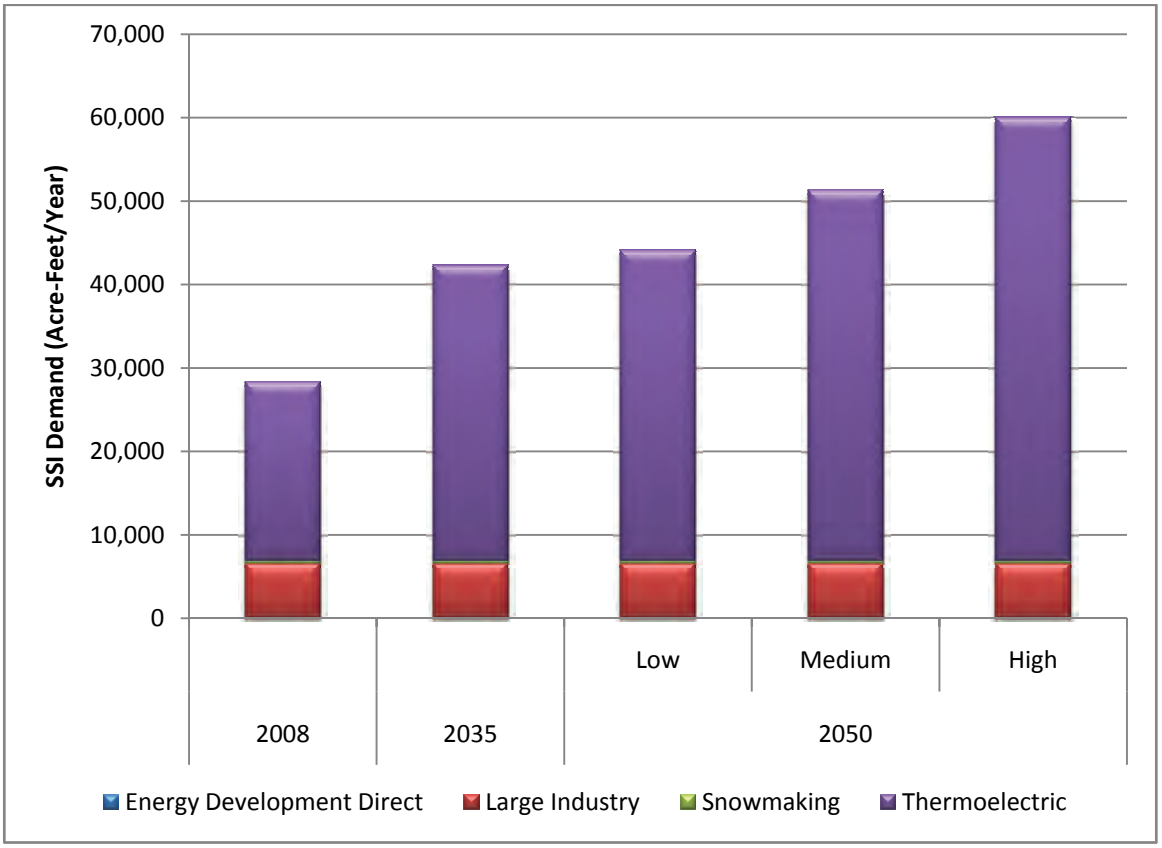


Figure 4-3 South Platte Basin SSI Water Demands

4.2.4 Statewide 2050 M&I and SSI Consumptive Needs Summary

Of the many factors affecting M&I water use, the projected increases in population clearly drive the increases in M&I use from 2000 to 2050. **Table 4-7** and **Figure 4-4** summarize the South Platte Basin's M&I and SSI water use for 2008 and projections including reductions as a result of passive conservation measures for 2035 and the 2050 low, medium, and high scenarios. Total statewide 2035 water demands are projected to be nearly 1.6 million AFY. 2050 water demands are projected to range from approximately 1.75 million AFY to nearly 2.1 million AFY. Figure 4-4 also shows that M&I water demands are estimated to exceed SSI demands for all of the future projections.

Table 4-7 Summary of M&I and SSI Demands for South Platte Basin (AFY)

Basin	Demand Type[1,2]	2008	2035	2050 Low	2050 Med	2050 High
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
Statewide	M&I	974,500	1,357,600	1,512,700	1,607,700	1,786,800
	SSI	187,760	235,990	235,890	261,490	322,090
	Total	1,162,260	1,593,590	1,748,590	1,869,190	2,108,890

1 M&I demands for 2035 and 2050 include passive conservation savings.
2 SSI demands include energy development, large industry, snowmaking, and thermoelectric.

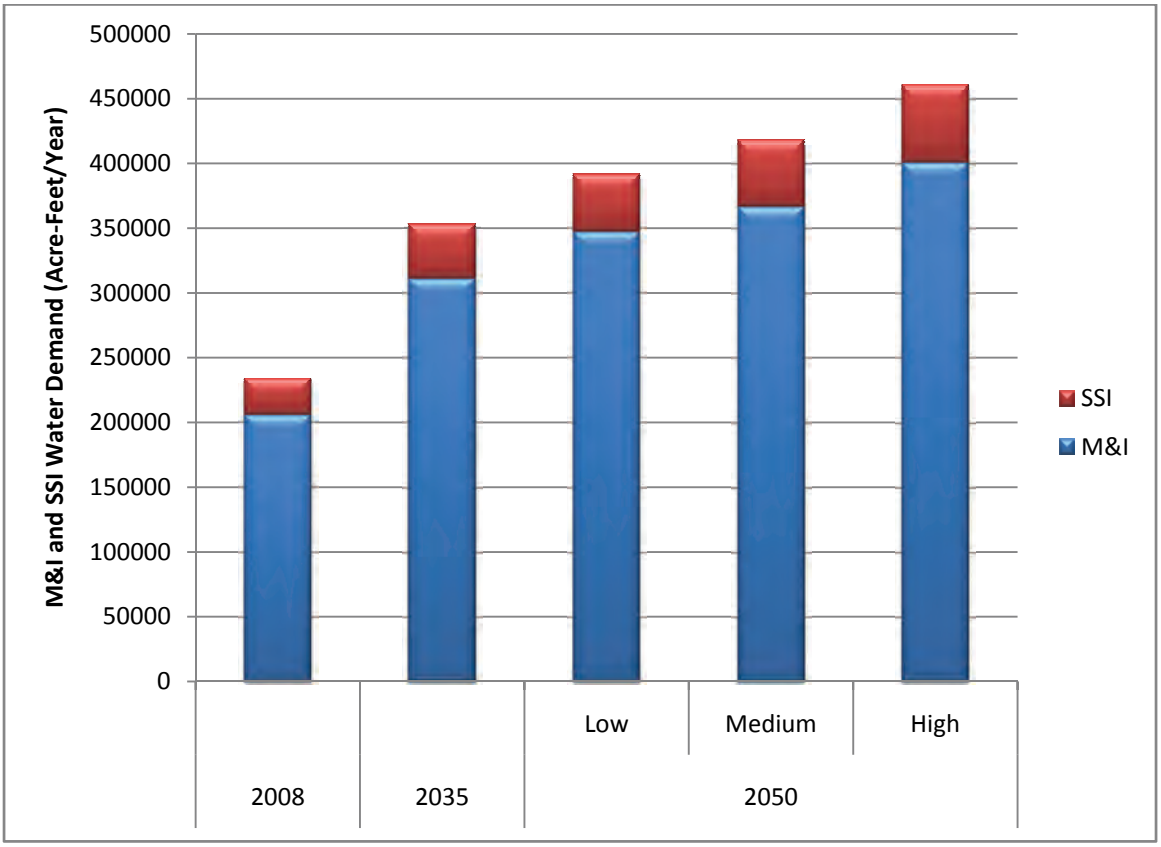


Figure 4-4. South Platte Basin M&I and SSI Water Demands

4.3 Agricultural Consumptive Needs

This section provides information about the methodologies utilized to develop a current tally of irrigated acres and summarizes how 2050 irrigated acres were estimated. In addition, this section provides an overview of existing and 2050 agricultural demands.

4.3.1 Agricultural Demand Methodology

This section describes the methods used to estimate the water needed to support Colorado's agriculture, both currently and in 2050. The estimates include consumptive use (CU) water only—rather than the generally larger volumes of water pumped or diverted—both for the irrigation of crops and for livestock production. CU includes the amount of diverted water that is used by plants through evapotranspiration processes, as well as water that is "lost" to soil evaporation or deep percolation into the groundwater aquifer. A portion of the total diverted amount returns to the stream through surface runoff or lagged groundwater return flows and therefore is not consumptively used.

Fort Collins, CO onion crop

Requirement (IWR), Water Supply Limited Consumptive Use (WSL CU), and the difference between these two numbers. CU modeling was executed using a recent decade of climate and water supply information. The objective was not to simulate what occurred over the past 10 years, but to estimate IWR and WSL CU for today's agricultural conditions and a plausible sample of climate and hydrology, exemplified by the recent decade. Future irrigation demand was examined by assuming that historical climate conditions will continue. The analysis assumed that agricultural demand is directly and linearly related to the number of acres irrigated.

In addition to the crop consumption described above, Colorado's agricultural demand includes three other types of CU that are associated with agricultural activity:

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

The Colorado Decision Support System (CDSS) program has developed processes for quantifying these uses in the context of developing basinwide water budgets, and water resources planning models. For this analysis, CDSS procedures were used to update the SWSI 1 estimates in those basins where a decision support system (DSS) has been implemented; where a DSS does not exist as in the Republican Basin, the CDSS procedures were generally applied if data were available to support the method. The following subsections provide an overview of the methodologies used to estimate current and future irrigated acres and agricultural water demands and the results. A detailed description of these methodologies and results is in Appendix I of the SWSI 2010 Report.

4.3.1.1 Current Irrigated Acres Methodology

The CDSS program has produced irrigated lands mapping and crop CU models in the Gunnison Basin. The maps are available as spatial databases, and include crop types, irrigation practices, and association with diversion structures or wells. The structure identifier associated with the irrigated land indicates the location of the headgate that serves the land. Irrigated acres are assigned to the water district where the diversion is located, which may not be where the irrigated acreage lies. Dates of the irrigated lands information varied with the basins including the number of years information as collected.

CDSS has not been implemented in the Republican Basins so information had to be gathered from other sources or developed within this project. Groundwater irrigated acreage for the Republican River Basin was obtained from the Republican River Compact Administration accounting spreadsheets for 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.

4.3.1.2 2050 Irrigated Acres Methodology

Using the most current irrigated acres for each basin as defined in the previous section as a baseline, estimates of 2050 irrigated acres were based on the following factors:

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

The first three factors (urbanization of existing irrigated lands, agricultural to municipal water transfers, and 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 qualitatively addressed 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 methodology is described in detail in Appendix I of the SWSI 2010 Report.

The M&I gap analysis (described in Section 5) was used as the basis for the analysis of irrigated acreage changes associated with agricultural to municipal water transfers. For each of Colorado's major river basins, 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 (see Section 5). Therefore, it does not take into account the projects or methods that may not be successful in meeting Colorado's future M&I demands; if IPPs are unsuccessful, it is likely that M&I water providers will turn to increased agricultural transfers to meet future demands. The following equation was used to estimate irrigated acres that would be needed for agricultural to municipal transfers to address M&I gaps:

Irrigated Acres Transferred = M&I Gap ÷ Transferrable Consumptive Use x (1 – Safety Factor)

A safety factor of 25 percent was applied to account for the additional amount of irrigated acres that may be needed to provide the transferred water on a firm yield basis.

CWCB interviewed entities within the South Platte, Rio Grande, and Republican River Basins to estimate what changes may occur in irrigated acres due to water management decisions affected by compact compliance or maintain 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. A detailed description of this qualitative assessment is available in Appendix I of the SWSI 2010 Report.

4.3.1.3 Current Agricultural Demand Methodology

Current irrigation demand for water in Colorado 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 WSL CU.

For this analysis, both average IWR and average WSL CU 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 Colorado is a dry state with over-appropriated streams.

Ranch in Fort Collins, CO

IWR estimation requires 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 in each basin, although the exact decade differed from basin to basin depending on available data. 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 show demand for "today's" agricultural conditions in Colorado, 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 is estimated by multiplying the number of cattle, sheep, and hogs located within a basin by their corresponding per capita use. Stockpond evaporation is based on net evaporation rates and stock pond surface area estimates. Details differ among the basins, but 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.

4.3.1.4 2050 Agricultural Demand Methodology

Following the techniques described in Section 4.3.1.2, 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.

Farm in Delta, CO

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.

4.3.2 Agricultural Demand Results

The following sections describe the results of the current and future agricultural demand analyses, which were performed based on the methodologies described above. These analyses included assessments of both irrigated acreage and associated agricultural consumptive water demands. Maps are included to identify the locations of existing irrigated lands across the state, as well as to show the range of irrigated acreage losses anticipated in each basin by 2050.

4.3.2.1 Current Irrigated Acres Results

Information developed for this effort was generated at the water district level. **Figure 4-5** shows the locations of Colorado's water districts and the spatial distribution of current irrigated acres in Colorado based on the methods presented previously. Note that spatial information was not available for the irrigated lands in the Republican River water districts.

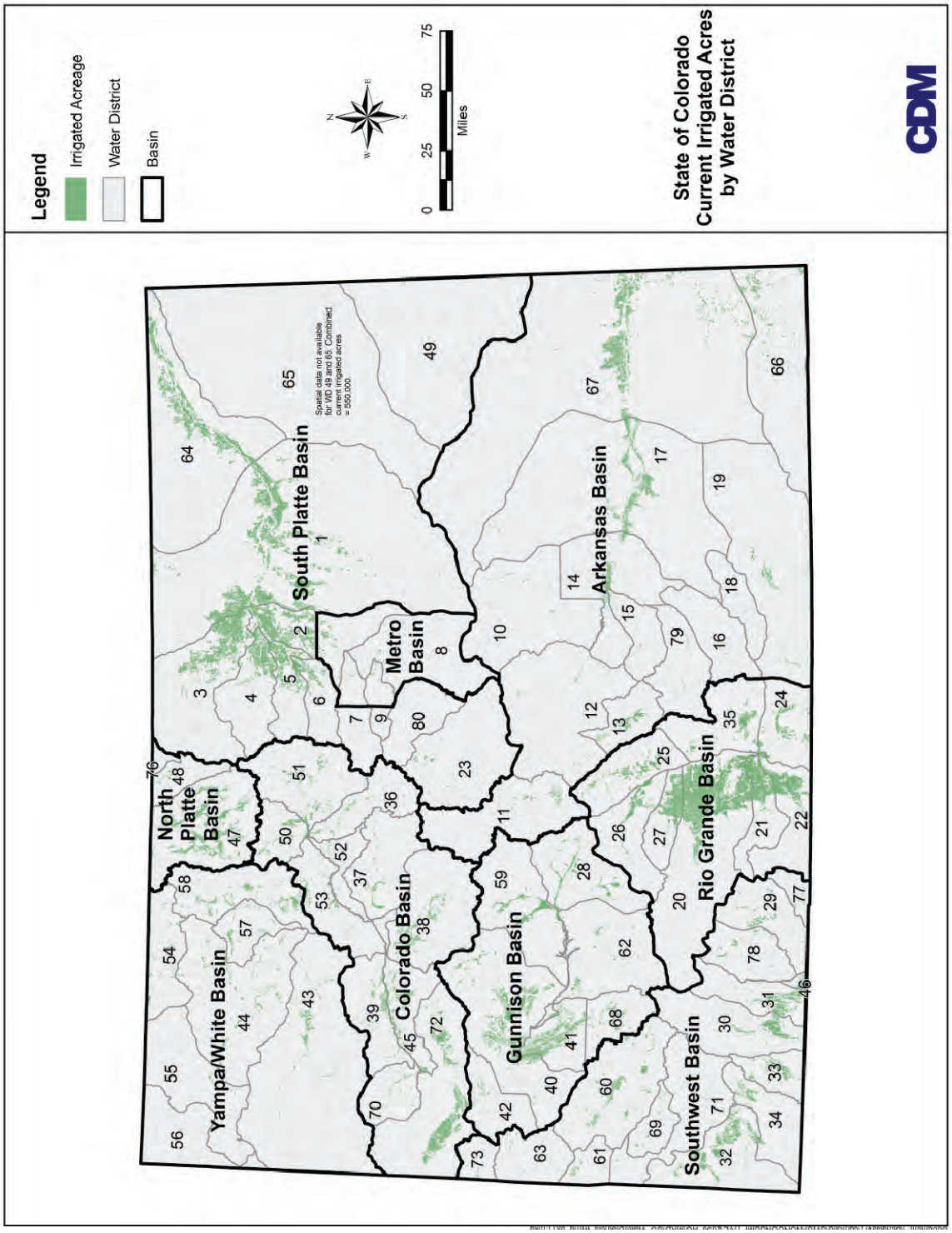


Figure 4-5 State of Colorado Current Irrigated Acres by Water District

Table 4-8 presents the number of irrigated acres in each river basin and the percentage of total that each basin represents. Colorado currently has 3,466,000 million acres of irrigated farmland across the state. The South Platte River Basin has the highest percentage of irrigated acres followed by the Rio Grande Basin and the Republican River Basin.

Table 4-8 Current Irrigated Acres by River Basin

Basin	Irrigated Acres	Percentage of Colorado's Irrigated Acres
Arkansas	428,000	12%
Colorado	268,000	8%
Gunnison	272,000	8%
North Platte	117,000	3%
Republican	550,000	16%
Rio Grande	622,000	18%
South Platte	**831,000**	**24%**
Southwest	259,000	7%
Yampa-White	119,000	3%
Statewide Total	**3,466,000**	**100%**

4.3.2.2 Future Irrigated Acres Results

Table 4-9 shows the results of future irrigated acres analysis. Future irrigated acres in Colorado may decrease by 115,000 to 155,000 acres due to urbanization alone, under low and high population growth scenarios, respectively. The basins with largest expected loss of irrigated acres due to urbanization are the South Platte, Colorado, and Gunnison Basins.

Table 4-9 also shows the potential loss of irrigated acres due to other reasons. The South Platte, Republican, and Rio Grande Basins are expected to lose irrigated acres due to a variety of factors, as follows:

- For the South Platte Basin, significant irrigated acres have been taken out of production in the last 5 years because a shortage of augmentation water 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 since the cost of acquiring augmentation water in the central South Platte River Basin is prohibitive for the agricultural community. This reduction in acreage is not reflected in the current irrigated acreage.

- 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 compact compliance reasons.

- In the Rio Grande Basin, the estimated decline in irrigated acres (80,000 acres) is related to the protection of the water table and senior water rights in the San Luis Valley through the establishment of Groundwater Management Subdistricts. This action would also assist Colorado in complying with the Rio Grande Compact by providing augmentation water to the Rio Grande and Conejos River to offset well depletions.

Table4-9 Future Irrigated Acres 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 from Planned Agricultural to Municipal Transfers	Decreases in Irrigated Acres from Agricultural to Municipal Transfers to Address M&I Gap		Estimated 2050 Irrigated Acres	
		Low	High			Low	High	Low	High
Arkansas	428,000	2,000	3,000	—	7,000	26,000	63,000	355,000	393,000
Colorado	268,000	40,000	58,000	—	200	11,000	19,000	190,800	216,800
Gunnison	272,000	20,000	26,000	—	—	1,000	2,000	244,000	251,000
North Platte	117,000	—	—	—	—	—	—	117,000	117,000
Republican	550,000	300	600	109,000	—	—	—	440,400	440,700
Rio Grande	622,000	800	1,000	80,000	—	2,000	3,000	538,000	539,200
South Platte	**831,000**	**47,000**	**58,000**	**14,000**	**19,000**	**100,000**	**176,000**	**564,000**	**651,000**
Southwest	259,000	4,000	6,000	—	—	3,000	7,000	246,000	252,000
Yampa-White	119,000	1,000	2,000	—	—	3,000	64,000	53,000	115,000
Statewide Total	**3,466,000**	**115,100**	**154,600**	**203,000**	**26,200**	**146,000**	**334,000**	**2,748,200**	**2,975,700**

Finally, Table 4-9 identifies approximately 26,000 acres that will be dried-up in the Arkansas, Colorado, and South Platte River Basins as a result of planned agricultural to municipal transfers. Additional transfers that may be required to meet M&I gaps are expected to decrease irrigated acreage from 160,000 acres to 334,000 acres statewide.

Overall, the future irrigation analysis shows that Colorado may lose about 500,000 to 700,000 acres of its irrigated lands by 2050 due to all factors combined. These acreages represent 15 to 20 percent of the current total irrigated lands. **Figure 4-6** shows the range of potential changes by basin. **Figure 4-7** shows the comparison between current irrigated acres and 2050 irrigated acres as both numbers of acres and percent change. Note that the basin with the highest percent change (Yampa-White, 34,000 acres, 29 percent) is not the same as the basin with the highest change in total acres (South Platte, 224,000 acres, 27 percent).

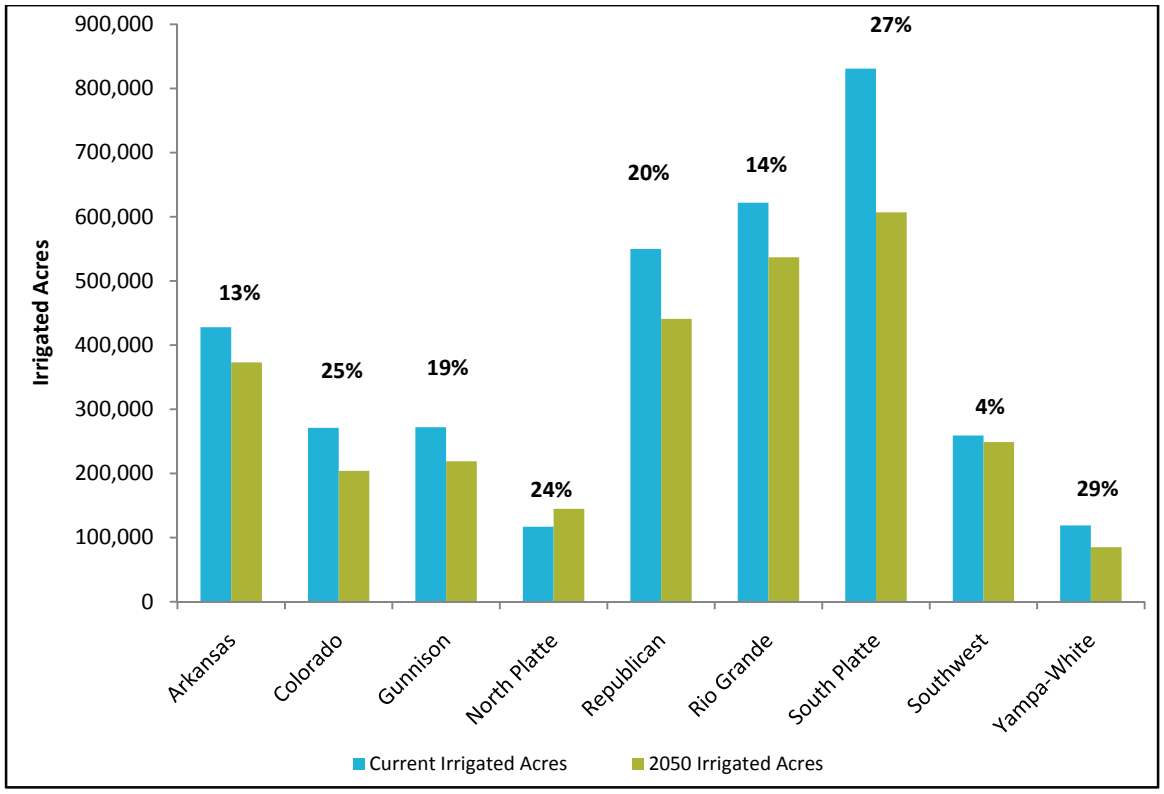


Figure 4-7 Comparison of Current and 2050 Irrigated Acres

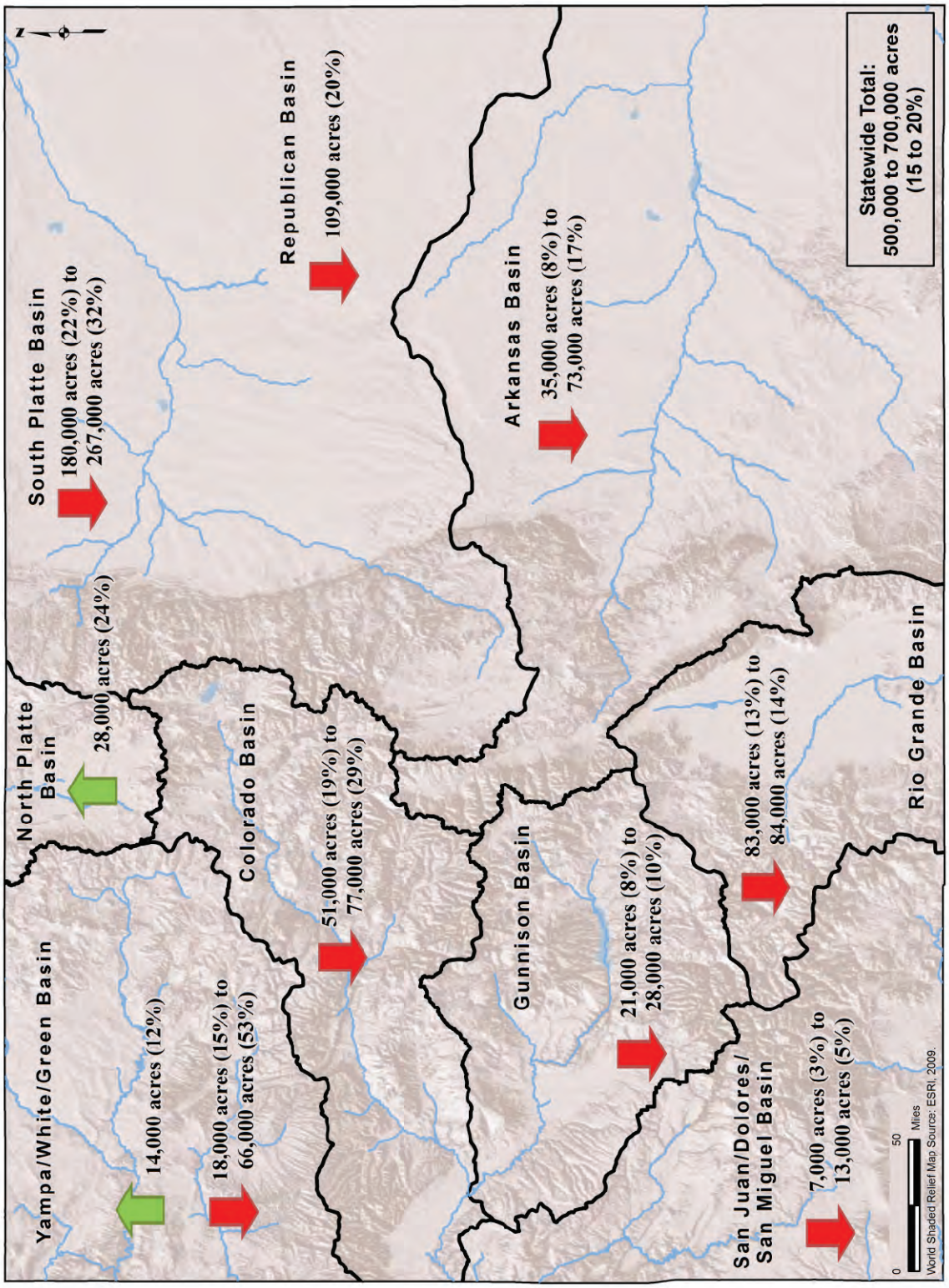


Figure 4-6 Potential Changes in Irrigated Acres by 2050

4.3.2.3 Current Agricultural Demand Results

Table 4-10 summarizes results of the average annual current agricultural demand by basin. It shows irrigated acres, IWR, WSL CU, and shortage (difference between IWR and WSL CU). Non-irrigation demand is also shown by basin. **Figures 4-8** and **4-9** show the current WSL CU and shortage amounts by basin. Basins with the highest agricultural water demand include the South Platte, Rio Grande, and Republican.

Table 4-10 Estimated Current Agricultural Demand by Basin

Basin	Irrigated Acres	Irrigation Water Requirement (AFY)	Water Supply-Limited Consumptive Use (AFY)	Shortage (AFY)	Non-Irrigation Demand (AFY)
Arkansas	428,000	995,000	542,000	453,000	56,000
Colorado	268,000	584,000	485,000	100,000	51,000
Gunnison	272,000	633,000	505,000	128,000	54,000
North Platte	117,000	202,000	113,000	89,000	12,000
Republican	550,000	802,000	602,000	200,000	67,000
Rio Grande	622,000	1,283,000	855,000	428,000	45,000
South Platte	**831,000**	**1,496,000**	**1,117,000**	**379,000**	**115,000**
Southwest	259,000	580,000	382,000	198,000	46,000
Yampa-White	119,000	235,000	181,000	54,000	24,000
Statewide Total	**3,466,000**	**6,819,000**	**4,791,000**	**2,028,000**	**470,000**

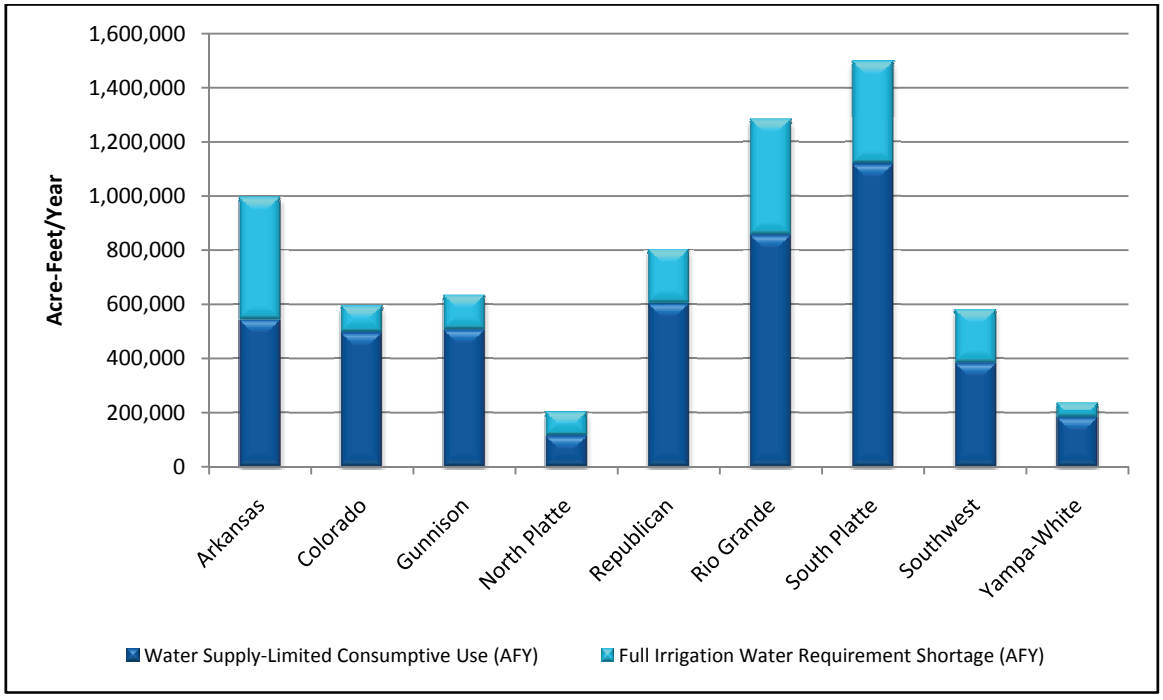


Figure 4-9 Current Agricultural Demands and Shortages

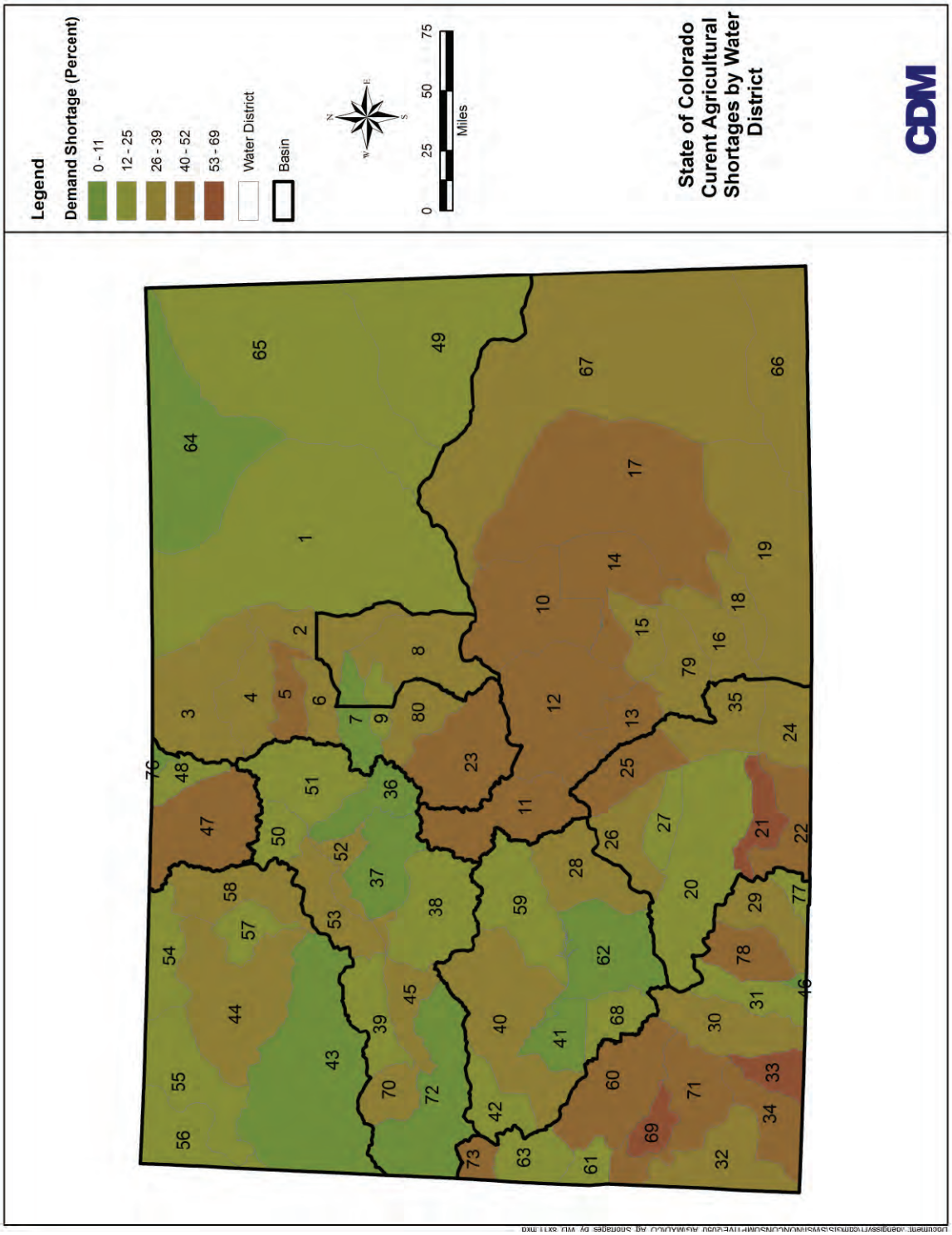


Figure 4-8 State of Colorado Current Agricultural Shortages by Water District

4.3.2.4 Future Agricultural Demand Results

Table 4-11 summarizes the estimated average annual agricultural demand by basin for the year 2050, assuming that historical climate and hydrology continues into the future. It shows irrigated acres, IWR, WSL CU, shortage, and non-irrigation demand. **Figure 4-10** shows the WSL CU and shortages by basin for the 2050 irrigated acres. Consistent with the projected decline in irrigated acres, declines in both irrigation and non-irrigation agricultural water demands are anticipated to occur in all basins except for the North Platte.

Table 4-11 Estimated 2050 Agricultural Demand by Basin

Basin	Irrigated Acres	Irrigation Water Requirement (AFY)	Water Supply-Limited Consumptive Use (AFY)	Shortage (AFY)	Non-Irrigation Demand (AFY)
Arkansas	373,000	862,000	476,000	386,000	49,000
Colorado	204,000	443,000	366,000	77,000	38,000
Gunnison	219,000	573,000	457,000	116,000	48,000
North Platte	145,000	250,000	140,000	110,000	14,000
Republican	441,000	640,000	480,000	160,000	5,000
Rio Grande	537,000	1,108,000	739,000	369,000	38,000
South Platte	**607,000**	**1,094,000**	**820,000**	**274,000**	**84,000**
Southwest	249,000	558,000	367,000	191,000	44,000
Yampa-White	85,000	209,000	170,000	39,000	17,000
Statewide Total	**2,860,000**	**5,737,000**	**4,015,000**	**1,722,000**	**337,000**

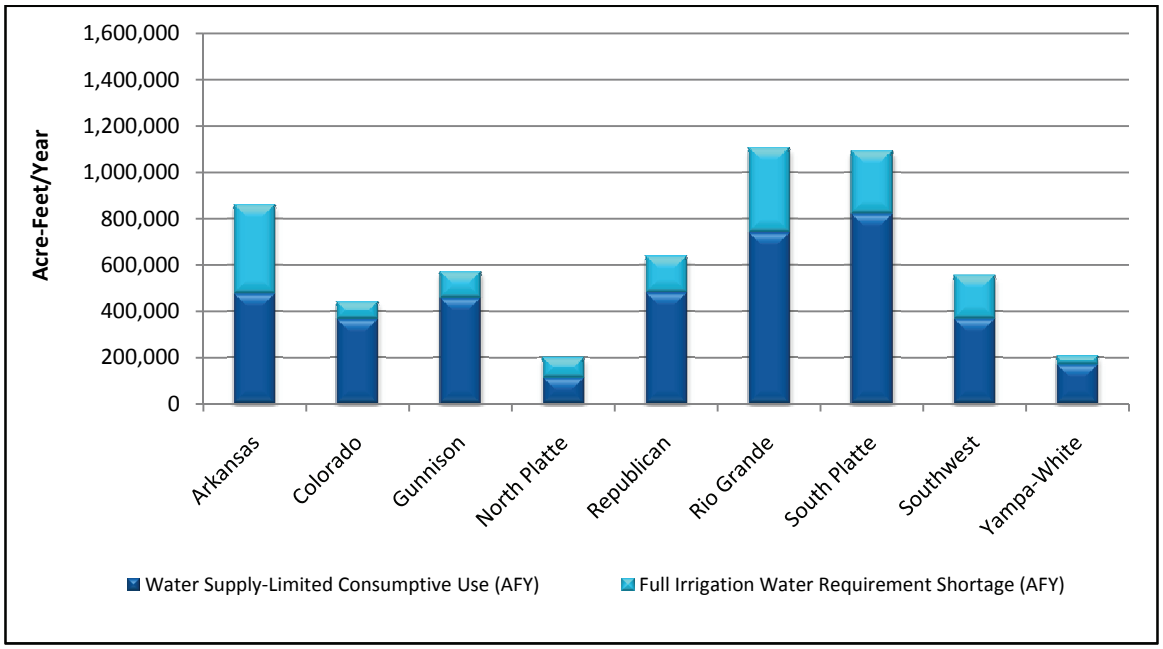


Figure 4-10 2050 Agricultural Demands and Shortages

Section 5
South Platte Basin Consumptive Projects and Methods and the M&I Gap

5.1 Projects and Methods to Address the M&I Gap Overview

Section 4 of this report summarizes the consumptive water needs across the State of Colorado and the South Platte Basin. As discussed in Section 1, the Colorado Water for the 21st Century Act requires the basin roundtables to identify projects and methods to meet their consumptive needs.

Section 5.2 summarizes the major projects and methods identified to meet future municipal and industrial (M&I) consumptive needs; Section 5.3 documents the resulting assessment of M&I gaps.

City of Fort Collins, CO

In order to identify M&I projects and methods, the Colorado Water Conservation Board (CWCB) worked with water providers and the basin roundtables to update the Statewide Water Supply Initiative (SWSI) 1 identified projects and processes (IPPs). This information was used to estimate a low, medium, and high 2050 M&I gap corresponding to the M&I demand projections summarized in Section 4 and different IPP success rates. To be clear, an M&I "gap" in the context of this study is not indicative of a future water supply shortfall; rather, it is a future water supply need for which a project or method to meet that need is not presently identified.

It is important for the reader to recognize that the analyses documented in this section are intended for the purpose of "big picture" statewide planning. While data and other information were collected from individual water providers, the results presented herein are for the purpose of general statewide and basinwide planning and are not intended to be used for individual provider planning, site-specific analysis, or project-specific purposes.

5.2 Projects and Methods to Meet M&I Consumptive Needs

Water providers throughout Colorado are pursuing water supply projects and planning processes to help meet future water demands. These IPPs, if successfully implemented, have the ability to meet some, but not all, of Colorado's 2050 M&I water needs. IPPs are defined as projects and methods local water providers are counting on to meet future water supply needs. Future M&I water supply needs that are not met by an IPP are considered an M&I water supply gap. The estimation of future M&I water supply gaps is dependent upon several factors, including current water use, forecasted future water use, and water provider predictions of new water supply that will be developed through IPPs.

Statewide, these analyses were performed on a countywide basis and aggregated by basin roundtable area. For the Front Range counties in the Arkansas, Metro, and South Platte Basins, the county results were aggregated to a regional subbasin level for presentation in this report and consistency with SWSI 1. The majority of population growth over the next 40 years is expected to occur in these basins.

5.2.1 Identified Projects and Processes Methodology

The first part of the M&I gap analysis is to calculate 2050 total new M&I water needs, which is described in Section 4. The second part of the 2050 M&I and SSI gap analysis is to calculate the anticipated yield from the water providers' 2050 IPPs, assuming 100 percent success rate. For counties with more than one surveyed water provider, all relevant information was compiled to create the most complete picture of projected water supplies in the county. This IPP yield is then subtracted from the 2050 net new water needs (i.e., demand increases above existing supplies) at the county level. Where the total water provider IPP yield in a county exceeded the projected county demand for the low, medium, or high scenarios, the extra water was assumed to not be available for redistribution to other counties unless otherwise noted.

Information on water providers' IPPs was obtained from the following sources:

- CWCB interviews and data collected from water providers throughout the state in 2009–2010
- Section 6 of the SWSI 1 report (published 2004, data based on projections to 2030)
- Basin roundtable updates (e.g., Arkansas 2008 report, June 2010 presentation by Applegate)

CWCB staff conducted outreach interviews in 2010 with most municipal water providers delivering 2,000 acre-feet per year (AFY) or more, including the top three water providers in each basin, where possible. Not every water provider responded; however, with significant basin roundtable assistance, many water providers submitted data in addition to the original list. This outreach was used to determine what projects and methods water providers are pursuing to meet their future needs along with confirmation of water demand data. In an effort to obtain more detailed data on providers' IPPs than was available for SWSI 1, interviewed entities were asked to delineate IPPs into the following categories:

- Agricultural water transfers
- Reuse of existing fully consumable supplies
- Growth into existing supplies
- Regional in-basin projects
- New transbasin projects
- Firming in-basin water rights
- Firming transbasin water rights

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 4. As requested by the Conservation Technical Advisory Committee and for the purposes of this analysis, active conservation is considered a strategy for meeting the M&I gap and is described in Section 7.

The categorized IPP data presented in this section is based on information provided by the interviewed water providers on what their firm treated water deliveries will be for each category of IPP. While some IPPs include features that could be applied across more than one category, CWCB relied upon the water providers' data to assign the various projects and methods to the single most appropriate category. For example, although not explicitly quantified herein, it is likely that the true yield anticipated from agricultural water 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 may also own agricultural water rights that are presently being leased back to agricultural water users; future M&I use of these supplies may be considered by some water providers to be growth into

existing supplies. Based on these efforts IPP data were updated for 75 providers covering approximately 80 percent of the population in Colorado. Many of the quantified IPPs specified by the interviewed M&I water providers are identified in Appendix J of the SWSI 2010 Report.

The interview summary provided by CWCB identified and quantified many of the water providers' IPPs associated with each category. Where IPP information was derived from other sources, professional judgment was used to assign predicted yield to the most appropriate category. This approach was primarily applied to IPP data from the SWSI 1 report, which tallied IPPs by county or subbasin, but generally did not categorize yields from specified types of IPPs.

Because of the need for flexibility, reliability, and future uncertainty, many water providers design projects to meet needs based on planning numbers, which are often greater than current per capita water usage rates. Some specific reasons include—1) ensuring water supply if another system fails, 2) planning for drought or climate change, 3) an expected increase in commercial water use, or 4) concerns that one or more planned projects will not be successfully implemented. Furthermore, many water rights limit the use of water to the specific water right holder, causing legal barriers to sharing water supplies. For these reasons, 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, a pro-rata share reduction was applied to each IPP category relevant to that county or subbasin. For example, total quantified IPPs for the interviewed providers in a particular county exceed 50,000 AFY, but IPPs required to meet 2050 net new water needs range from 18,000 AFY to 30,000 AFY. A percentage of the total 50,000 AFY yield from IPPs is associated with each of the seven categories of IPPs, but since less IPP yield is actually needed to meet demands, the same category distribution percentages were applied to the lesser need. In other words, the amount of yield from each IPP category is reduced such that only the amount actually necessary to meet 2050 new water needs is applied.

Because of the need for flexibility, reliability, and future uncertainty, many water providers design projects to meet needs based on planning numbers, which are often greater than current per capita water usage rates.

Note, however, that this methodology and data presentation 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 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 volume quantified for a particular county is assumed to not be available to meet water supply gaps in other counties, unless specified otherwise. Likewise, there was no intention of implying intra-county sharing among water providers, unless specifically noted. By proportionally scaling back each entity's 2050 IPP yields when the sum of all entities' IPPs in a particular county exceed the forecasted 2050 net new water needs for that county—and explicitly accounting for provider-specified gaps—it is CWCB's intention to avoid implying that any one provider's excess yield would be used to meet the shortfall (i.e., gap) of another water provider.

5.2.2 Estimation of 2050 IPP Yield by Basin

A broad range of water management solutions with varying levels of supply are planned for each of the basins. The following sections summarize the yields of IPPs statewide and for each county or region in each basin at the 100 percent success rate. As described above, due to the number of counties and distinct areas in the Arkansas, Metro, and South Platte Basins, those basins are summarized by region, whereas each of the other basins is discussed at a county level. Because of the overall volume of demand and the size of the projected gaps in the South Platte and Arkansas Basins, those basins' IPPs lists are more populated than the other basins' lists.

Many water providers are pursuing multiple projects and will need to pursue all of these identified projects to meet their increased demand by the year 2050. This is due to the reality that each of the IPPs has associated risk and may not yield all of the anticipated water supply. Alternate IPP yield success rates (i.e., less than 100 percent) are addressed subsequently in Section 5.3.2. The results of calculations based on the alternate IPP success rates are incorporated into the gap analysis presented in Section 5.3.3. Additionally, many of these IPPs will benefit multiple beneficiaries and therefore address a number of objectives concurrently. However, challenges exist in determining funding sources and acquiring water rights to support the multiple uses. In addition to quantified IPP yields, the tables for each basin also include a general summary of the major projects and other IPPs in each county or region. The consumptive projects and methods will be summarized in further detail in the Basin Needs Assessment reports during 2011.

5.2.2.1 Statewide

Statewide, the new water supplies needed for M&I and self-supplied industrial (SSI) use by the year 2050—above and beyond all existing supplies—are estimated to range from about 600,000 AFY to nearly 1 million AFY (see Section 4). This range reflects the uncertainty associated with forecasting water demands 40 years into the future, in particular SSI demands associated with energy development and other market-driven commodities. Based on extensive interviews with water providers, input from basin roundtable and Interbasin Compact Committee (IBCC) members, and a thorough review of other pertinent information, IPPs have been identified that will meet a significant portion of these future new demands.

Applying the general methodology for assessing IPPs described in Section 5.2.1, the IPPs were grouped into seven primary categories. **Table 5-1** identifies the anticipated range of yield from each category for each basin. For this and many of the subsequent tables, values are presented as a range, with the low and high yield values shown. Where the yield values do not change from low to high, a single value is shown rather than a range. Although the interviewed water providers generally provided demand and IPP data for a 2050 medium growth scenario, the ranges presented herein derive from the use of low, medium, and high population and demand levels for 2050 for the various analyses associated with SWSI 2010.

As shown in Table 5-1, quantified IPPs at 100 percent yield success would provide approximately 430,000 AFY, or about 72 percent of the new demands under the low growth scenario. At the high end, again assuming 100 percent success rate, IPPs would total about 580,000 AFY and represent approximately 58 percent of the high demand increase. The largest categories of IPP yields by volume are projected to be regional in-basin projects (150,000 AFY to 170,000 AFY) and growth into existing supplies (100,000 AFY to 160,000 AFY). **Figure 5-1** depicts the data graphically; for the individual basins that follow, the corresponding figures can be found in Appendix J.

Table 5-1 Major Categories of Identified Projects and Processes by Basin (Yields at 100% Success Rate) [1]

Basin	Agricultural Transfer (AFY)	Reuse (AFY)	Growth into Existing Supplies (AFY)	Regional In-Basin Project (AFY)	New Transbasin Project (AFY)	Firming In-Basin Water Rights (AFY)	Firming Transbasin Rights (AFY)	Total IPPs at 100% Success Rate (AFY)
Arkansas	9,200 – 11,000	23,000 – 32,000	2,300 – 2,600	37,000	0	6,100 – 7,300	10,000 – 11,000	88,000 – 100,000
Colorado	2,900 – 8,000	500	14,000 – 28,000	13,000 – 15,000	0	11,000 – 19,000	0	42,000 – 70,000
Gunnison	400 – 500	0	1,100 – 1,700	11,000 – 15,000	0	900	0	14,000 – 18,000
Metro	20,000 – 33,000	14,000 – 21,000	55,000 – 86,000	34,000 – 39,000	13,000 – 23,000	900 – 1,400	3,500 – 4,800	140,000 – 210,000
North Platte	0	0	100 – 300	0	0	0	0	100 – 300

Table 5-1 Major Categories of Identified Projects and Processes by Basin (Yields at 100% Success Rate) [1] (continued)

Basin	Agricultural Transfer (AFY)	Reuse (AFY)	Growth into Existing Supplies (AFY)	Regional In-Basin Project (AFY)	New Transbasin Project (AFY)	Firming In-Basin Water Rights (AFY)	Firming Transbasin Rights (AFY)	Total IPPs at 100% Success Rate (AFY)
Rio Grande	0	0	2,900 – 4,300	0	0	3,000 – 4,300	0	5,900 – 8,600
South Platte	**19,000 – 20,000**	**5,000 – 7,000**	**20,000 – 30,000**	**37,000 – 39,000**	**0**	**22,000 – 26,000**	**18,000 – 21,000**	**120,000 – 140,000**
Southwest	0	0	5,200 – 7,300	9,000 – 13,000	0	0	0	14,000 – 21,000
Yampa-White	0	0	3,500 – 4,900	6,600 – 9,000	0	0	0	10,000 – 14,000
Total	**51,000 – 73,000**	**43,000 – 61,000**	**100,000 – 160,000**	**150,000 – 170,000**	**13,000 – 23,000**	**44,000 – 58,000**	**32,000 – 37,000**	**430,000 – 580,000**

[1] Aggregated basin total values rounded to two significant digits to reflect increased uncertainty at larger geographic scales.

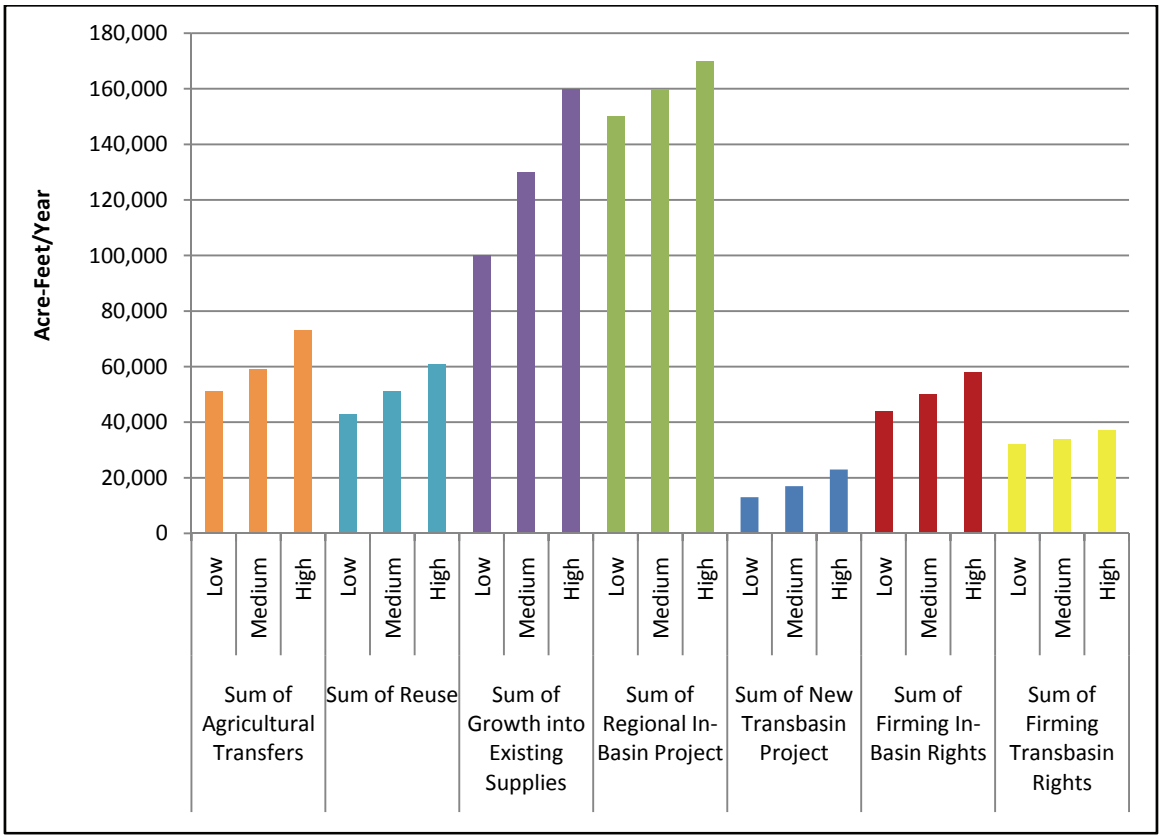


Figure 5-1 Statewide Summary of Yield for IPP Categories at 100% Success Rate

5.2.2.2 South Platte Basin

For the purpose of conducting the IPP and gap analysis updates, the counties of the South Platte Basin were aggregated to regional subbasins, as follows:

- 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)

The regions of the South Platte Basin are depicted in **Figure 5-2**.

Most of the interviewed M&I water providers indicated that they believe they will be able to meet 2050 needs using existing supplies, projects that are now underway, and future plans and projects. Most providers are pursuing enlargement of existing reservoirs and new storage, and consider those actions critical to meeting future needs.

Projects contributing to meeting the future needs of Northern South Platte M&I users include the Northern Integrated Supply Project (NISP) and the Windy Gap Firming Project (WGFP), both applied for by the Northern Colorado Water Conservancy District acting on behalf of numerous participating water providers and presently undergoing National Environmental Protection Act (NEPA) review. Yield from these projects was allocated to the counties in which the participants are located. Other major projects include the Halligan and Milton Seaman Reservoir enlargements proposed by the Cities of Fort Collins and Greeley, respectively. In recent CWCB interviews, the Cities of Longmont and Loveland indicated future yield from agricultural transfers via water rights dedication policies; the City of Greeley plans to pursue acquisition of Cache la Poudre Basin agricultural water rights. Other key Northern region projects include Erie's reclaimed water project; Longmont's Union Reservoir enlargement, and Union Pumpback Project; and a portion of the Chatfield Reallocation Project yield for entities in Weld County.

City of Loveland, CO

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. NISP represents a major new source of water for Morgan County (4,900 AFY). Based on SWSI 1 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 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.

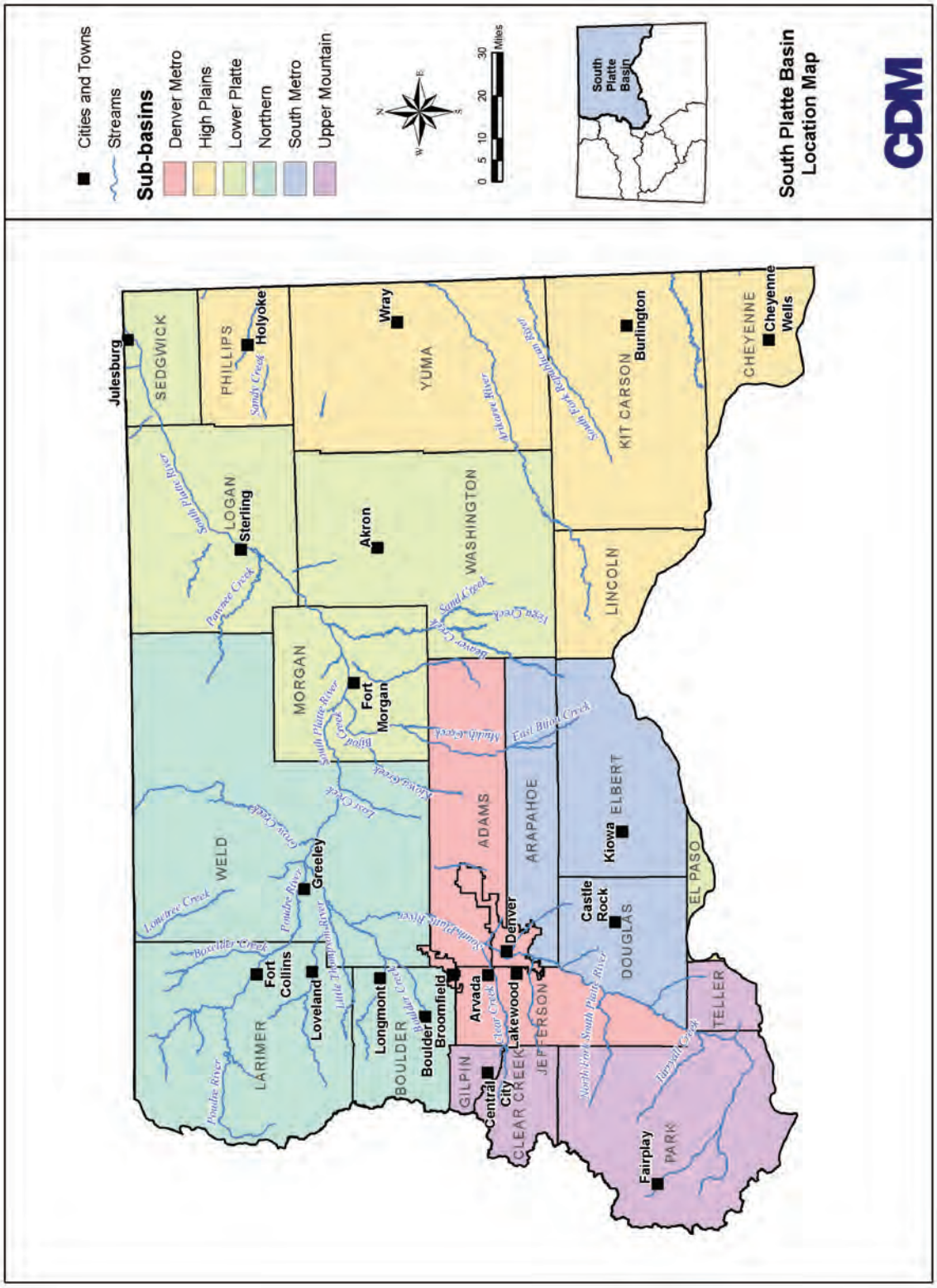


Figure 5-2 South Platte Basin Location Map

Jefferson County is in the process of regulating densities in certain mountain areas in order to prevent over-development of the limited groundwater resources. The Upper Mountain Counties Aquifer Sustainability Project, which was completed in early 2011, provides much greater detail on the current and future water needs of this region (the results of this study are summarized in Section 6.3.5). Despite these potential limitations, yield assumptions from SWSI 1 were followed for the present study, and IPPs for the Upper Mountain Counties region were set equal to 90 percent of 2050 net new M&I and SSI water needs. A small amount of the Chatfield Reallocation Project was assumed to be included in Park County's IPPs (42 AFY for Center of Colorado Water Conservancy District).

Anticipated yields from each category of IPPs at 100 percent success rate are summarized for the South Platte Basin in **Table 5-2.**

Table 5-2 South Platte Basin IPP Summary at 100% Success Rate

Region or County	Agricultural Transfer (AFY)	Reuse (AFY)	Growth into Existing Supplies (AFY)	Regional In-Basin Project (AFY)	New Transbasin Project (AFY)	Firming In-Basin Water Rights (AFY)	Firming Transbasin Rights (AFY)	Total IPPs at 100% Success Rate (AFY)
High Plains	0	0	1,400 – 3,400	0	0	0	0	1,400 – 3,400
High Plains IPP • Nontributary groundwater								
Lower Platte	0	0	2,400 – 5,000	4,900	0	2,300 – 5,100	0	9,600 – 15,000
Lower Platte IPPs • Growth into existing supplies • Augmentation plans • NISP								
Northern	18,900 – 20,500	5,400 – 7,300	14,200 – 17,600	31,900 – 34,500	0	17,000	18,400 – 21,300	105,800 – 118,200
Northern IPPs • Growth into existing supplies • Agricultural transfers • Reclaimed water projects • Union Reservoir enlargement • NISP • WGFP • Halligan Reservoir enlargement • Milton Seaman Reservoir enlargement • Chatfield Reallocation project								
Upper Mountain	0	0	2,500 – 3,700	40	0	2,500 – 3,700	0	5,000 – 7,500
Upper Mountain IPPs • Growth into existing supplies • Augmentation plans • Chatfield Reallocation Project								
Total[1]	**19,000 – 20,000**	**5,000 – 7,000**	**20,000 – 30,000**	**37,000 – 39,000**	**0**	**22,000 – 26,000**	**18,000 – 21,000**	**120,000 – 140,000**

[1] Aggregated basin total values rounded to two significant digits to reflect increased uncertainty at larger geographic scales.

5.3 M&I Gap Analysis

The IPPs being pursued by local water providers represent significant quantities of water and the implementation of these local projects and plans is critical to meeting Colorado's future water supply needs. However, even with the implementation of the IPPs, there are still remaining M&I and SSI consumptive water supply gaps that will need to be satisfied. As stated previously, the calculated gaps do not necessarily represent a future water supply shortage, but the gaps do demonstrate where additional work is needed to identify projects and methods to meet those future needs. The following sections summarize the calculations and results of the 2050 M&I and SSI gap analysis. As described previously, this analysis includes 2050 low, medium, and high gap values to account for the inherent uncertainty in long-range population, demand, and water supply forecasting. Future M&I and SSI demands were assessed in Section 4 of this report.

Section 5.3.1 presents the M&I and SSI gap calculation methodology generally, followed by details on the variations that occur within the calculations for each basin. The calculations as described in Section 5.3.1 are based on the assumption of 100 percent success rate for the development of IPP yield. Section 5.3.2 describes alternate (i.e., less than 100 percent) IPP yield success rates for each basin as they are applied to estimate the 2050 medium and high gaps. Section 5.3.3 summarizes the results of the gap analysis at the statewide level and for each of the nine basin roundtable areas.

The results of the gap analysis presented in this report are based on the estimated firm yield of IPPs. Furthermore, the demand values that are integral to the gap calculations are based on water providers' treated water deliveries and do not account for losses during raw water collection, treatment, and distribution, which are highly variable depending on, among other things, water source, types of treatment processes, and age and condition of distribution system. Additionally, there are many future uncertainties such as the potential for climate change, drought, infrastructure failure, and other factors. Therefore, raw water needs are very likely to be greater than the gap values presented in this report.

There are many future uncertainties such as the potential for climate change, drought, infrastructure failure, and other factors.

Note that current and future agricultural consumptive demands and shortages were assessed in Section 4 of this report. Calculated irrigation shortages are based on available water supply being less than the ideal amount required for meeting the CU requirements of a particular crop. Changes in these calculated results for 2050 relative to 2008 are generally driven by the anticipated loss of irrigated land to development and other factors. The discussions that follow apply only to the M&I and SSI consumptive gap analysis.

5.3.1 M&I Gap Analysis Methodology

For the purpose of this study, the M&I and SSI water supply gap is defined as follows:

M&I and SSI Water Supply Gap = 2050 Net New Water Needs – 2050 IPPs

where:

2050 Net New Water Needs = (2050 low/medium/high M&I baseline demands – high passive conservation - current M&I use) + (2050 low/medium/high SSI demands – current SSI use)

2050 IPPs = Water Provider Anticipated Yield from: Agricultural Transfers + Reuse + Growth into Exiting Supplies + Regional In-basin Projects + New Transbasin Projects + Firming In-basin Water Rights + Firming Transbasin Water Rights

If the available IPPs exceeded the 2050 water needs for a particular county, the IPPs were reset equal to the 2050 water needs. As stated previously herein, this calculation effectively scales back the yield of each IPP in a pro-rata fashion in order to present only the amount of yield necessary to meet water supply needs at the 2050 planning horizon. Sometimes this occurs for all three growth scenarios, sometimes for only low or low and medium. It is generally assumed that one county's surplus IPPs would not be reallocated to another county and that one provider's surplus would not be specifically allocated to meet another provider's gap. This approach was applied in all basins, unless specified otherwise.

The 2050 M&I and SSI gap is referred to in the results tables (see Section 5.3.3) as the "information/real" gap. The "real" gap is based on known numerical data from the *Demands to 2050 Report*, water provider interviews and data, SWSI 1, and other sources. Based on this information, 2050 M&I and SSI demand forecasts exceed the anticipated yields of water providers' IPPs and the result is a real, defined gap. An "information" gap arises due to a lack of numerical data to support more detailed gap quantification for some water providers or even counties and subbasins.

The preceding description represents the general approach to the M&I gap analyses, with the yields of IPPs based on the 100 percent success rate. However, the process was modified as necessary for each county and basin based on the available source data. The following sections outline variations to the methodology in each basin. These are general descriptions and do not necessarily capture every variation for every county; however, additional details about the calculations for each county or region are provided in Appendix J of the SWSI 2010 Report.

5.3.1.1 South Platte Basin

Following are the assumptions used to revise the South Platte Basin gap calculations:

- The 2050 net new water needs were calculated based on the Demands to 2050 Report as described for the general approach.
- IPPs for the various regions of the South Platte Basin were assessed as described in Section 5.2.2.2.
- Information/real gaps for the counties in the Northern region were calculated as 2050 net new water needs minus IPPs (low/medium/high); Boulder County appears to have no 2050 water supply gaps.
- Based on the calculation of IPPs, the effective information/real gaps for the outlying regions of the South Platte are as follows: Upper Mountain Counties (10 percent of 2050 net new M&I and SSI water needs); Lower South Platte (50 percent of 2050 net new M&I and SSI water needs); and High Plains (zero gap).

5.3.2 Gap Analysis with Alternate IPP Yield Scenarios

The assumptions and calculations described in Section 5.3.1 above evaluate the gap based on a 100 percent success rate for IPP yield development. To assess the full range of the 2050 M&I and SSI gap, CWCB developed three potential scenarios to bracket the range of the M&I and SSI gap for low to high scenarios. Each scenario has a variable IPP yield success rate applied as a percentage of total IPP yield. For the low gap scenario, it was assumed that 100 percent of the IPPs (see Section 5.2.1) could be applied to the 2050 net new water needs.

For the medium and high gap estimates, the yield of the IPPs was assumed to be varied based on discussions from the IBCC, CWCB, and basin roundtables. For the medium gap scenario, it was assumed that the IPP yield would be reduced based on percent success rates discussed by IBCC in their scenario discussions for the alternative portfolio (see Section 7). IPP yield for the high gap scenario is assumed to be reduced based on the percent success rates as defined in the status quo portfolio that has been discussed by the IBCC. The percentage success rates for IPP yields for the medium and high scenarios are presented in **Table 5-3**.

Table 5-3 IPP Success Rates for the Medium and High Gap Scenarios

Basin	IBCC Alternative Portfolio IPP Yield Success Rates	IBCC Status Quo Portfolio IPP Yield Success Rates
Arkansas	90%	75%
Colorado	90%	90%
Gunnison	90%	90%
Metro	60%	50%
North Platte	90%	90%
Rio Grande	90%	90%
South Platte	**60%**	**40%**
Southwest	75%	75%
Yampa-White	90%	90%

The gap calculations based on alternate IPP yield success rates are best demonstrated by example. The Colorado Basin has an existing (2008) demand of 68,000 AFY and a 2050 low growth demand of about 132,000 AFY, representing an increase of nearly 65,000 AFY. IPPs associated with the Colorado Basin low growth scenario are 42,000 AFY (at 100 percent implementation), leaving a 2050 supply gap of 22,000 AFY under the low gap scenario. The Colorado Basin has a 2050 medium growth demand of 150,000 AFY, representing an increase of 82,000 AFY over the existing demand. Medium growth IPPs total 54,000 AFY at 100 percent yield, but based on Table 5-11, only 90 percent (49,000 AFY) of the yield is assumed to be successfully developed under the medium gap scenario. The result is a gap of about 33,000 AFY in 2050. High growth scenario demands are approximately 180,000 AFY, which is an increase of about 110,000 AFY over the existing scenario. High growth IPPs total 70,000 AFY at 100 percent yield, but under the high gap scenario, again only 90 percent (63,000 AFY) success is achieved. Thus, the Colorado Basin high gap is about 48,000 AFY.

A similar process is utilized for the other basins. For the medium and high statewide analyses, the success rates in Table 5-3 are applied to each basin prior to calculating the overall gaps on an aggregate basis.

5.3.3 2050 M&I and SSI Gap Analysis Results

The water supply gaps resulting from the assumptions and calculations defined in Section 5.3.1 and Section 5.3.2 are summarized in the following sections, first statewide, then for each basin by subbasin (region) or county. The full set of gap results implies nine total gap scenarios based on low, medium, and high M&I demands and three IPP yield scenarios (100 percent success rate, an alternative success rate, and a status quo success rate). For the purpose of discussion, however, the results are reduced to three scenarios in the tables presented in the following sections. These three scenarios encapsulate the full range of anticipated M&I and SSI water supply gaps in 2050, from the lowest low gap scenario (lowest demands with 100 percent IPP success rate) to the highest high gap scenario (high demands with status quo IPP success rates).

5.3.3.1 Statewide

Colorado faces a significant M&I water supply gap in 2050. Under the low gap scenario (low demands and 100 percent IPP success rate), the statewide gap is 190,000 AFY. Under the medium gap scenario (medium demands and an alternative IPP success rate), the statewide gap is about 390,000 AFY. Under the high gap scenario (high demands and status quo IPP success rate), the statewide gap is about 630,000 AFY. By 2050, Colorado's M&I gap could be between 32 percent and 66 percent of new M&I demands.

Table 5-4 provides a summary of each basin's increased M&I and SSI demands relative to current conditions (defined for this study as 2008), the amount of that increase met by the IPPs, and the results of the gap calculations. In general, the low IPPs plus the low remaining M&I and SSI gap equal the low increase in M&I and SSI demand, with some minor variability due to rounding at the county or regional level. The same is true for the medium and high values. The Arkansas and Metro Basins are exceptions to this rule due to the inclusion of additional gap volumes associated with the replacement of existing nonrenewable groundwater sources.

Table 5-4 Statewide M&I and SSI Gaps in 2050[1]

Basin	Increase in M&I and SSI Demand (AFY)			Estimated Yield of Identified Projects and Processes (AFY)			Estimated Remaining M&I and SSI Gap after Identified Projects and Processes (AFY)		
				100% IPP Success Rate	Alternative IPP Success Rates	Status Quo IPP Success Rates	Gap at 100% IPP Success Rate	Gap at Alternative IPP Success Rates	Gap at Status Quo IPP Success Rates
	Low	Med	High	Low	Med	High	Low	Med	High
Arkansas[2]	110,000	140,000	170,000	88,000	85,000	76,000	36,000	64,000	110,000
Colorado	65,000	82,000	110,000	42,000	49,000	63,000	22,000	33,000	48,000
Gunnison	16,000	19,000	23,000	14,000	14,000	16,000	2,800	5,100	6,500
Metro[3]	180,000	210,000	280,000	140,000	97,000	100,000	63,000	130,000	190,000
North Platte	100	200	300	100	200	300	0	20	30
Rio Grande	7,700	9,900	13,000	5,900	6,400	7,700	1,800	3,600	5,100
South Platte	**160,000**	**180,000**	**230,000**	**120,000**	**78,000**	**58,000**	**36,000**	**110,000**	**170,000**
Southwest	20,000	25,000	31,000	14,000	13,000	15,000	5,100	12,000	16,000
Yampa-White	34,000	48,000	95,000	10,000	11,000	13,000	23,000	37,000	83,000
Total	**590,000**	**710,000**	**950,000**	**430,000**	**350,000**	**350,000**	**190,000**	**390,000**	**630,000**

[1] Aggregated basin total values rounded to two significant digits to reflect increased uncertainty at larger geographic scales.
[2] Arkansas gaps include additional 13,500 AFY for Urban Counties replacement of nonrenewable groundwater supplies.
[3] Metro gaps include additional 20,850 AFY for South Metro replacement of nonrenewable groundwater supplies.

Colorado faces immediate M&I water supply needs. **Figure 5-3** illustrates the timing of the statewide M&I and SSI gap for the medium gap scenario. The statewide existing supply is 1,161,000 AFY and is assumed to remain constant through 2050, except for the replacement of nontributary groundwater in Douglas and El Paso counties. Under the medium gap scenario Colorado's immediate M&I water supply needs are met with the successful implementation of the IPPs. The associated yield of the IPPs increases steadily from 2010 through 2020, then at a higher rate of growth through 2030. Under the medium gap scenario, the IPPs are fully implemented by 2030 and yield about 350,000 AFY. Without the successful implementation of additional IPPs, increases in demand after 2030 are assumed to be gap, leading to a 2050 M&I gap of approximately 390,000 AFY for the medium gap scenario.

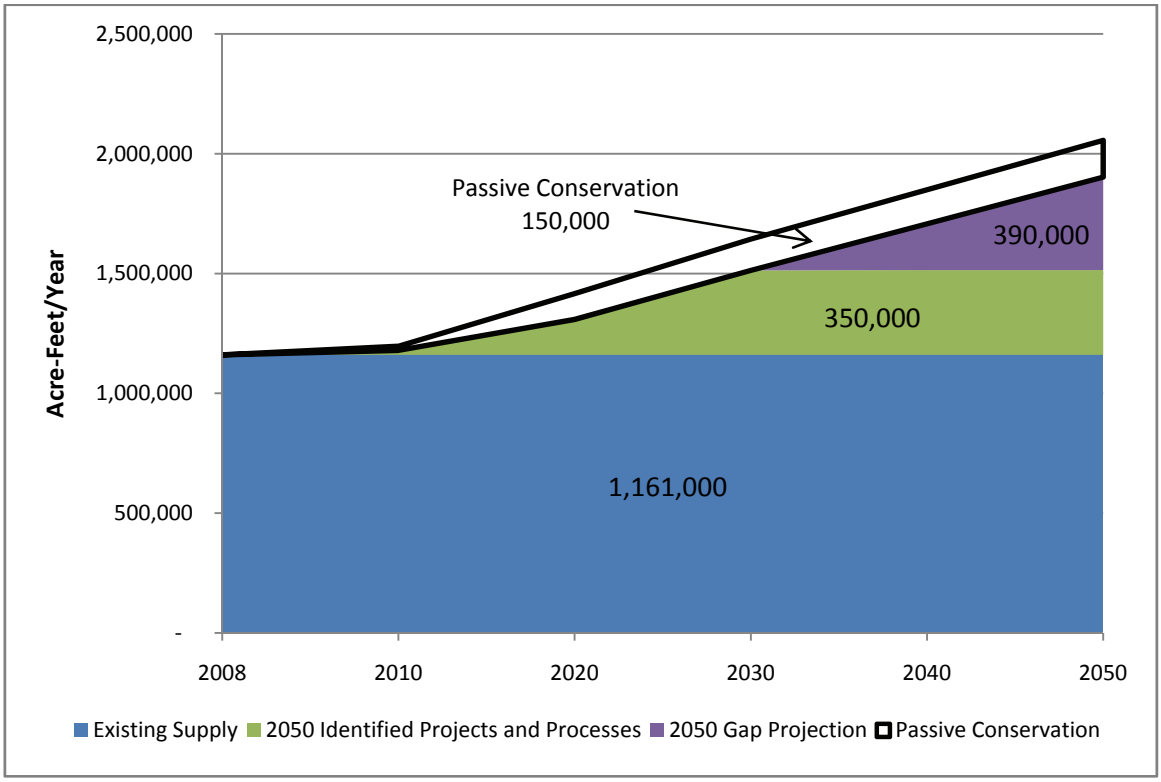


Figure 5-3 Statewide M&I and SSI Gap Summary Medium Scenario (IPPs at 70% Success Rate)

Note that while this plot does illustrate the temporal evolution of existing supplies, IPPs, and the gap, it is not intended to serve as a definitive timeline for the development of these parameters. A level of uncertainty remains for most components of this analysis; demand increases may come sooner or later than projected and IPPs may have more or less success than anticipated in these calculations. Thus, the figure functions as a representation of the interrelated nature of IPPs and the gap. At any given point in time, the sum of existing supplies, IPPs, and gap are equal to demands. The figure illustrates that the need for successful implementation of the IPPs is immediate. As long as the development of IPPs keeps pace with demands, the gap will be minimal. However, if demands continue to increase beyond the development of presently identified IPPs or if successful IPP yield development occurs at a lower rate, the gap will continue to grow in magnitude and will appear at an earlier point in time. It is also important to note the spatial variability of the M&I gap. Some areas of the state will have an M&I gap sooner than others. Plots illustrating the low and high gap scenario statewide and the low, medium, and high gap scenarios for all basins are included in Appendix J.

Figure 5-4 illustrates the relative percentages of 2050 net new water needs occupied by IPPs and the gap for each basin for the medium gap scenario. The pie chart shown on the map for each basin is scaled to represent the magnitude of the 2050 medium demand. IPP success rates are defined as shown for the "Alternative Portfolio" in Table 5-3; at the statewide level, the overall IPP success rate is approximately 70 percent for the medium gap scenario.

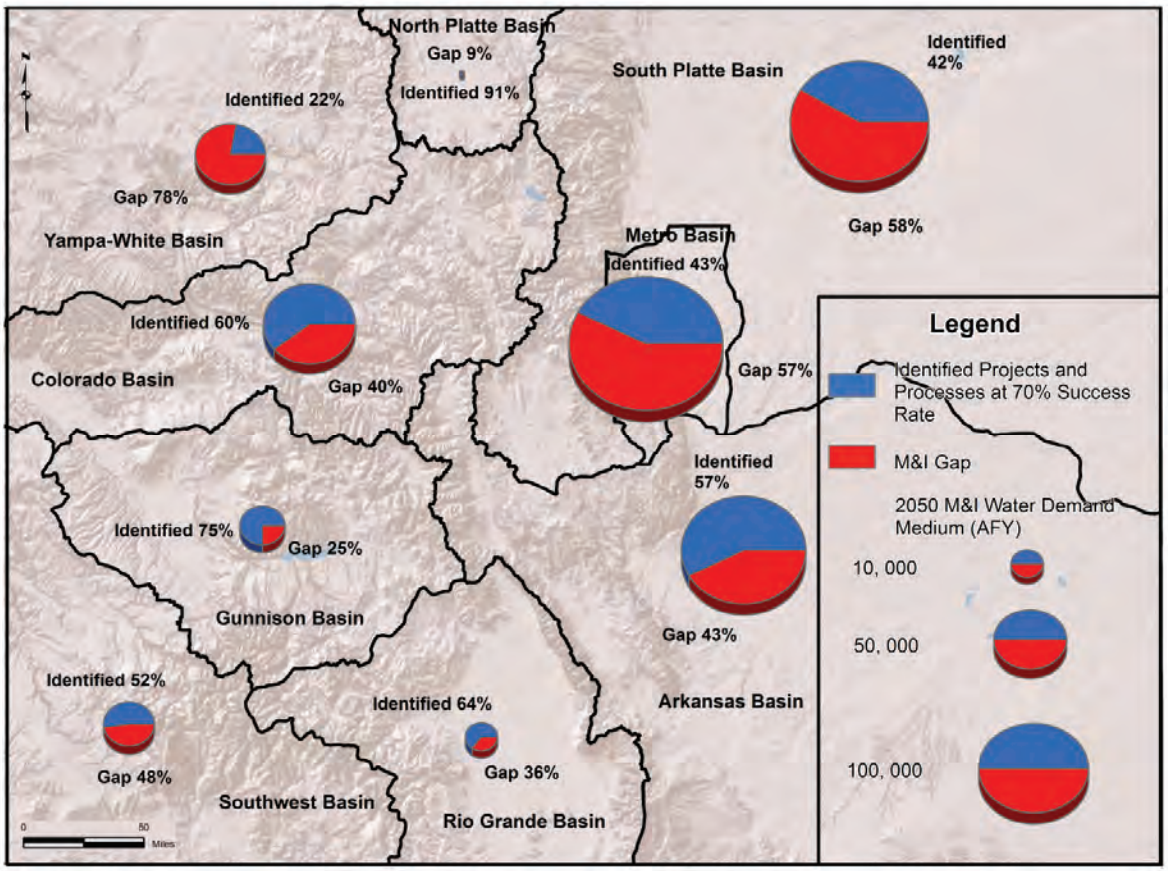


Figure 5-4 2050 M&I and SSI Gap Analysis – Medium Gap Scenario

For the Arkansas, Colorado, Gunnison, North Platte, and Rio Grande Basins, IPPs (illustrated as the blue part of the pie charts) meet 50 percent or more of the 2050 medium demand as a result of 90 percent IPP yield success rate in these basins. Southwest Basin IPPs also exceed 50 percent of 2050 medium demand despite a success rate of only 75 percent. The Yampa-White Basin has a 90 percent IPP yield success rate for the medium gap scenario, but the high yet uncertain demands associated with future SSI uses result in a very large water supply gap (78 percent, illustrated in red) in 2050. Future M&I and SSI water supply gaps for the South Platte and Metro Basins exceed 50 percent due to significantly reduced IPP yield success rates, at 60 percent. For these basins in particular, and also in the Arkansas Basin, a significant reduction in the success of yield development from planned projects and processes identified by Front Range water providers will likely lead to much greater increases in agricultural transfers as a means to meet future demands (see Section 4).

It must be clearly understood that the low, medium, and high gap scenarios evaluated in this study are based on assumptions about the implementation of IPPs made for the purposes of conducting the analyses. In reality, both demand growth and the development of IPPs will be impacted by various factors that will likely cause them to fall somewhere between the low and high values highlighted above. However, it remains highly probable that there will be some level of gap regardless of the level of IPPs development, and a portfolio of solutions will be needed to meet Colorado's future M&I water needs.

Of particular importance will be the implementation of new projects and sources of water in the event that not all IPPs currently undergoing NEPA review to receive permits for project construction from the jurisdictional federal agency (U.S. Bureau of Reclamation or U.S. Army Corps of Engineers for most ongoing Environmental Impact Statement projects). The list of these projects includes high-yield regional projects such as NISP, WGFP, Southern Delivery System, the Moffat Collection System Project, Chatfield Reallocation, and others.

The significance of the yield that would be provided by IPPs currently or soon to be engaged in the NEPA process—particularly in the South Platte, Metro, and Arkansas Basins—is illustrated in **Figures 5-5** and **5-6**. For the medium growth scenario and assuming 100 percent IPP success rate, South Platte Basin and Metro IPPs in NEPA represent 115,000 AFY of potential yield, or about 40 percent of the total IPP yield for the combined basins. Likewise, NEPA IPPs in the Arkansas Basin total nearly 49,000 AFY, or roughly 51 percent of overall IPP yield for the medium growth scenario. Note that in Figures 5-5 and 5-6 the new demand values also include the replacement of nonrenewable groundwater.

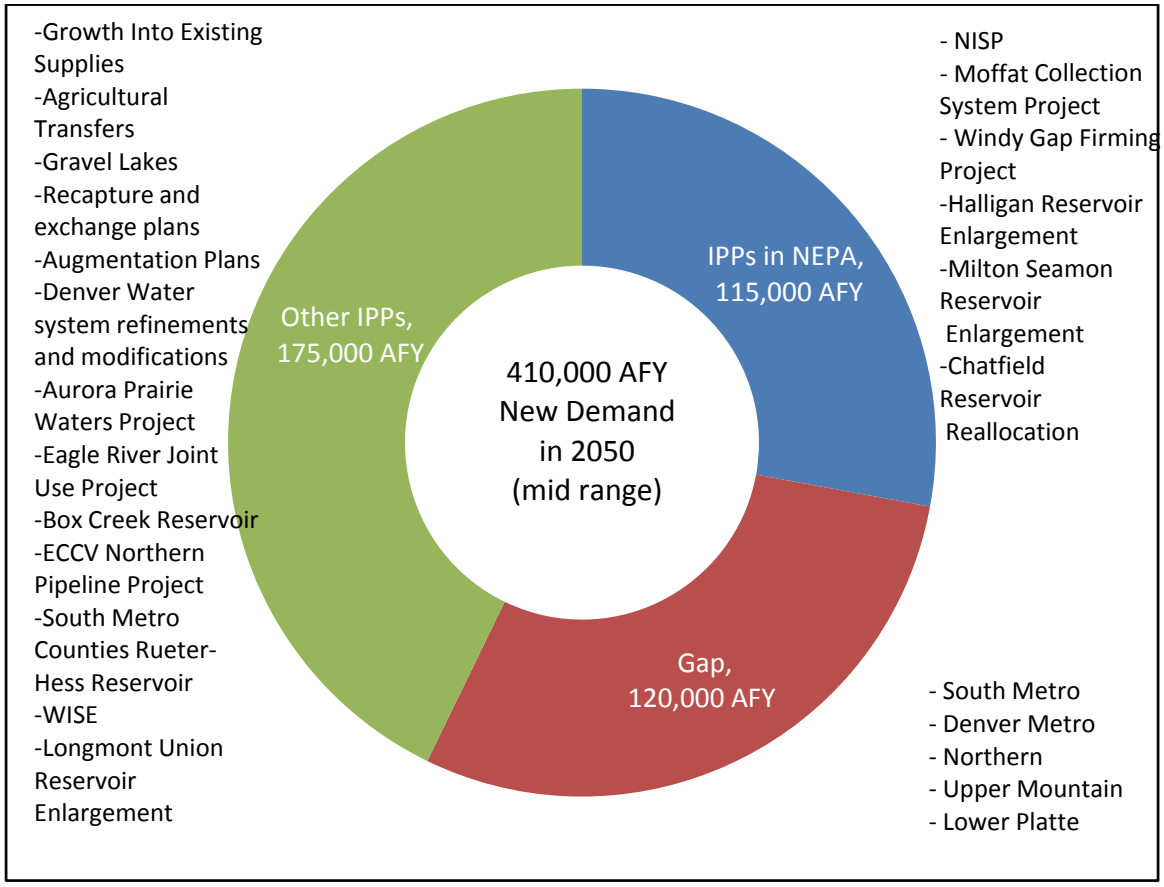


Figure 5-5 Potential Yield of NEPA Projects Relative to 2050 New Demands, Other IPPs, and Gap in South Platte and Metro Basins

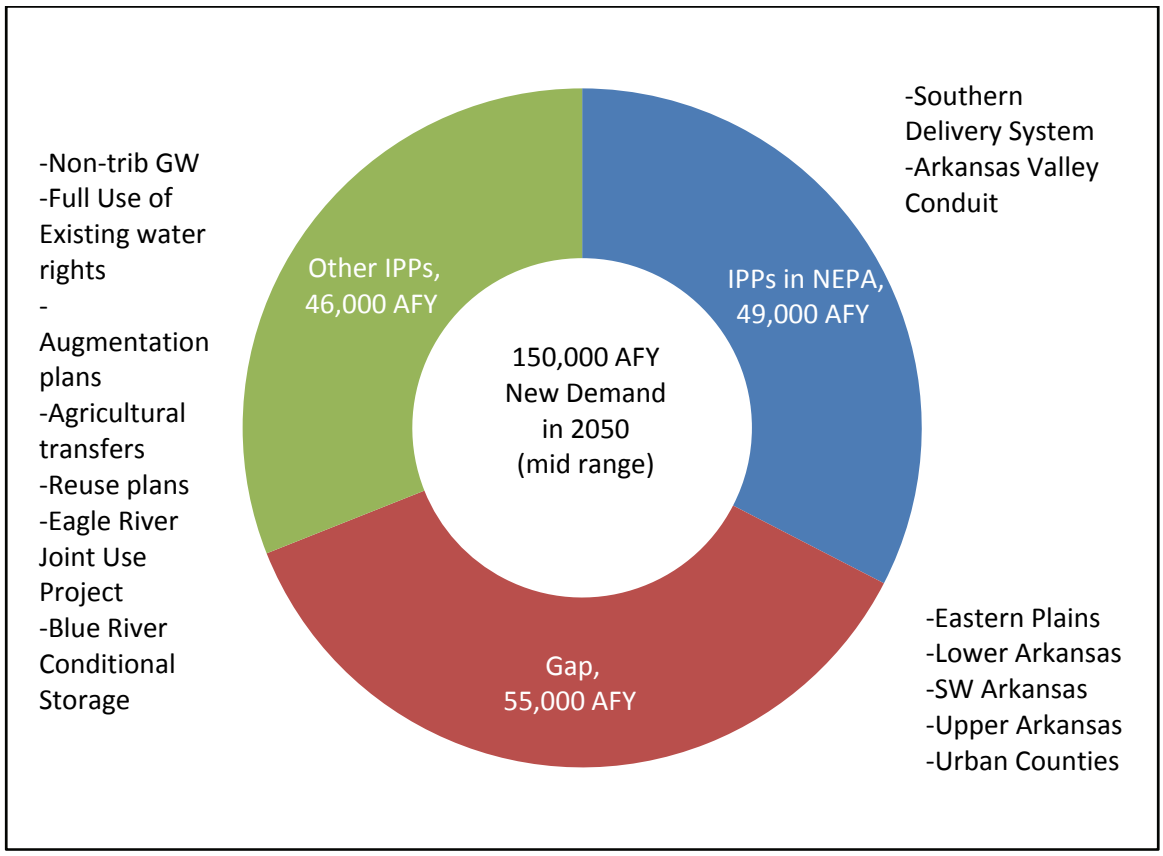


Figure 5-6. Potential Yield of NEPA Projects Relative to 2050 New Demands, Other IPPs, and Gap in Arkansas Basin

The following section provides additional results of the gap analysis for each basin roundtable area.

5.3.3.2 South Platte Basin

Table 5-5 summarizes the estimated 2050 increases in M&I and SSI demands, the amount of that increase met by the IPPs, and the estimates of the 2050 water supply gap for each region in the South Platte Basin. Figure 5-5 in Section 5.3.3.1 illustrates the importance of projects undergoing NEPA evaluation to the successful development of IPP yield in the basin. The existing supply, which remains constant through 2050 and across all gap scenarios, is estimated to be 234,000 AFY. Under the low gap scenario (100 percent IPP success), the gap is about 36,000 AFY by 2050. For the medium gap scenario (60 percent IPP success), maximum IPP development is 78,000 AFY and the corresponding gap is approximately 110,000 AFY by 2050. Under the South Platte high gap scenario, 58,000 AFY of IPPs are developed (based on a 40 percent success rate), resulting in a gap of 170,000 AFY in 2050. This information is also summarized in **Figures 5-7 through 5-9**. From a regional perspective, the largest gaps occur in the Northern region, consistent with the high levels of current and future demands and urbanization in Boulder, Larimer, and Weld Counties.

Table 5-5 South Platte Basin M&I and SSI Gaps in 2050

Region or County	Increase in M&I and SSI Demand (AFY)			Estimated Yield of Identified Projects and Processes (AFY)			Estimated Remaining M&I and SSI Gap after Identified Projects and Processes (AFY)		
				100% IPP Success Rate	Alternative IPP Success Rate (60%)	Status Quo IPP Success Rate (40%)	Gap at 100% IPP Success Rate	Gap at Alternative IPP Success Rate (60%)	Gap at Status Quo IPP Success Rate (40%)
	Low	Med	High	Low	Med	High	Low	Med	High
High Plains	1,400	2,300	3,400	1,400	1,400	1,400	0	900	2,100
Lower Platte	19,200	23,800	30,100	9,600	7,100	6,000	9,600	16,600	24,000
Northern	131,200	151,400	184,900	105,800	65,500	47,300	25,500	85,900	137,700
Upper Mountain	5,500	6,800	8,300	5,000	3,700	3,000	600	3,100	5,300
Total[1]	**160,000**	**180,000**	**230,000**	**120,000**	**78,000**	**58,000**	**36,000**	**110,000**	**170,000**

[1] Aggregated basin total values rounded to two significant digits to reflect increased uncertainty at larger geographic scales.

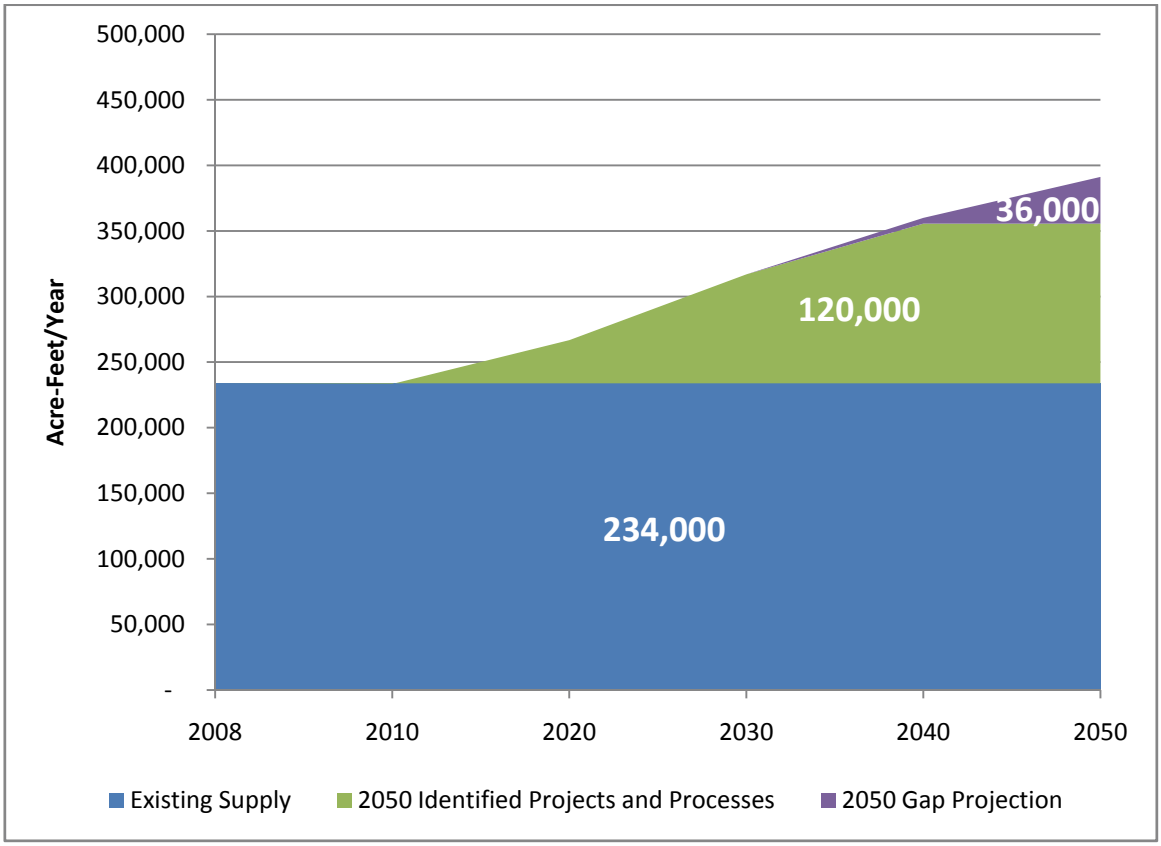


Figure 5-7 South Platte Basin M&I and SSI Gap Summary Low Scenario (IPPs at 100% Success Rate)

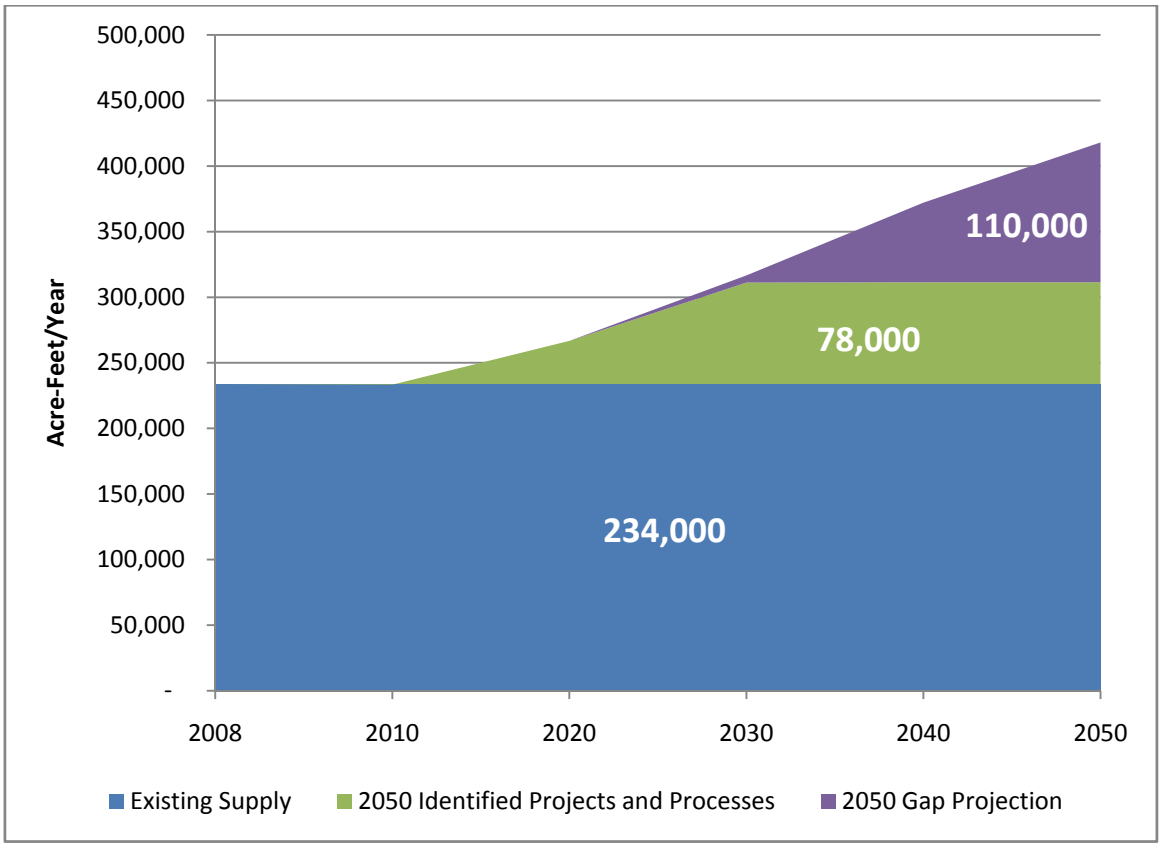


Figure 5-8. South Platte Basin M&I and SSI Gap Summary Medium Scenario (IPPs at 60% Success Rate)

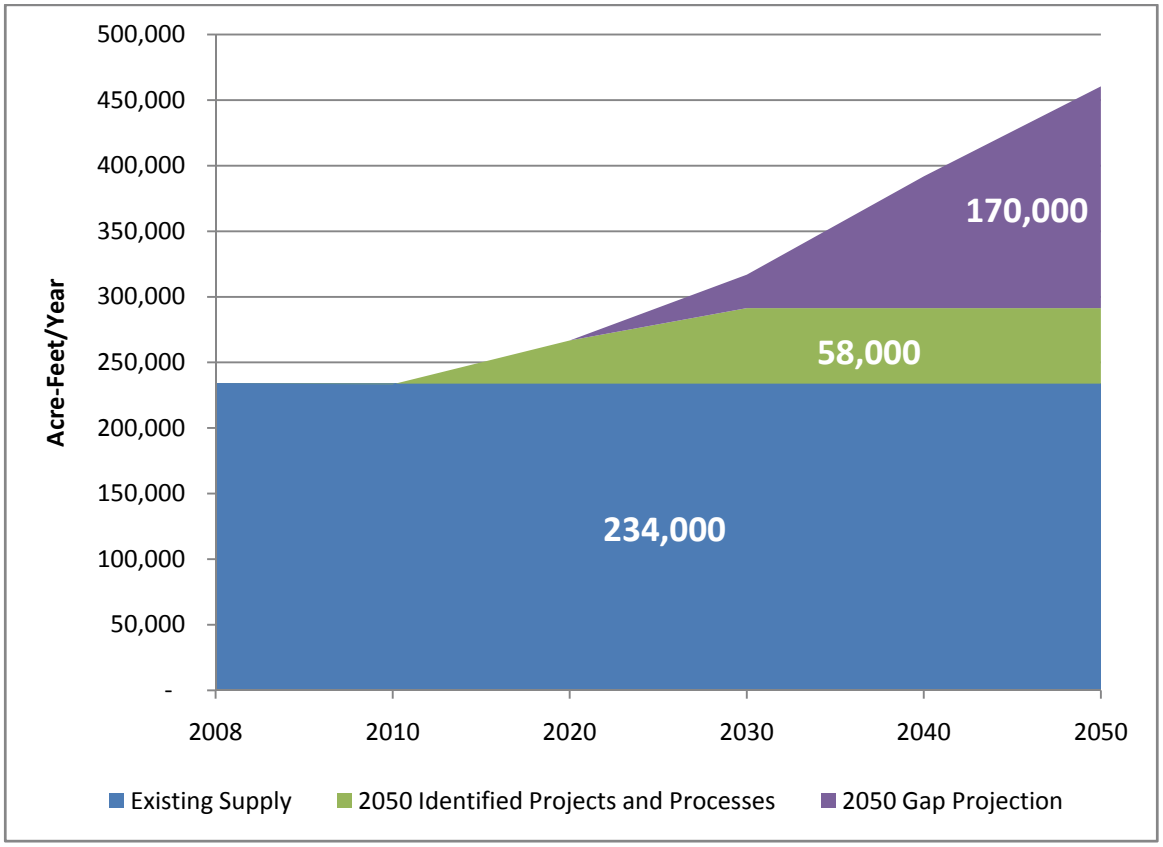


Figure 5-9. South Platte Basin M&I and SSI Gap Summary High Scenario (IPPs at 40% Success Rate)

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Section 6
South Platte Basin Water Availability

6.1 Water Availability Overview

Justice Gregory J. Hobbs of the Colorado Supreme Court has stated "The 21st Century is the era of limits made applicable to water decisionmaking. Due to natural western water scarcity, we are no longer developing a resource. Instead, we are learning how to share a developed resource." These words of wisdom should serve as guidance for all parties interested in Colorado water. The amount of water available for use within the state is finite.

Big Thompson River

The Statewide Water Supply Initiative (SWSI) 2010 analyzes Colorado's water availability based on recent work by the Colorado Water Conservation Board (CWCB) and the basin roundtables. SWSI 2010 finds that unappropriated water in the South Platte, Arkansas, and Rio Grande Basins is extremely limited, and reliance on nonrenewable, nontributary groundwater as a permanent water supply creates reliability and sustainability concerns, particularly along the Front Range. It also finds that Colorado River compact entitlements are not fully utilized and that water in the Colorado River system may be available to meet future needs. However, in order to develop new water supplies in the Colorado River system, projects and methods will be needed to manage the risks of additional development.

6.2 Methodology to Evaluate Surface Water Supply Availability

This section provides a summary of statewide surface water and groundwater availability. This update summarizes work to-date completed by the CWCB and the basin roundtables through the development of their basinwide water needs assessments. A comprehensive analysis of water availability for each basin was completed in SWSI 1 and is only partially updated. Future SWSI updates will provide updated water availability analysis in each basin based on additional Colorado Decision Support System (CDSS) modeling tools.

In addition to the analysis of water availability in SWSI 1, the SWSI 2010 update specifically includes an updated analysis for the basins within the Colorado River system as part of the CWCB's Colorado River Water Availability Study (CRWAS), which is summarized here. Updated information is also included for the South Platte Basin based on results of analysis directly associated with the South Platte Basin Roundtable Task Order.

In another effort related to water availability, statewide drought planning has occurred through the preparation and implementation of the Colorado Drought Mitigation and Response Plan (DMRP). In 2010, the CWCB conducted a comprehensive revision of the DMRP. The updated plan provides a blueprint for how the state will monitor, mitigate, and respond to drought.

The potential effects of climate change are quantified in the CRWAS, and provided at various locations throughout the Colorado River Basins. Reliable climate change analyses are not yet available for the other basins and are not included in this update.

6.3 Statewide Water Availability Summary

The purpose of this section is to summarize the available data and studies indicating the level of water availability in each basin and the location of opportunities for further new water supply development.

Table 6-1 summarizes the findings from SWSI 1 related to water supply development potential under interstate compacts and U.S. Supreme Court decrees. Colorado has entered into and is affected by nine interstate compacts, two equitable apportionment decrees, and one international treaty.

Table 6-1 Major Interstate Compacts, Decrees, and Endangered Species Programs by Basin

River Basin	Flows Legally Available under Compact or Decrees for Future Development	Interstate Compacts, Equitable Apportionment Decrees and Endangered Species Recovery Programs	Year of Compact or Decree
Arkansas		Arkansas River Compact	1948
		Kansas vs. Colorado	1995
Colorado	✓	Colorado River Compact	1922
		Upper Colorado River Basin Compact	1948
		Upper Colorado River Endangered Fish Recovery Program	—
		Rio Grande, Colorado, and Tijuana Treaty between United States and Mexico	1945
Dolores/San Juan/ San Miguel (Southwest)	✓	Colorado River Compact	1922
		La Plata River Compact	1922
		Upper Colorado River Basin Compact	1948
		Animas-La Plata Project Compact	1969
		San Juan River Basin Recovery Implementation Program	—
		Rio Grande, Colorado, and Tijuana Treaty between United States and Mexico	1945
Gunnison	✓	Colorado River Compact	1922
		Aspinall Unit Operations	—
		Upper Colorado River Basin Compact	1948
		Upper Colorado River Endangered Fish Recovery Program	—
		Rio Grande, Colorado, and Tijuana Treaty between United States and Mexico	1945

Table 6-1 Major Interstate Compacts, Decrees, and Endangered Species Programs by Basin (continued)

River Basin	Flows Legally Available under Compact or Decrees for Future Development	Interstate Compacts, Equitable Apportionment Decrees and Endangered Species Recovery Programs	Year of Compact or Decree
North Platte/ Laramie	✓	Nebraska vs. Wyoming	1945
		Wyoming vs. Colorado	1957
		Platte River Recovery Implementation Program	—
Rio Grande		Rio Grande River Compact	1938
		Costilla Creek Compact (amended)	1963
		Rio Grande, Colorado, and Tijuana Treaty between United States and Mexico	1945
South Platte	✓	South Platte River Compact	1923
		Republican River Compact	1942
		Platte River Recovery Implementation Program	—
Yampa/White/Green	✓	Colorado River Compact	1922
		Upper Colorado River Basin Compact and Yampa River Portion	1948
		Upper Colorado River Endangered Fish Recovery Program	—
		Rio Grande, Colorado, and Tijuana Treaty between United States and Mexico	1945

These agreements establish how water is apportioned between Colorado and downstream states as well as between the United States and Mexico. Each agreement has a significant effect on the development of future water supplies in Colorado. Additional information about the compacts is provided in Section 1.4.

SWSI 1 found there are no reliable additional water supplies that can be developed in the Arkansas and Rio Grande Basins, except in very wet years. The North Platte Basin has the ability to increase both irrigated acres and some additional consumptive uses, consistent with the North Platte Decrees. The South Platte Basin has water that is legally and physically available for development in wet years, although unappropriated water is extremely limited.

Compact entitlements in the Colorado River Basins are not fully utilized and those basins (Colorado, Gunnison, Southwest, and Yampa-White) have water supplies that are legally and physically available for development given current patterns of water use.

6.4 South Platte Basin Water Availability

Part Two of the South Platte Basin Roundtable Consumptive Needs Assessment identified and investigated the following key areas related to water availability:

- Develop projections of competing water supply (Section 6.4.1)
- Identify any unappropriated water (Section 6.4.2)
- Describe current versus historic river administration (Section 6.4.3)
- Quantify and project consumable effluent reuse (Section 6.4.4)

These issues are described in detail in the following sections. In addition, the Upper Mountain Counties Aquifer Sustainability Project, completed in early 2011, supplements SWSI 2010 and prior work completed by the South Platte Basin Roundtable by providing a region-specific look at the unique water supply and

demand characteristics of Clear Creek County, Gilpin County, the mountainous western part of Jefferson County, and the part of Park County that is within the South Platte Basin. A summary of this study is provided in Section 6.4.5.

6.4.1 Competing Water Supply Projections

One of the concerns expressed by several members of both basin roundtables was that many water providers are looking to the same agricultural water sources for future supplies, such as units in the Colorado-Big Thompson Project (CBT) and agricultural water rights in the South Platte Basin **downstream** of Denver. There is particular concern by the South Platte Basin Roundtable that the Metro Basin will increasingly look to agricultural water rights in the South Platte Basin, given the projections of significant growth and limited available supplies and agricultural water rights in the Metro Basin. Alternatively, the Metro Basin believes it has little choice but to turn to agricultural sources of water, given the lack of support for importing water from other areas of the state, and having aggressively pursued water conservation, reuse of available effluent, and use of local sources.

6.4.1.1 Colorado-Big Thompson Project

Originally intended primarily as a supplemental agricultural water supply, CBT water is now utilized by numerous drinking water providers within the Northern Colorado Water Conservancy District (NCWCD) in the South Platte Basin as a primary source of existing and future raw water supply. Use of this water is limited to the NCWCD boundaries located entirely within the South Platte Basin Roundtable. The continued acquisition of these units by municipal and industrial (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 CBT units potentially available for purchase from individual allottees owning Class D units. **Figure 6-1** shows the current ownership of the 310,000 units of CBT water. Class B units represent those units that are owned by M&I users. Class C units are owned by mutual irrigation companies and related organizations for the benefits of all of their shareholders, such as the North Poudre Irrigation Company (NPIC). Class D units are owned by individuals.

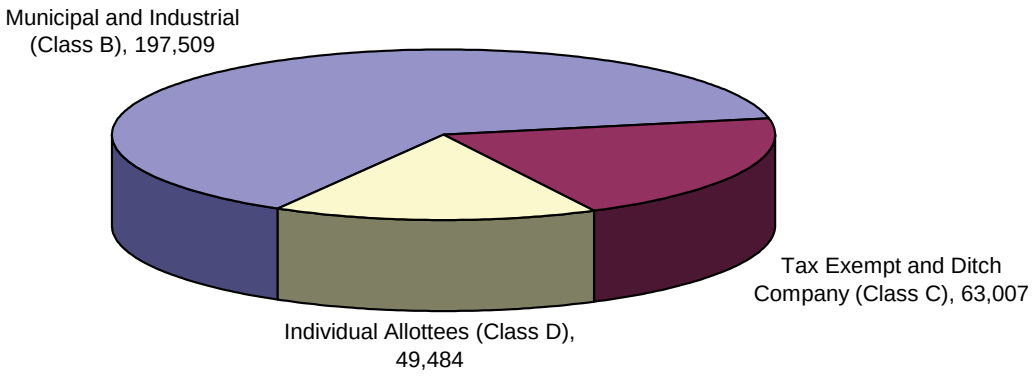

Figure 6-1 Current Ownership of CBT Water Units

The NPIC owns 40,000 CBT units in addition to Poudre River water rights. The majority of shares in the NPIC are owned by water providers including the City of Fort Collins and the Tri-Districts. 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 CBT units as they develop north into the NPIC service

area. This effectively removes the 40,000 NPIC CBT units from a pool of potential units available for acquisition by other water providers.

Many of the water providers that own units are capped at their present level of CBT ownership by rules established by the NCWCD Board and cannot directly acquire additional units. However, in most cases, they can acquire additional CBT 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 ability to continue to acquire significant numbers of CBT units through annexations or developers given the limited availability of units. Over 60 percent of CBT water is currently directly owned by municipal, industrial, and domestic users, including:

- Boulder
- Broomfield
- Central Weld County Water District
- Erie
- Greeley
- Fort Collins
- Fort Lupton
- Fort Morgan
- Loveland
- Longmont
- Tri-Districts (Fort Collins Loveland, North Weld County and East Larimer County Water Districts)
- Xcel Energy

6.4.1.2 Agricultural Water Rights Transfers

M&I providers in the South Platte and Metro Basins have historically met their demand and will continue to pursue the acquisition and transfer of agricultural water rights. This can include direct acquisition and transfer of agricultural water rights or employing alternative agriculture transfer techniques such as rotational fallowing programs or interruptible supply agreements (see Section 7). Historically, M&I agricultural water rights acquisitions have resulted in traditional agricultural transfers resulting in dry-up of irrigated land rather than any rotational crop management or fallowing programs that rotate the dry-up of irrigated lands.

There is less 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 Metro and South Platte M&I providers are actively negotiating with owners of irrigation water rights along the South Platte in Water Districts 1, 2, and 64 and many of its tributaries for the purchase of agricultural water rights. This places water providers in the Metro Basin 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 CBT return flows by agricultural users in Water Districts 1 and 64. These CBT return flows can only be used within the boundaries of the NCWCD.

Many of these negotiations are not public and are subject to confidentiality agreements until the acquisitions are concluded. Thus, it is not possible to verify the competition for the same sources. However, it is likely that the more senior irrigation rights are being sought by more than one entity. The authors of this report have heard mention of numerous pipelines being considered to pump back to the Metro area consumptive use water from converted irrigation water rights from the Brighton to Sterling reach of the South Platte River in Water Districts 1, 2, and 64 as well as some of the tributaries. In addition to the costs of purchasing and transferring the water rights, 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 the M&I providers. Some basic data about the location and type of irrigated land within the basins is shown below.

6.4.1.3 Major Water Supply Projects Involved in Permitting

Many water providers in the South Platte Basin are relying on the Northern Integrated Supply Project (NISP), the Windy Gap Firming Project, and the Halligan and Seaman Reservoirs Water Supply Project to meet a portion of their water demands through 2050. These projects, which are currently all in the National Environmental Protection Act (NEPA) federal permitting process, would provide over 90,000 acre-feet per year (AFY) of firm yield. If these projects are not permitted or constructed, it will significantly increase the competition for agricultural water rights in the South Platte Basin. The NISP draft Environmental Impact Statement has estimated that the "No Action" Alternative for the water providers in that project would result in the dry-up of approximately 70,000 acres of irrigated land as providers acquire and transfer agricultural water rights to replace the anticipated yield from this project.

Many water providers in the South Platte Basin are relying on the Northern Integrated Supply Project, the Windy Gap Firming Project, and the Halligan and Seaman Reservoirs Water Supply Project to meet a portion of their water demands through 2050.

6.4.1.4 Development of Conditional Water Rights Aim at the Same Available Water

There are many existing decrees for conditional water rights that have not yet been developed. The South Platte Basin Roundtable was concerned that the owners of these conditional rights might be aiming at much of the same water supply to provide for these projects. That is part of the reason we requested an analysis of the available unappropriated water. Since existing conditional decrees are generally excluded from the legal analysis of water availability, we thought it would be appropriate to consider the factual reality that many proposed projects may be going after much of the same physical water supply. In light of the data presented below about the small amount of undeveloped water left in the South Platte Basin, it seems apparent that there is not sufficient water available to develop all of the conditional water rights, and that the development potential for native South Platte water to meet future consumptive needs is quite limited.

6.4.2 Identification of Unappropriated Water

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

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

6.4.2.1 Historical Hydrology – Precipitation and Runoff Patterns

River flows in the basins in the 2000s have shown a return to normal precipitation and runoff patterns after 3 decades of above-average flows. **Figures 6-2 through 6-4** show the flows by decade at the Henderson, Kersey, and Julesburg gages, respectively, and their period of record (POR) averages. At all three gages, flows during the decades of the 1970s through the 1990s are above average. Since 2000, flows are below average. It is notable that as one moves downstream from Henderson to Kersey and to Julesburg, the 2000 flows fall further and further below the average. 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;
- Demands from large numbers of junior recharge rights that have been appropriated and/or used more heavily in the 2000s; and
- Reduced return flows from upstream due to reuse of treated effluent, reuse of lawn irrigation return flows from reusable sources, and watering restrictions and water conservation efforts that reduce M&I return flows, especially outdoor use return flows.

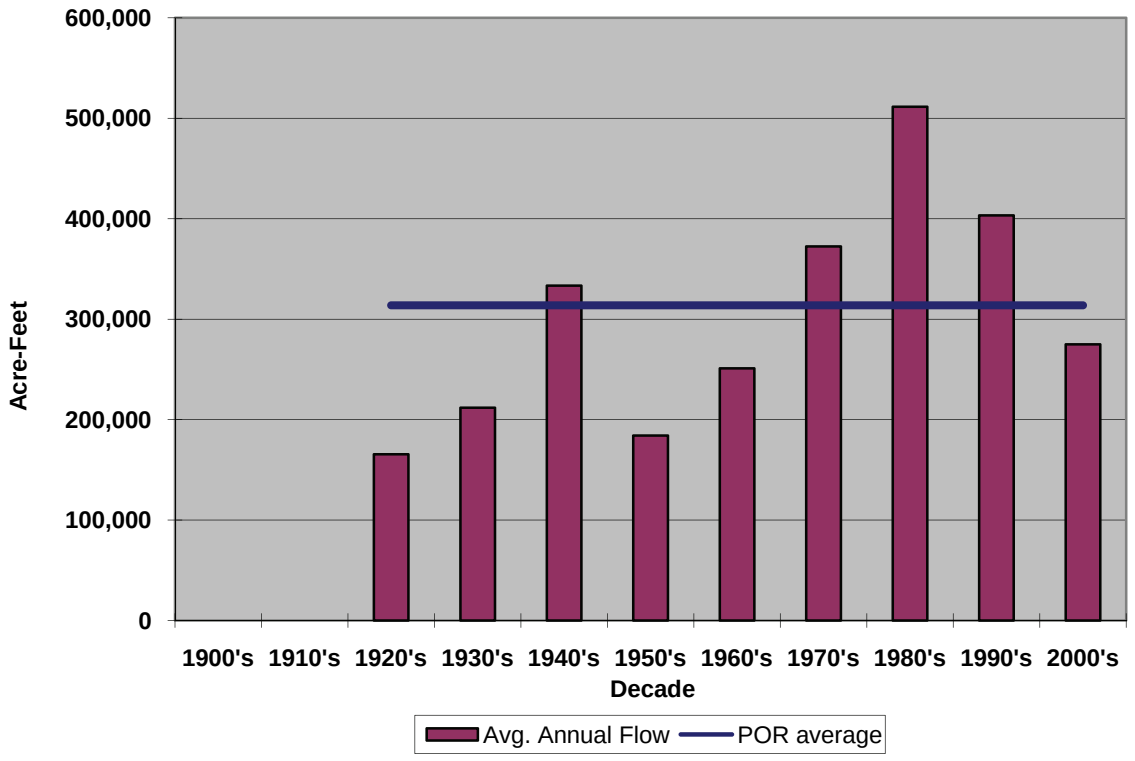

Figure 6-2 South Platte River at Henderson POR: 1927 through 2005

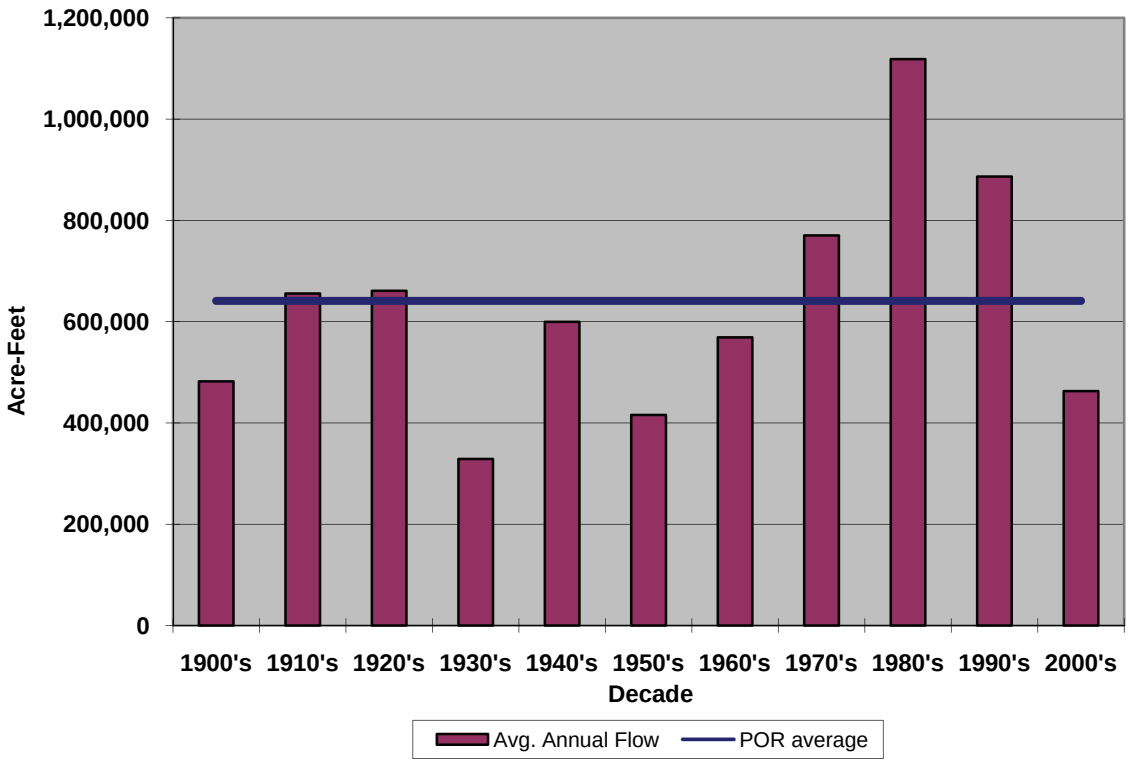

Figure 6-3 South Platte River at Kersey POR: 1902 through 2005

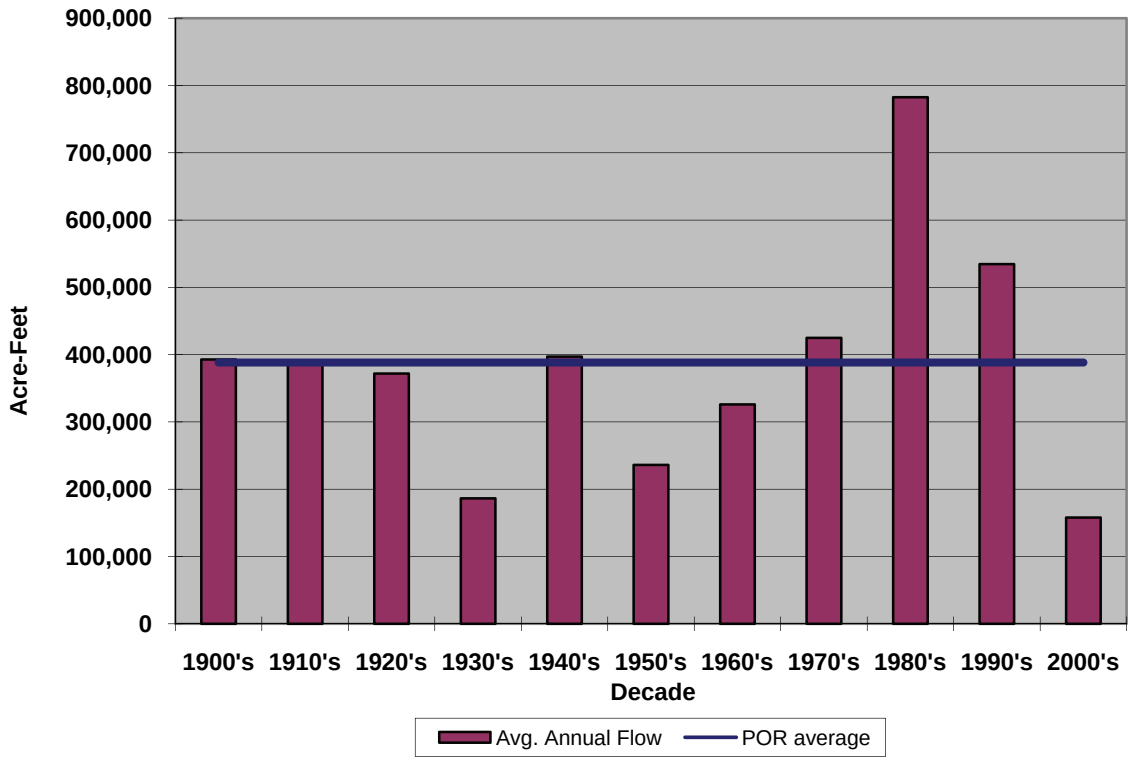

Figure 6-4 South Platte River at Julesburg POR: 1903 through 2005

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. While this same pattern occurred in the 1950s, it was not nearly as dramatic. **Figure 6-5** 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.

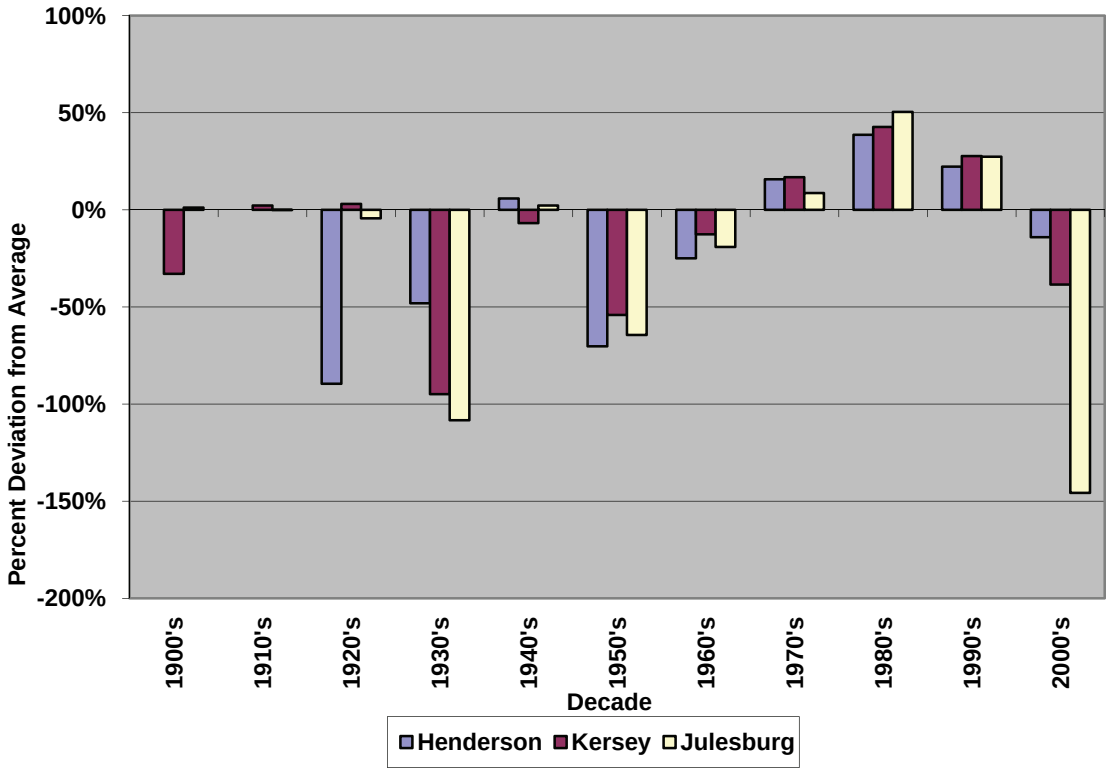

Figure 6-5 Percent Deviation from POR Averages

6.4.2.2 Water Supply Availability as Evaluated by Water Allocation Models

As part of their needs assessment, the South Platte and Metro Basin Roundtables conducted additional water availability analysis that built upon the SWSI 1 findings. Several water allocation models have been developed to determine legally-available flow at various points throughout the basin. The State of Colorado through the CWCB and the Division of Water Resources is currently developing surface and groundwater models for the South Platte Basin through the South Platte Decision Support System (SPDSS). Since the SPDSS models are not yet completed, older results from Denver Water's model, PACSM, the NISP study, and the Lower South Platte River Water Management and Storage Sites Reconnaissance Study were used to illustrate legally available supplies. These studies use different PORs, have varying assumptions of the development of existing conditional storage rights, do not reflect the recent change in river administration, and are not directly comparable. However, they are used for illustrative purposes to show limited availability in the Metro and South Platte Basin. **Table 6-2** shows the POR, model, minimum, median, average, and maximum available flows. **Figure 6-6** shows the location and median amount of legally-available water based on the various models. As noted, there are varying assumptions incorporated into these models and many may not reflect current river administrative practices; therefore, these results should be viewed as illustrative, pending more detailed results. Recent Denver PACSM results for availability at the Henderson and Kersey gages were not available and are not shown in the table or graph.

South Platte River

Table 6-2 South Platte Basin Water Allocation Models Summary

Gage Location	Model	POR (Water Year)	Min (AF)	Median (AF)	Average (AF)	Max (AF)
Near South Platte	PACSM	1950-1980	0	**2,000**	30,452	235,000
Chatfield	PACSM	1950-1980	0	**2,000**	36,000	289,000
Henderson[1]	PACSM	1950-1980	0	**155,000**	196,300	559,000
Kersey[1]	NISP	1950-2001	0	**162,100**	305,500	1,672,500
Sedgwick	LSPWMSSR	1944-1998	0	**70,800**	198,000	1,722,500

[1] Values for Henderson and Kersey are best available estimates pending updated Denver PACSM results

Results from water allocation models can be used to generate firm yield to storage curves (yield curves). The yield curve uses water availability data to determine how much storage is needed to reliably yield a given amount of water assuming no monthly shortages. **Figure 6-7** shows the yield curve for the South Platte River at Chatfield Reservoir. The curve shows storage to yield ratios of approximately 10:1 up to about 4,000 AFY of firm yield. Additional firm yield would require significant additional volumes of storage. For example, 10,000 AFY of firm yield at this location would require nearly 325,000 acre-feet (AF) of storage. This may not meet the needs for some users of firm supplies. However, it constitutes a valuable opportunity for users in the southern portions of the Metro Basin that may be able to capture average yields in greater amounts than the firm yields to offset groundwater pumping.

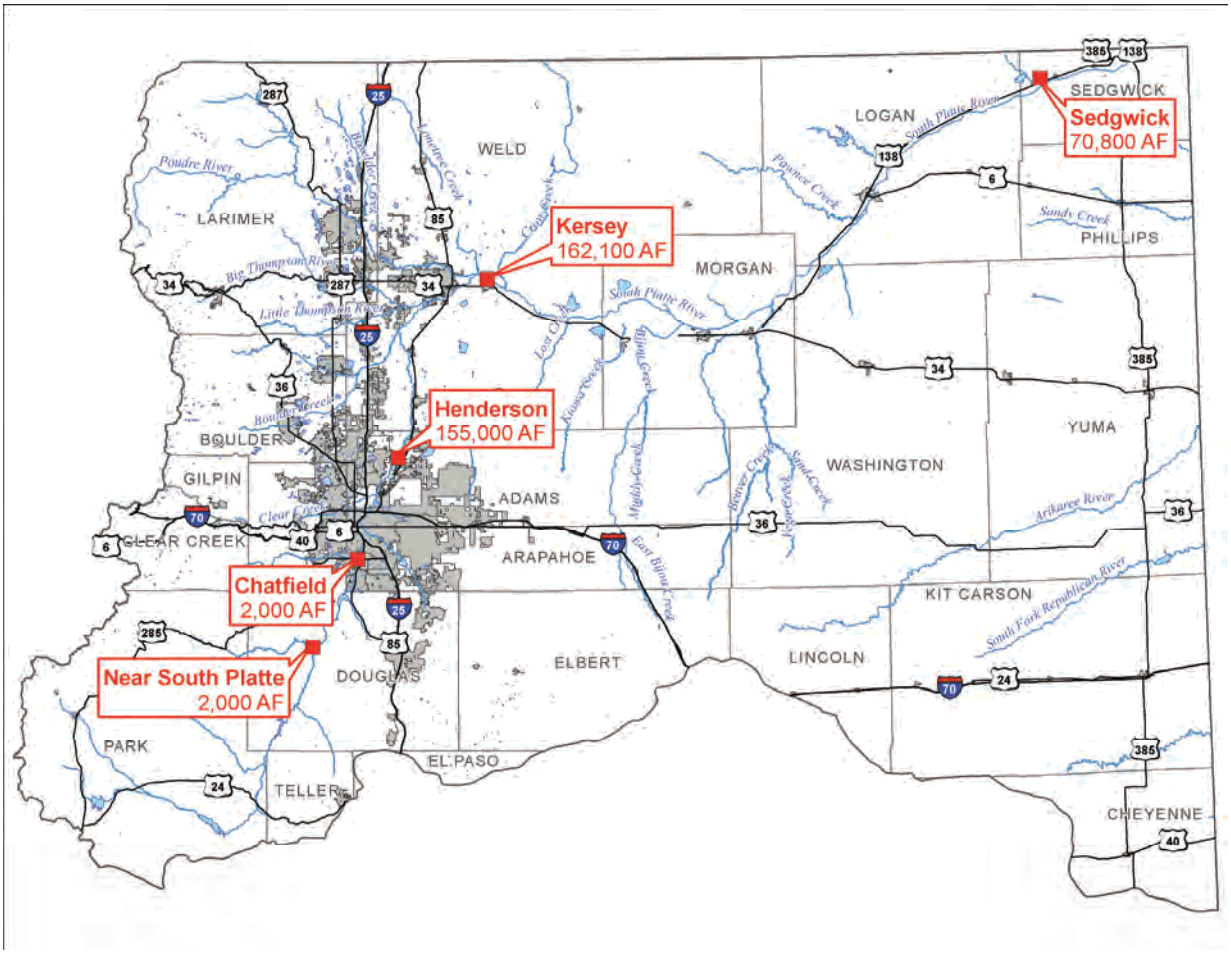

Figure 6-6 Estimated Median Amount of Available Flow in South Platte Basin Based on Various Models

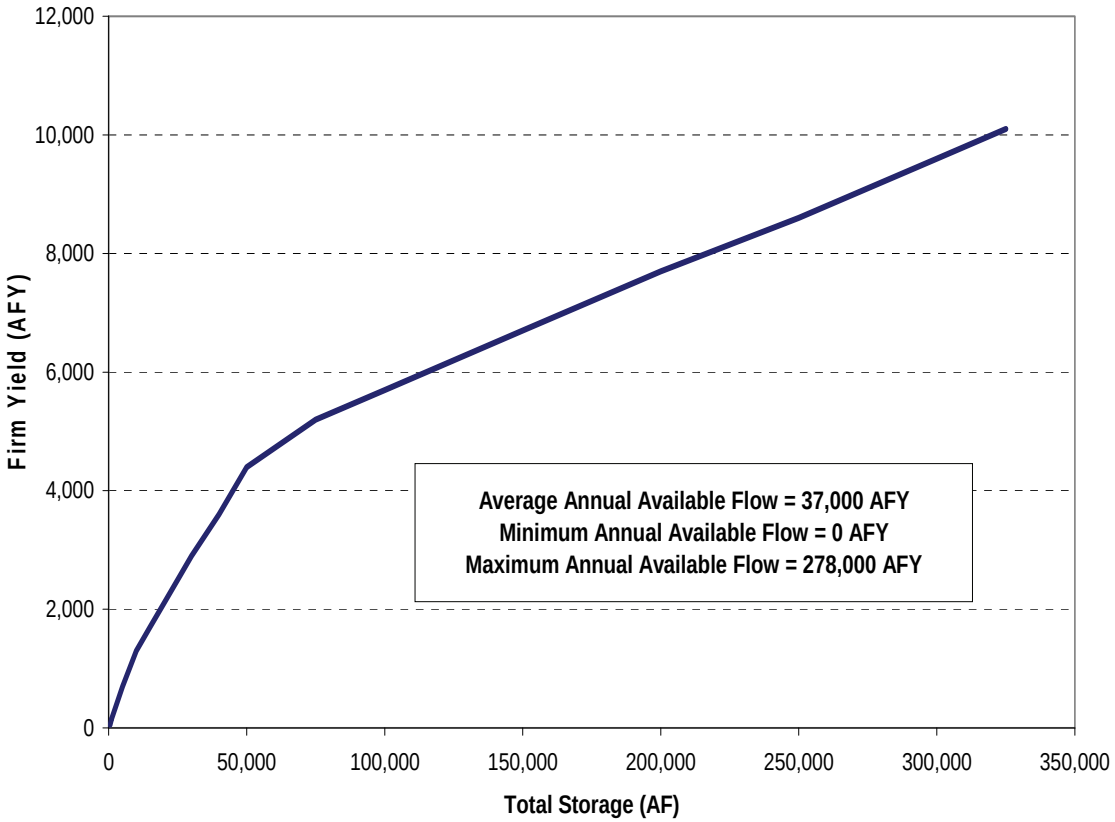

Figure 6-7 Yield Curve, South Platte River below Chatfield

Based on the analyses conducted by the South Platte Basin Roundtable, it was concluded that beyond the implementation of the basin's identified projects and processes, there is little to no unappropriated water remaining in the Metro and South Platte Basins that can produce a firm yield in the upper and lower portions of the South Platte River Basin. A large amount of storage would be required to obtain firm yield from storage in extremely wet years where water may be available for appropriation. This water would have to be carried over in storage over multiple dry years with annual evaporation and seepage losses.

In addition to limited surface water availability, some of the nontributary groundwater supplies in the South Metro area need to be replaced. As was discussed in Section 5 of this report, the Metro Basin Roundtable anticipates that 20,850 AFY of nontributary groundwater will need to be replaced in the South Metro area.

6.4.2.3 Conjunctive Use of Groundwater and Surface Water

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

to use reallocated Chatfield Reservoir storage and other storage reservoirs conjunctively with their Denver Basin nontributary groundwater supplies.

6.4.2.4 Anticipated Changes in River Conditions and Impacts on Water Availability

Over the next decade, several key 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 diverting under junior water rights. This storage will be used for return flow obligations on transferred agricultural rights directly or by exchange upstream to M&I providers intakes 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.
- Increase instream depletions from growth in phreatophytes along the South Platte River.

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

6.4.2.5 Gravel Lake Development

Many M&I providers have already purchased and constructed, or are planning to acquire and construct lined gravel lake storage to capture return flows along the South Platte and the Cache la Poudre. **Table 6-3** presents a partial list of planned or completed gravel lakes with their capacities if known. There are numerous other gravel mine sites downstream of the Denver Metro area that will also likely develop into gravel lake storage on a longer timeline. **Table 6-4** presents planned or existing water development activities. 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 upgradient side of the lakes are rising and causing issues associated with shallow water tables.

Table 6-3 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

Table 6-3 Known Existing or Planned Gravel Lake Storage (continued)

Owner	Name	Existing Storage Capacity (AF)	Planned Storage Capacity (AF)
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	
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
	Total of Known Capacities	**71,950**	**83,500**

Table 6-4 Existing or Planned Water Development Activities in the Denver Metro Area

Entity	Nonpotable Reclaimed	Gravel Lake Storage	Exchanges Upstream	Transfer of Ag Rights	Capture of Consumable Return Flows	Augmentation of Depletions or Return Flows
Centennial WSD		✓		✓	✓	✓
City of Arvada		✓	✓	✓	✓	✓
City of Aurora	✓	✓	✓	✓	✓	✓
City of Brighton		✓		✓	✓	✓
City and County of Broomfield	✓	✓		✓	✓	
City of Northglenn	✓	✓	✓	✓	✓	✓
City of Thornton	✓	✓	✓	✓	✓	✓
City of Westminster	✓	✓	✓	✓	✓	✓
Central Colorado Water Conservancy District		✓		✓		✓
Consolidated Mutual Water Company		✓	✓	✓	✓	✓
Denver Water	✓	✓	✓		✓	✓
South Adams County Water and Sanitation District	✓		✓	✓	✓	✓
South Metro Water Supply Authority Members (13 providers)	✓	✓	✓	✓	✓	✓
United Water and Sanitation District		✓	✓	✓	✓	✓

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:

- Platte River Recovery Implementation Program (PRRIP)
- Recreational in-channel diversions (RICDs)
- Development of conditional storage water rights
- Development of new and conditional recharge projects
- POR 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

The PRRIP purpose is to provide Endangered Species Act (ESA) compliance for existing and new water related activities in the Platte River Basin. This means that the PRRIP can serve as a reasonable and prudent alternative to offset the effects of water-related activities that are likely to cause jeopardy for one or more of the endangered species protected by the PRRIP. If a new project in the South Platte Basin cannot utilize the protection of the program, then it would have to seek to meet ESA compliance with its own plan and this may be difficult to accomplish if not impossible since the Fish and Wildlife Service has required one-for-one replacement of new depletions for projects permitted prior to the PRRIP.

The PRRIP has placed certain obligations on the State of Colorado that impact the ability to implement a large new diversion on the Lower South Platte River where unappropriated water in some years is more likely. Colorado's Plan for Future Depletions, Attachment 5, Section 9 of the PRRIP sets forth the conditions for accounting for a future new depletion. The PRRIP provides for some additional development in the South Platte River Basin after June 30, 1997 and the conditions for this new development are set forth in Section 9. New water-related activities would not be covered once wastewater exchange/reuse and new native South Platte gross water deliveries exceed 98,010 AF in the February to July period (Section 1.H.1). Section 1.H.2 also provides that Colorado will not construct a reservoir larger than 2,000 AF on the mainstem of the South Platte River anywhere below Denver.

The amount and location of conditional water rights are further illustrated in **Figures 6-8** and **6-9**.

During the spring runoff of 2007, there was a period of "free river" where more water was available than was needed for use. **Figure 6-10** shows the flows at several key gages along the South Platte River. This figure demonstrates the large amount of use on the lower reaches of the river, including reservoir fills, recharge plans, and lower return flows due to higher irrigation efficiencies. These types of depletions will only increase over time as more of these uses are implemented.

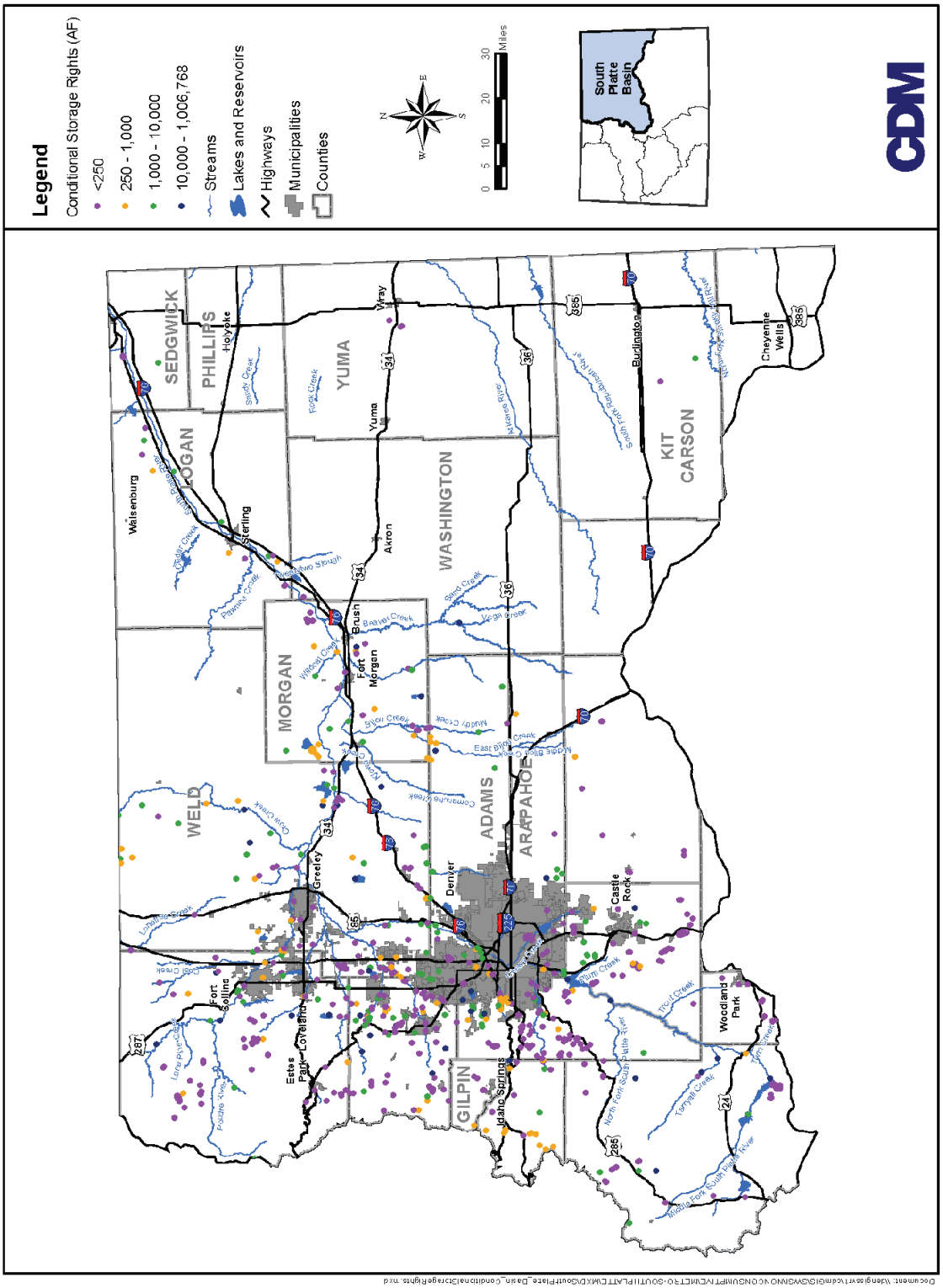

Figure 6-8 Location and Amounts of Conditional Storage Rights in the South Platte Basin (Water Division 1)

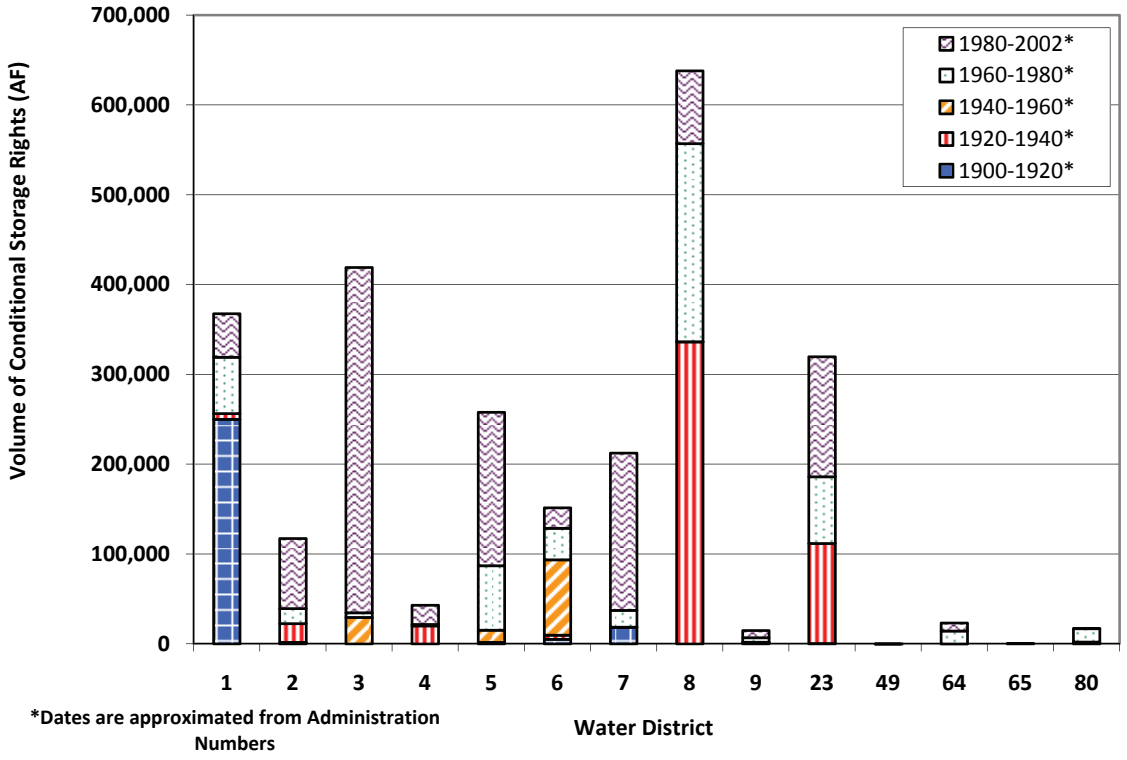

Figure 6-9 Amount of Conditional Storage Rights by Priority and Water District

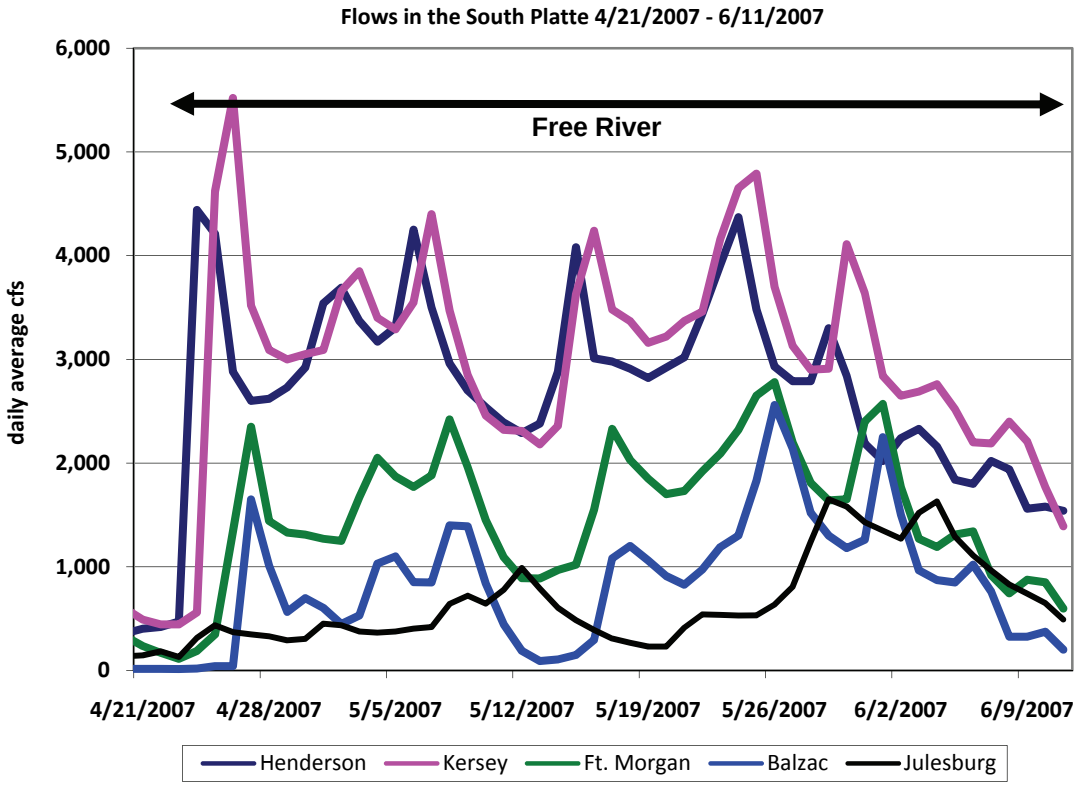

Figure 6-10 Free River Flows on the South Platte River, Spring 2007

In 2008, the snowpack was actually better than in 2007, but the call was on the river all spring resulting in no "free river" conditions. This was not expected and impacted the diversions by junior recharge projects that usually divert in the spring under above-average snowpack conditions. This only reinforces the conclusion that the South Platte River water supplies and river administration are going through a "shake out" period as the river responds to the changing demands and competition for water as mentioned above. Thus, taking into consideration all of the above, there is little unappropriated water to develop in the South Platte River.

6.4.3 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 dependent on changes in others. **Figure 6-11** shows the water districts in the South Platte (Division 1). Major water developments that impacted the South Platte River study area during the period from 1950 to present are summarized below.

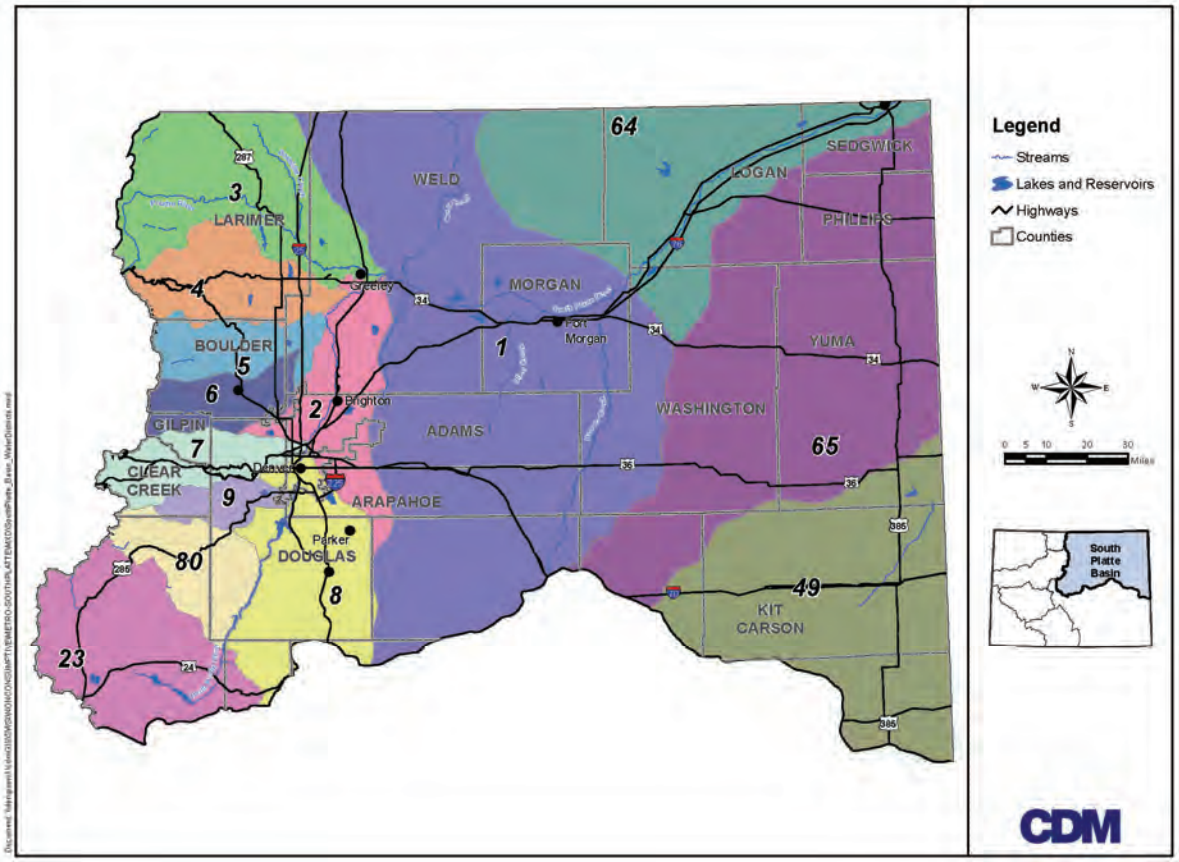

Figure 6-11 South Platte and Metro Basin Water Districts (Water Division 1)

- Mid-1950s to present: Full operation of CBT and transition from agricultural to M&I uses of CBT water and agricultural supplies throughout both 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 through Otero pump plant and pipeline.
- Early-1970s to present: increased use by effluent exchange of Denver Water's Blue River return flows.
- Mid 1970s to present: Nontributary water supplies utilized to meet municipal water supply needs with additional return flows in the river.
- Late 1970s to present: Center pivot sprinkler systems installed to increase agricultural irrigation efficiencies.
- 1980s to present: Water conservation plans implemented by municipalities with increasing measures, reducing lawn irrigation return flows (LIRFs).
- Early-1980s to present: Increased adjudication of well augmentation plans and junior recharge water rights.
- Late 1980s: City of Thornton changes Water Supply and Storage Company shares in the Poudre Basin and seeks to exchange to gravel pits along the South Platte River and to the Burlington Ditch.
- Late 1990s to present: Metro area water providers acquire gravel pit storage along the South Platte River for reuse projects, exchanges, and augmentation.
- Late-1990s to present: Metro area municipalities pursue nonpotable recycling plants and nonpotable use of fully consumable water supplies.
- Late 1990s: Cities of Fort Collins, Littleton, and Golden obtain RICD water rights.
- 2000s: Metro area water providers acquire irrigation water rights in Water Districts 1, 2, and 64.
- 2002: Return to historical levels of use of downstream senior storage rights for supplemental irrigation and/or for augmentation of well pumping depletions. It should be noted that 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 or have a water court approved plan 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.

6.4.3.1 South Platte Mainstem Evaluation

River Calls

In the South Platte River Basin, there are two basic types of calls – standard and bypass. When a standard call is placed, any water right junior to the senior calling right and located upstream is curtailed completely. Multiple calls can be active in the river basin at the same time, and if this occurs the upstream calls are always 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 flows to Nebraska in the summer and fall months when historically the river was dry or very low flow (see **Figure 6-12**).

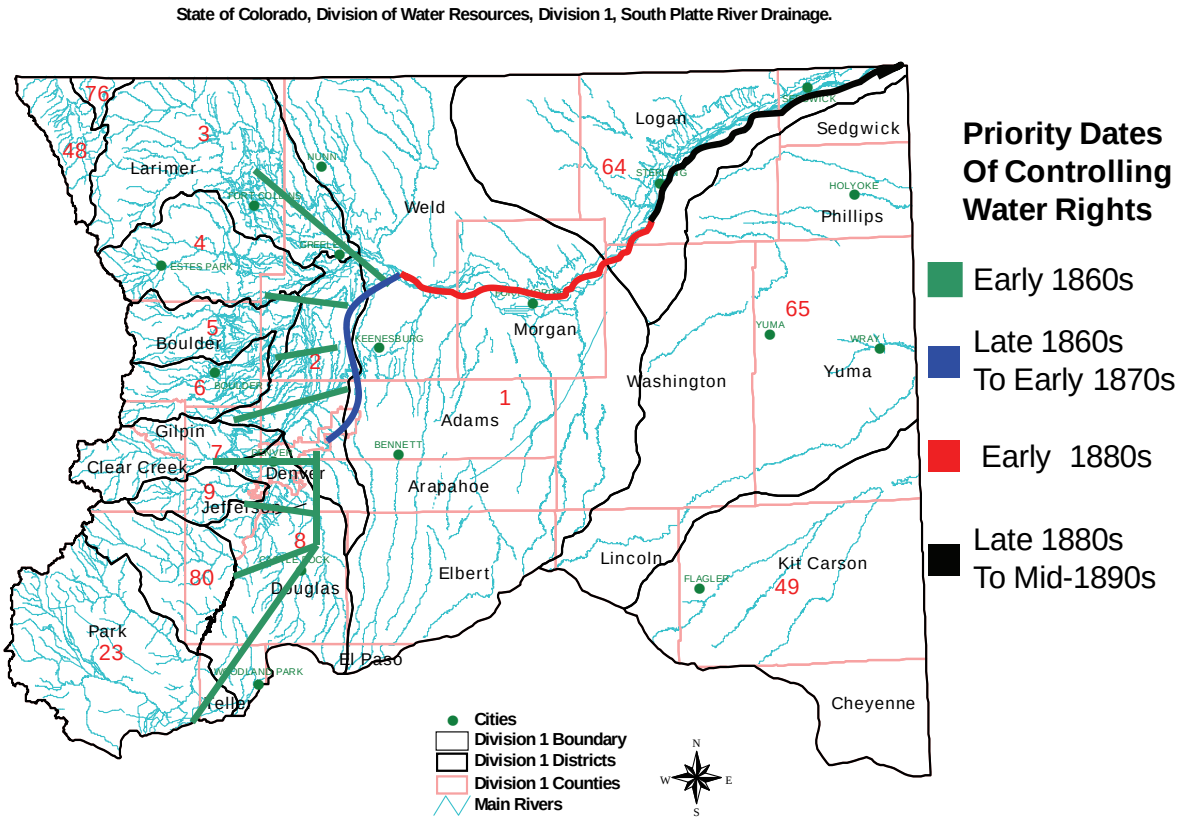

Figure 6-12 Priority Dates of Controlling Water Rights

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 that is passing 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 6/271889 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."

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. It should be noted that 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 historically 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 that occurring on the mainstem, except during higher flows and during 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.

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.

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

An historical call dataset from 1950 to present that is consistent with current call recording standards has recently been developed with input from Division 1 personnel based on the following approach as part of the SPDSS development.

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 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, in particular the 1882 rights, 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."

Call Regime over Time

Major reservoirs along the South Platte are shown in **Figure 6-13**. A simplified straightline diagram of major diversions along the mainstem of the South Platte is attached to this memo. Detailed straightline diagrams that include water rights priorities can be found at the Colorado decision support website at http://cdss.state.co.us/DNN/SouthPlatte/tabid/58/Default.aspx.

The historical South Platte River calls were reviewed in the context of water development and changes in river administration in the basin. Mainstem calls can be characterized based on two regions – those occurring upstream and downstream of Water District 2. The relative priority dates of controlling water rights in each Water District have been estimated by the Division Engineer and are shown in Figure 6-13.

An analysis of the water right priorities, including bypass calls that would have historically called out a junior water right below the Jay Thomas Ditch and a junior water right above the Burlington Ditch, indicate the following.

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 that did not historically need to place calls to receive their water, to place calls, during both the irrigation and non-irrigation seasons, to prevent the juniors from diverting the 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 2000, 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 and then place a call if needed during the runoff season to fill their reservoirs. Under some circumstances, this may have maximized use in Colorado and helped reduce the amount of water flowing out of Colorado to Nebraska. However, during times when there was insufficient water to fill the downstream reservoirs, and deliveries were not physically possible from certain junior reservoirs that had stored out-of-priority or such deliveries were not required by state water administration officials, the runoff season call placed by the downstream reservoirs resulted in injury to senior rights that would have otherwise been in priority during the runoff season. In 2003, some of the senior reservoirs themselves did not completely fill, and they were injured by the historical practice. So, the owners of the senior reservoirs withdrew their consent to historical Gentleman's Agreement.

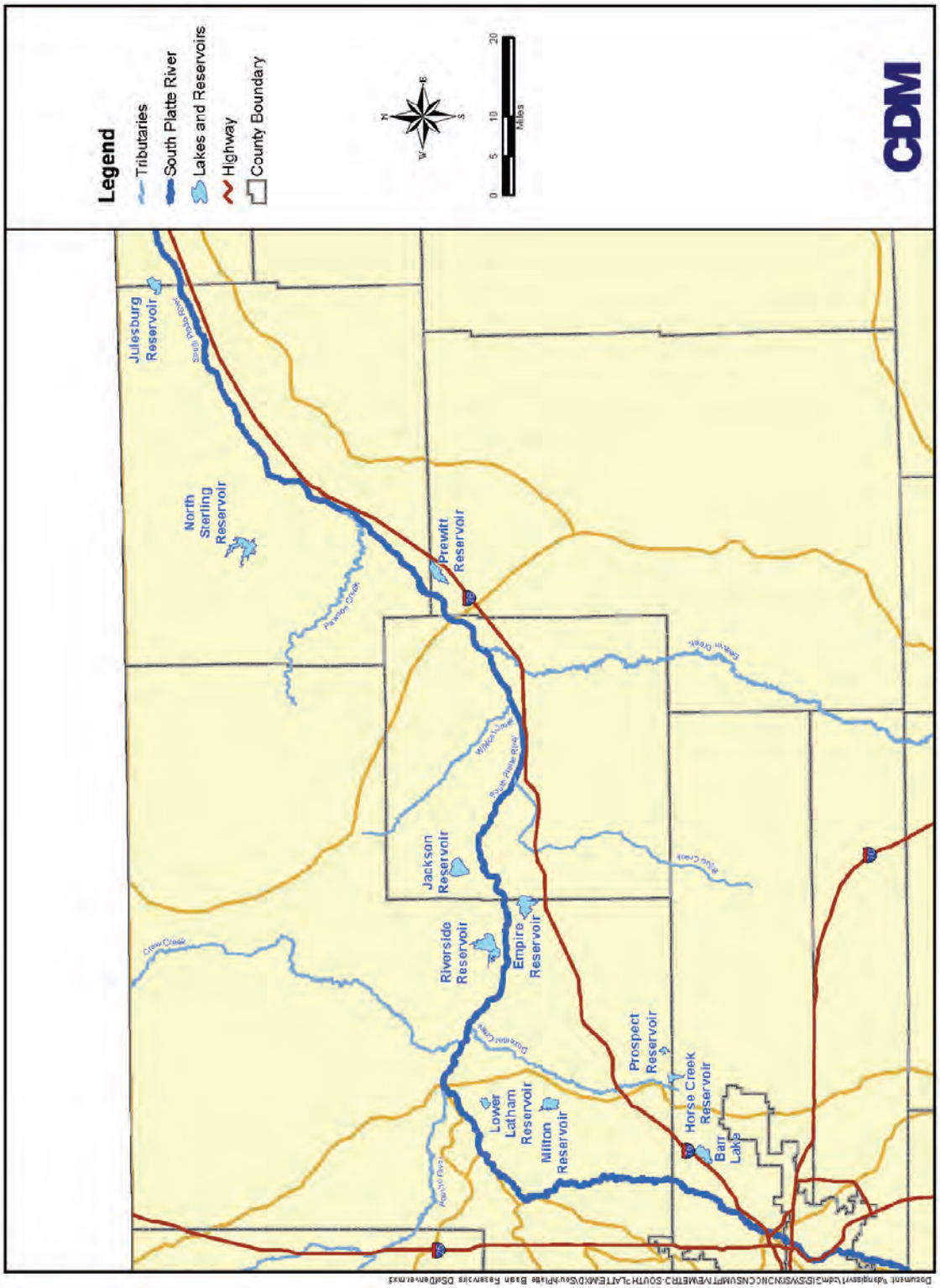

Figure 6-13 Major South Platte Reservoirs Downstream of Denver

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

The Division Engineer can allow storage in junior upstream reservoirs at a time of call by a downstream senior reservoir if the water stored can be released to the senior reservoir if it does not fill (CRS 37-80-120). The Division Engineer presently has a policy allowing upstream out-of-priority storage after notice and a comment period for potentially affected water users, the use of the "paper fill" requirement for affected downstream senior reservoirs, and 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, the 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 been recorded and affected upstream water rights more frequently since the mid- to late-1970s.

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

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

Besides being more efficient, sprinkler irrigation is automated (most likely the motivation for the investment). This automation allows a producer to irrigate with minimal preparation to a field. In years past, producers that flood/furrow irrigate would go to significant work to prepare ditches, headlands, tubes, etc. before irrigation was possible. In that scenario, farmers were reluctant to irrigate unless things were extremely dry (particularly early in the season). With the adaptation of automated sprinklers, irrigation occurs at the "push of the button," and more than likely forces a deeper call on the river (as compared to flood/furrow irrigation).

The Division Engineer has developed a comparison of the frequency of calls in Division 1 for the periods 1950 – 2002 and 2003 – 2006. **Figure 6-14** illustrates the significant increase in river calls experienced over the past few years.

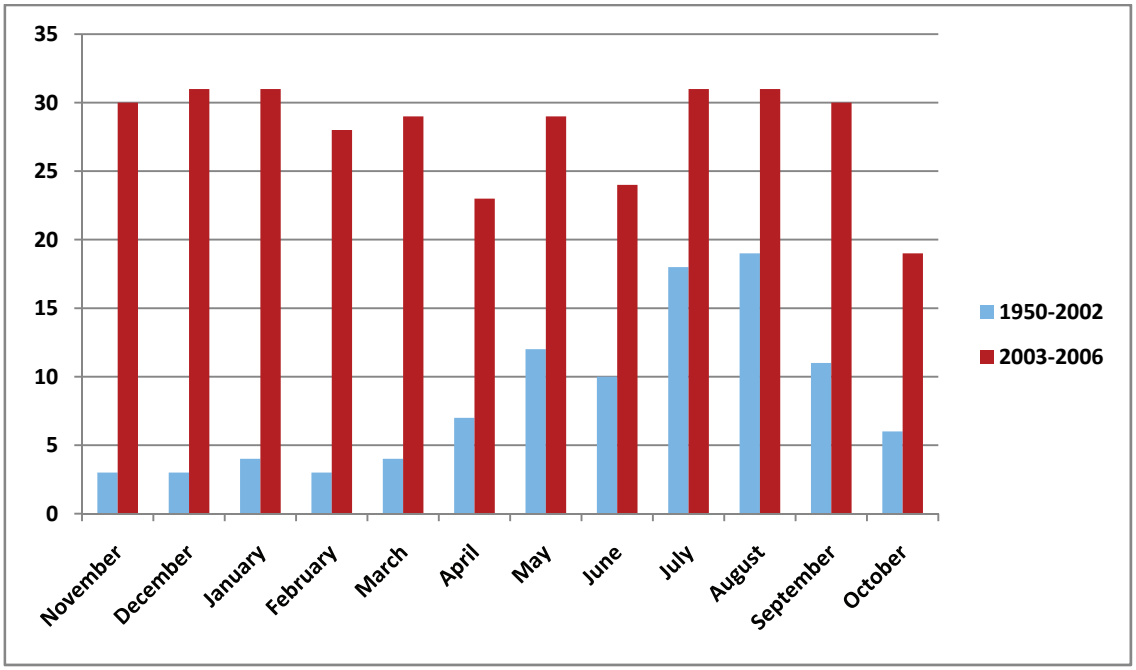

Figure 6-14 Division 1 Call Comparison (District 1 Calls Senior to Administration No. 44698, 5-26-1972)

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, including:

- Recorded storage calls have become more frequent and more junior over time.
- The senior early- to mid-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 and about the mid- to late-1970s. The Burlington 1885 water right has also been recorded more often after and about the mid- to late-1970s. There has been a general trend to more junior direct flow bypass call after the late 1970s.

6.4.3.2 Tributary Water District Evaluation

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 also 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 by the municipal providers in the district of fully consumable supplies will increase over time, further reducing the amount of water that has historically benefited downstream water rights both in District 3 but also in Districts 1 and 64. Based upon these activities in the future, it is apparent that this district may also see calls returning to levels more senior than has been experienced recently.

A significant change in water supply that occurred in Districts 2, 3, 4, 5, and 6 has been the transfer of ownership of CBT water from agricultural to municipal control since the project has been completed. In 1950, 85 percent of the CBT shares were owned and used by agriculture with the remaining 15 percent

owned by municipal. Presently, only 34 percent is owned by agriculture with the remaining owned by municipal interest (see Figure 6-1). In most years, much of the municipal water is still leased to agricultural interests.

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 Water District 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 upstream 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. As a result of a water rights stipulation, the City of Golden has a portion of its RICD right to up to 13 small reservoirs upstream that will provide year-round augmentation credits.

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

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 experienced along the mainstem and Water District 3 since this district historically is more affected by the calls in District 2. The change in seniority of the river calls in District 2 will have some impact on District 8 water rights, such as Cherry Creek Reservoir, that historically have benefited from the calls becoming more junior in the more recent years.

Water District 9 (Bear Creek)

The reuse of fully consumable supplies may increase over time by the municipalities in District 9; however, this may not have as great an impact on calls as that experienced along the mainstem and Water District 3.

Water District 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 district's storage water rights that historically benefited from the calls becoming more junior in the more recent years and the direct calls have occurred later over time.

6.4.4 Consumable Return Flow Reuse

Many M&I users have existing consumable return flows that, in the future, they will reuse 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 CBT 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. The following are recent or planned direct and indirect uses of fully consumable supplies:

- Denver Water Nonpotable Reuse Plant (currently 12 cfs, planned to 68 cfs)
- 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, Castle Pine Metro, Castle Pines North Metro, 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. However, with rising scarcity and costs of developing new water supplies, reuse is becoming more feasible and practical. **Figure 6-15** shows the proportion of reusable Denver Water effluent that was reused at the Metro and Bi-City wastewater plants between 1995 and 2004. The figure shows reuse rates climbing since 1999.

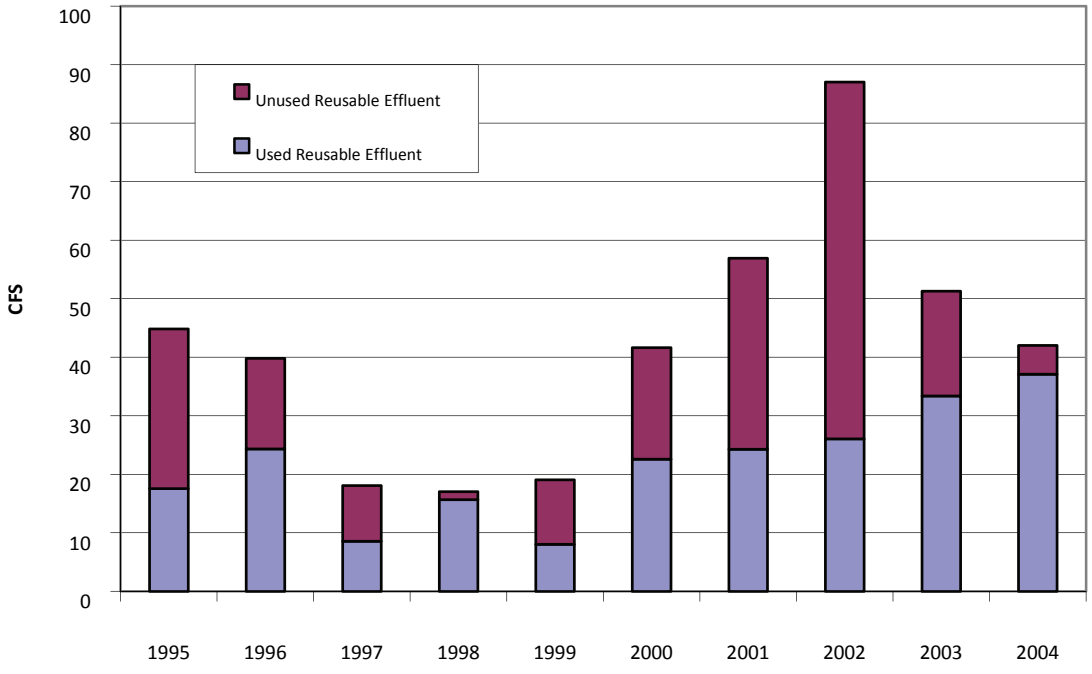

Figure 6-15 Average Daily Used and Unused Denver Water Reusable Effluent at the Metro and Bi-City Wastewater Plants (1995 - 2007)

6.4.5 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 study area, which is 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 are summarized in Section 1.2 of the project report, included as Appendix A. These objectives and the location of supporting information in the report addressing these objectives are provided below.

- Determine current and future populations and land use types projected to 2050
  - Current and future population projections – Table 2-3
  - Part-time population projections – Table 2-4
  - Transient population analysis – Section 2.4.3
- Determine current and future water demands to 2050
  - Current demands for community SWPs – Table 2-7
  - Future demands for community SWPs – Table 2-8
  - Current and future demands for surveyed SWPs – Table 2-12
- Determine water demands related to tourism outside of community SWPs
  - Recreational user demands – Table 2-13
- Identify existing improved and unimproved plats outside of community SWPs to estimate buildout water demands
  - Privately held parcels outside of SWP areas – Table 2-15
  - Water demand outside of SWP service areas – Table 2-21
- Evaluate sustainable groundwater supply based on recharge rates
  - Recharge estimates on private lands – Table 3-3
  - Estimate of potentially developable recharge – Table 4-1
- Assess groundwater sustainability based on recharge and demands for current and future conditions
  - Sustainability summary based on lot size – Figures 4-4 to 4-6

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 approximately 128,000 to 148,000, 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 U.S. Geological Survey 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 over 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 more distant from regional streams. Water that is pumped for onsite water supply is discharged to onsite waste disposal system 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 and individual wells may not be able to produce sufficient 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. Since 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 decisionmakers with information to assess sustainability issues. The maps shown on Figures 4-4 to 4-6 are useful planning maps and indicate areas where there may be the potential 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.

6.4.6 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, water uses, etc. It is difficult to identify direct relationships between the major water developments in the basin and the change in the call regime. In general, the call regime has been administered more frequently and more junior calls are recorded over time, which is to be expected as junior water rights continue to be appropriated and begin operating. Introduction of transbasin supplies in the mid-1950s from the CBT project and in the mid-1960s from the Roberts Tunnel and the 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 seen 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, 2, 3, 4, 5, and 6 to affect the change in year round flows in each Water District and ultimately in Water District 64. **Figure 6-16** shows the annual flow from 1927 to 2006 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.

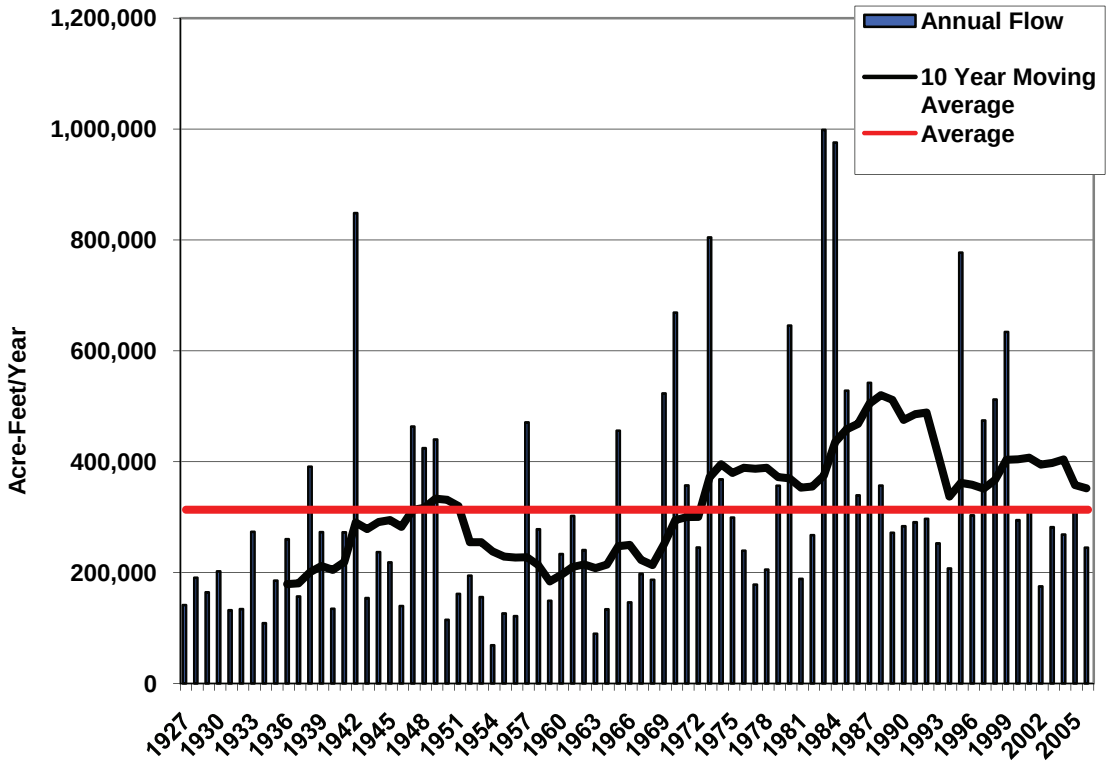

Figure 6-16 Annual Flow for the South Platte River at Henderson from 1927 to 2006

It is also difficult to identify the effects on calls of more widespread tributary well use, construction of M&I reservoirs, and increased operation of the Denver Water exchange, among other developments in the South Platte River Basin. As M&I users begin the reuse of their fully consumable water supplies, which includes transbasin water, nontributary water supplies, and transferred agricultural water rights, and agricultural users develop their conditional recharge projects and return to historical levels of use of reservoir water, this will ultimately result in less water available to downstream water rights and will result in river calls returning at least to those that existed prior to the mid-1970s. Figure 6-16 shows 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. Other Metro area municipalities have similar projects planned, including Aurora, Thornton, and others. The construction and lining of gravel pits for storage may block 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, historically the water needed to meet future growth would have come from increased storage water, changed agricultural water rights, and transbasin water, and the return flows from these sources provided additional return flows for use by downstream irrigators.

The continued growth in the use of center pivot sprinklers and the lining of ditches and laterals will increase agricultural irrigation efficiencies but ultimately will also impact future river flows that historically benefited from "inefficiencies of 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 impact of more efficient irrigation practices such as center pivot sprinklers 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. The total acreage of irrigated lands using sprinklers has been estimated as part of the SPDSS effort. **Figures 6-17** and **6-18** illustrate the amount of irrigated land and the relative water sources for selected years that were analyzed as part of the SPDSS irrigated acreage mapping effort. As shown in **Figure 6-19**, there has been a significant increase over time in the use of sprinklers in Division 1.

The impact to recharge projects may also limit their 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 junior recharge water rights that have recently been developed. The 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 that historically used wells early in the irrigation season who are now diverting their direct flow water rights and placing calls earlier than has occurred since the mid-1970s.

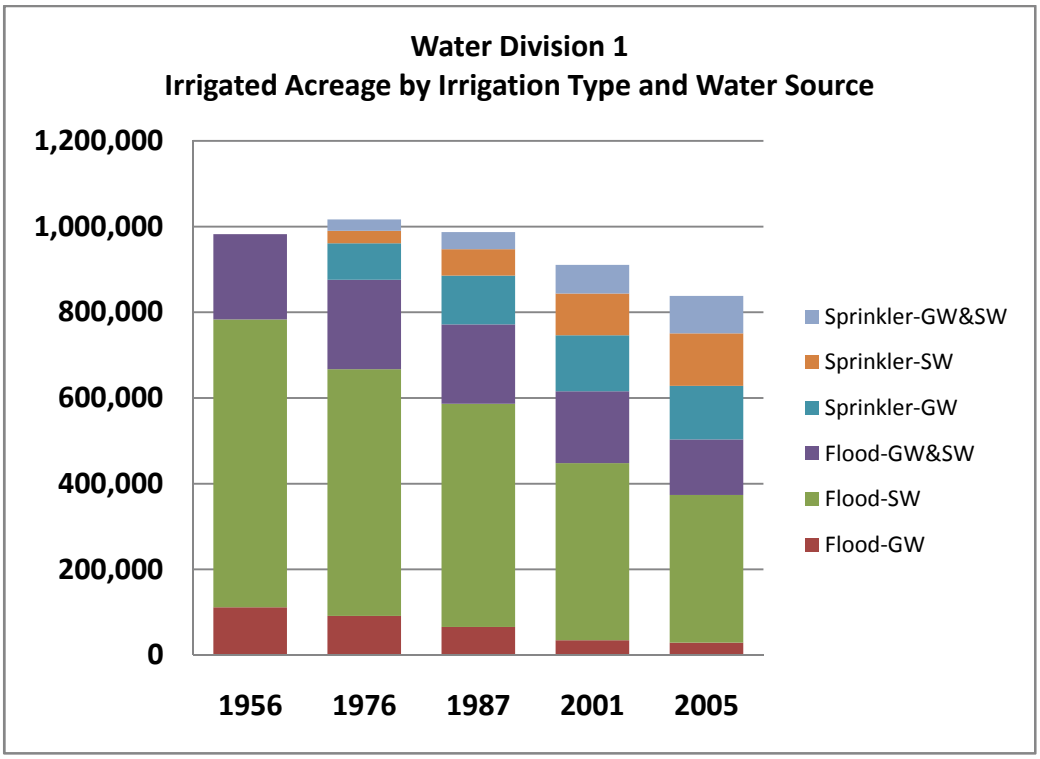

Figure 6-17 Irrigated Acreage by Irrigation Type and Water Source

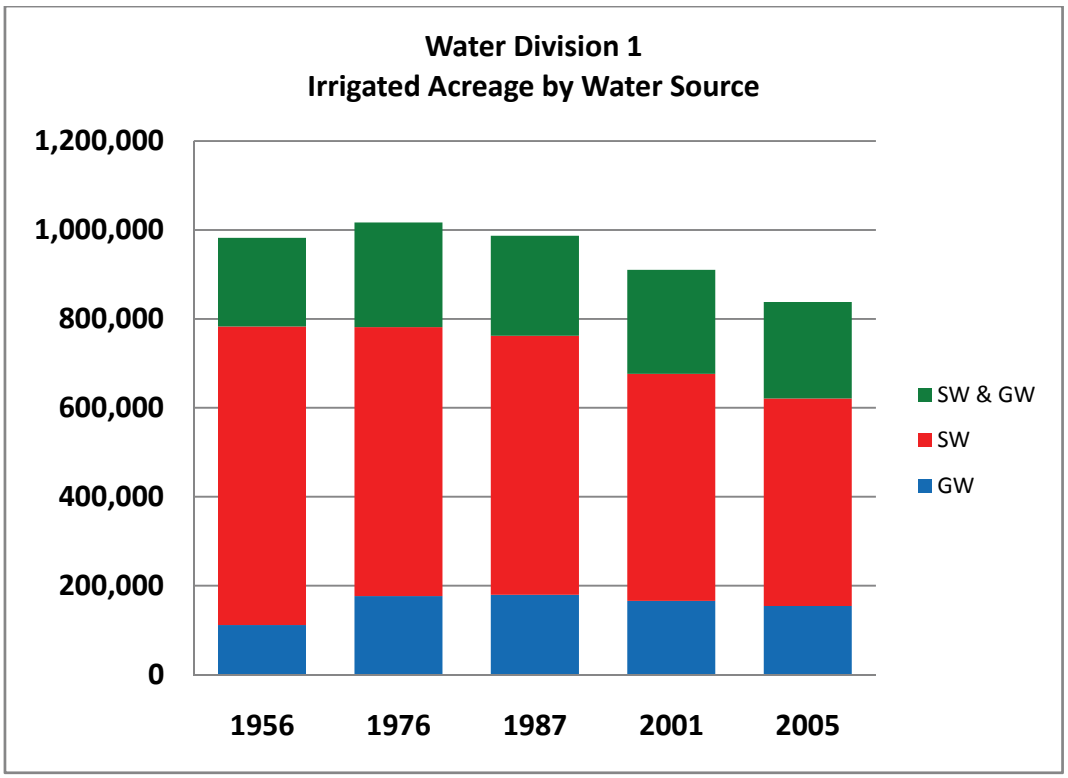

Figure 6-18 Irrigated Acreage by Water Source

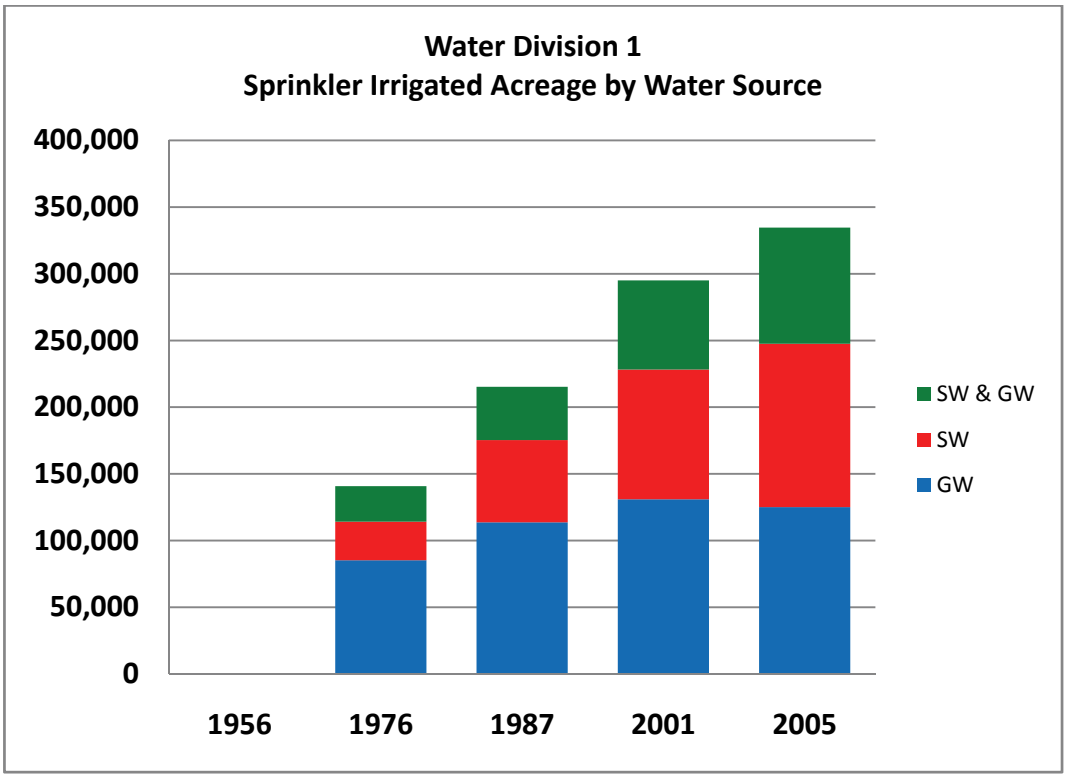

Figure 6-19 Sprinkler Irrigated Acreage by Water Source

6.5 South Platte Basin Water Supply Availability Conclusions

1. Competing Water Supply Projections: The South Platte Basin Roundtable believes that there is a significant overlap in the projection of available future water supplies by many municipal water providers within the basin.

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

    b. Although native agricultural water rights are generally more available, competition for those rights located close to M&I development will be severe.

    c. Whether done through CBT acquisitions or native water rights acquisitions, meeting future municipal demands by simply drying up irrigated lands poses real risk for the basin. Irrigated agriculture is a significant contributor to the economy of the basin. The roundtable views large scale agricultural dry-up as an undesirable means for meeting future water demands.

2. Unappropriated Water: In general terms, the South Platte Basin is one of the most highly developed river basins in Colorado. On average, water is used and reused approximately 6 to 7 times between the Front Range headwaters and the state line.

    a. In most areas in the upper portion of the basin, there is virtually no unappropriated water available. 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.

    b. In the lower portion of the basin, where some unappropriated water is available in some years, extensive efforts are already underway to develop and use that water. Many municipal water providers already have conditional water rights that are being developed. Many agricultural water users have developed significant recharge projects within the past 10 to 20 years to replace well depletions from irrigation wells. The roundtable believes that what water is available for development will be developed as part of existing projects either well along in planning or underway.

    c. Therefore, additional development of unappropriated water is simply not going to be a significant source of water to meet future consumptive needs within the basin.

3. Changing River Administration: As a general matter, changes in river administration have tightened and decreased the availability of water from both existing water rights and the development of junior conditional water rights.

    a. Since 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.

    b. 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.

c. Increasing use of sprinkler irrigation in irrigated agriculture is decreasing the amount of return flows available to satisfy downstream water rights.

d. 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.

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.

5. Water Conservation Plans (discussed in Section 4): Most municipalities within the basin have developed or are developing water conservation plans. Following the drought of 2002, water conservation has been prominent, and more conservation is expected to be implemented in the future. Although conservation will undoubtedly reduce the future water supply gap by some increment, it will not alone be sufficient to meet additional future water demands.

6. General Conclusions: Based upon the work done in SWSI 1 and the task order summarized in this section, the South Platte Basin Roundtable has concluded that the future water supply gap in the basin is large, and likely growing. However, this roundtable is already convinced that the future water supply gap in the basin is an urgent problem that must be addressed with all due speed.

   a. Efficient use of all existing water supplies within the basin is already happening to a large extent, and will increase in the future. However, existing water supplies combined with some incremental development of conditional water rights will not be sufficient to meet the basin's future needs.

   b. A large-scale dry-up of irrigated agriculture to meet future M&I water needs will cause significant negative economic impacts to the basin, and to the state as a whole.

   c. Both the basin, 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 basin. Speedy completion of current studies of water availability in the Colorado River Basin, and studies of project concepts to develop and use available water statewide, is imperative.

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Section 7
Projects Funded with WSRA Grants

Chatfield Reservoir Reallocation Environmental Impact Statement and Feasibility Report

APPLICANT: The Greenway Foundation

APPROVED: March 2007

STATUS: Complete

WSRA FUNDS: $130,000 - Joint Application:
$103,000 - Metro Basin Account
$27,000 - South Platte Basin Account

MATCHING FUNDS: $206,000

DESCRIPTION:
The purpose of the Chatfield Reallocation Feasibility Study (FS) is to investigate the potential for the reallocation of storage from the flood control to multi-purpose use, to formulate plans of improvement, and to obtain approval of higher U.S. Army Corps of Engineers authority. The FS, which will consist of an Environmental Impact Statement (EIS) and a feasibility report (FR), will include an analysis of existing and alternative operations of Chatfield Reservoir individually, and to the extent necessary for the hydrologic studies, systemically with Cherry Creek and Bear Creek Reservoirs. The FS will estimate potential changes to downstream flows and to reservoir pool elevations as well as the potential consequences to water supplies, flood damages, recreation opportunities, water quality, and fish and wildlife habitat. Historical streamflow records will be utilized to test effects of different flood control and water supply regulation scenarios. The EIS/FR is equally cost shared with the local non-federal sponsor (Colorado Water Conservation Board [CWCB]) through a FS cost share agreement.

Clear Creek Water Banking and High Altitude Storage

APPLICANT: Clear Creek County

APPROVED: May 2007

STATUS: Complete

WSRA FUNDS: $52,000 (Basin Account)

MATCHING FUNDS: None

DESCRIPTION:
Clear Creek County created a high-altitude water storage bank to provide water for basin-wide needs, improving bother water quality and quantity. Since 2000, the county has been working on engineering analyses and legal issues to evaluate potential reservoir sites and acquire water rights. The county recently filed for conditional storage rights and a basinwide augmentation plan. The current project involves comparing the county's nine conditional storage sites with respect to environmental risks, geologic hazards, permitting processes, construction costs, coordination on federally-owned lands, etc. The scope of work centers around collecting and analyzing additional engineering information regarding the proposed reservoirs. A matrix analysis was used as a comparison tool to rank each site. This ranking system allows the county to develop a planned approach in the development of the reservoirs based on geographic need within the county, environmental issues, water administration issues, construction costs, and geologic hazards.

Ovid Reservoir Comprehensive Feasibility Study

APPLICANT: District 64 Reservoir Company

APPROVED: September 2007

STATUS: In Progress

WSRA FUNDS: $176,000 (Basin Account)

MATCHING FUNDS: Approximately $1,000,000

DESCRIPTION:
The Ovid Reservoir Comprehensive FS is the first phase of the reservoir project encompassing technical work, modeling, and permit applications. The reservoir is strategically located in the lower river, providing a number of opportunities to supply augmentation, meet agricultural and municipal needs, assist with compact administration, and aid Colorado's participation in endangered species recovery efforts. A detailed evaluation of possible operating scenarios will be outlined for dry year, wet year, and average year hydrologic conditions along with various policy scenarios including implications of the Platte River Recovery Implementation Program obligations. A detailed review of preliminary engineering for the reservoir will also be performed to identify regulatory or technological changes. In addition, the study will explore issues and opportunities of a potential partnership with the Julesburg Irrigation District for the use of the Peterson Ditch. If the project proves to be feasible, the study will identify funding options for Phase II.

Lower South Platte Wetland Initiative Phase I

APPLICANT: Ducks Unlimited, Inc.

APPROVED: September 2007

STATUS: Complete

WSRA FUNDS: $278,476 (Statewide Account)

MATCHING FUNDS: $500,255

DESCRIPTION:
This project is designed to develop three wetland recharge projects along the lower South Platte River in Morgan, Logan, and Sedgwick Counties. Water will be diverted into wetlands in the winter when it is legally available and allowed to infiltrate into the alluvial aquifer, and eventually back to the river channel. Detailed modeling has been performed to assure that recharge water returns to the river at the predicted time. Recharge projects have become a widely accepted and dependable technique for meeting the demands of water users along the river. River management of recharge projects has permitted many junior water rights holders to continue operating legally. Aside from retiming legally available flows, wetland recharge projects provide significant benefits to migrating and wintering birds in the important flyway of the lower South Platte. More than 20 species of migratory birds and 27 species of waterfowl of national importance depend on such wetlands. In addition, the wetlands will be utilized for waterfowl hunting, which contributes significantly to the local economies. Recharge credits from the wetlands will benefit the Platte River Recovery Program as well as numerous municipal and agricultural collaborators.

Stage Dischargers Data Loggers and Telemetry Installation Project

APPLICANT: Northern Colorado Water Conservancy District, Lower South Platte Water Conservancy District, and Colorado Division of Water Resources

APPROVED: January 2008

STATUS: In Progress

WSRA FUNDS: $48,800 (Basin Account)

MATCHING FUNDS: In-kind Services

DESCRIPTION:
This project involves the installation of stage discharge data loggers and cell phone modems on diversion structures and return flow augmentation structures to provide real time flow information. The principle focus will be on structures on the mainstem of the South Platte downstream of Denver and upstream of Kersey (District 2). Data loggers and telemetry has already been set up on most major diversion structures downstream of Kersey in a cooperative program between Northern Water, Lower South Platte Water Conservancy District, and Division of Water Resources with some support from the Colorado Water Conservation Board funding of the Division of Water Resource's hydrography program. Project costs include only equipment as in-kind services will be used for installation in coordination with the various ditch companies by Division of Water Resources, Lower South Platte Water Conservancy District, and/or Northern Water representatives. In addition, these agencies will set up necessary networking to transfer, store, and present the information on the internet. The project will provide an excellent complement to the state's existing diversion and stream gage satellite program and is also complimentary to the work being done for the Colorado Decision Support System in obtaining better data concerning river flows and diversions.

Upper Mountain Counties Water Needs Assessment

APPLICANT: Clear Creek County on Behalf of the Upper Mountain Counties Water Needs Consortium

APPROVED: May 2008

STATUS: In Progress

WSRA FUNDS: $174,350 - Joint Application:
$43,587 - Metro Basin Account
$130,763 - South Platte Basin Account

MATCHING FUNDS: $8,070

DESCRIPTION:
In March 2008 the four upper mountain counties in the South Platte headwaters (Park, Jefferson, Clear Creek, and Gilpin) formed the Upper Mountain Counties Water Needs Consortium. The purpose of the Consortium is to "perform a study to accurately identify water needs, available water supplies and any shortages that may exist in the Upper Mountain Counties, and identify projects and or actions that may be needed to address any shortages." The needs assessment seeks to determine the long-term availability of groundwater in the fractured and faulted bedrock aquifers of the study area and evaluate if the use of groundwater at build-out can be sustained. The study will use historical precipitation data (1950 to present), recharge related to this precipitation, and data on increased groundwater use to analyze hydrologic variation over the period during wet, average, and dry years. The project will provide a more accurate assessment of the water demands in the study area that are highly dependent upon groundwater in fractured and faulted bedrock aquifers.

Weld County School District RE1 Wetland Partnership

APPLICANT: Ducks Unlimited, Inc.

APPROVED: July 2008

STATUS: In Progress

WSRA FUNDS: $42,109.90 (Basin Account)

MATCHING FUNDS: $160,000

DESCRIPTION:
This project involves the creation of a model, high quality recharge wetland near the South Platte River in Weld County, Colorado. Low-level embankments will pool water secured from two sources—one right procured by the Central Colorado Water Conservancy District (CCWCD) for their augmentation plan and another right to be procured by the Weld County School District (WCSD) to meet their substitute supply needs. This pooled water will recharge the South Platte River alluvial aquifer and provide approximately 2 acres of wetland habitat for waterfowl during the migration and wintering periods. The project's primary purpose is to secure a reliable water supply for the WCSD to irrigate school grounds, sport fields, and other facilities in Gilcrest, Platteville, and other communities of southern Weld County. The project will also allow DU and CCWCD to test the working relationships necessary to successfully deliver a planned multi-million dollar expansion of the wetland recharge partnership into the middle reaches of the South Platte River in Colorado. DU ultimately seeks to have this project serve as a demonstration of the utility of wetland recharge projects in meeting water supply needs, providing habitat for wildlife, especially waterfowl, and the strength of consumptive-nonconsumptive partnerships.

Solicitation of Stakeholder Input through a South Platte Edition of Headwaters

APPLICANT: Colorado Foundation for Water Education

APPROVED: July 2008

STATUS: Complete

WSRA FUNDS: $32,038 - Joint Application:
$16,019 - Metro Basin Account
$16,019 - South Platte Basin Account

MATCHING FUNDS: $10,900

DESCRIPTION:
This project entails the creation of a special South Platte Edition of Colorado Foundation for Water Education's (CFWE's) Headwaters Magazine to provide a tool for Metro and South Platte Basin Roundtable members to actively solicit input from affected local governments and stakeholders on their needs assessment and proposed projects and methods for meeting those needs. Headwaters magazine is CFWE's most widely available and well-known educational resource, distributed to over 6,000 residents of Colorado and the West. The project is intended to educate basin roundtable stakeholders about the basin's geography, water supply, environmental challenges, water management agencies (including the Interbasin Compact Committee and roundtables), and water needs. CFWE will provide support to basin roundtable members in their outreach efforts by providing materials and assisting in their distribution, and attending a limited number of speaking engagements on behalf of the basin roundtable to discuss the contents of the issue.

South Platte Water Protection and Wetland Restoration

APPLICANT: Ducks Unlimited, Inc.

APPROVED: September 2008

STATUS: In Progress

WSRA FUNDS: $825,552 (Statewide Account)

MATCHING FUNDS: Approximately $2,000,000

DESCRIPTION:
This project focuses on the protection of existing and future water rights on properties contributing to the Statewide Water Supply Initiative objectives and the Platte River Recovery Program. The project seeks to restore wetlands on these properties while providing long-term protection via conservation easements for multiple uses and benefits. Similar to other land trusts, Ducks Unlimited, Inc. (DU) works with willing landowners to purchase conservation easements on properties of value for waterfowl and other wildlife. These properties and associated DU projects also benefit the public by providing higher water quality, retiming water through wetland recharge, and enhancing waterfowl hunting opportunities and economic impacts. The project will compliment the Tamarack Ranch, a significant component of the Platte River Recovery Program. The project will also provide for a wide range of nonconsumptive uses while retiming river flows to harness surpluses for augmentation use in dry months.

Arickaree River Well Retirement Program

APPLICANT: The Nature Conservancy of Colorado

APPROVED: September 2008

STATUS: In Progress

WSRA FUNDS: $99,920 ($19,984 - Basin Account; $79,936 - Statewide Account)

MATCHING FUNDS: $471,920

DESCRIPTION:
The Nature Conservancy is working with the Republican River Water Conservation District to retire three active irrigation wells near the Arickaree River in Yuma County. The Nature Conservancy is also assessing the value of retiring two permitted but inactive irrigation wells in the immediate vicinity as part of this effort. Colorado State University (CSU) researchers have determined that these five wells are part of a group of wells that if permanently retired would provide significant flow benefits to the 16-mile "live" reach of the Arickaree River. The "live" reach supports perhaps the best remaining population of brassy minnow in Colorado along with a number of native plains fish, including the plains minnow, orange throated darter, and red shiner. The targeted wells also lie upstream of the proposed curtailment zones for compact compliance. Well retirements upstream of the curtailment zones will supplement river flows, thus increasing the Arickaree's contribution to Colorado's compact obligations and reducing the likelihood of any required curtailments.

Halligan Seaman Water Management Project: Shared Vision Planning Model

APPLICANT: City of Greeley

APPROVED: September 2008

STATUS: Complete

WSRA FUNDS: $101,740 ($25,435 - Basin Account; $76,305 - Statewide Account)

MATCHING FUNDS: $271,109

DESCRIPTION:
The City of Greeley is working with the City of Fort Collins, North Poudre Irrigation Company, CSU, and the Nature Conservancy to move forward on the Halligan Seaman Water Management Project via a Shared Vision Planning (SVP) model. The SVP model is a collaborative stakeholder process intended to bring about more effective permitting for water projects. This SVP effort is proposed to improve streamflows on the North Fork and mainstem of the Cache la Poudre River above the confluence with the North Fork. The SVP Work is related to the ongoing review of two Section 404 permits to expand storage at two existing reservoirs on the North Fork to provide the water supply needed for future population growth and some agricultural production. Preferred alternatives have been identified as the expansion of Halligan Reservoir in 2010 and the expansion of Seaman Reservoir in 2030. The SVP study will consider only sub-alternatives that avoid or minimize negative environmental impacts. It will incorporate operational, hydrologic, water rights, and flow recommendations, as well as criteria for ecological and biological components into a river flow regime in order to fully assess reservoir operations alternatives in the context of the required National Environmental Protection Act permitting process. The SVP uses traditional U.S. Army Corps of Engineers planning principles but modifies them to include earlier and more intensive collaboration with a wide variety of stakeholders. If successful, SVP could become a model for other water projects in the United States.

Demonstration of Membrane Zero Liquid Discharge Process for Drinking Water Systems

APPLICANT: Colorado Department of Public Health and Environment, Water Quality Division

APPROVED: September 2008

STATUS: Contracting

WSRA FUNDS: $800,000 - Joint Application:
- $25,000 - Arkansas Basin Account
- $25,000 - South Platte Basin Account
- $50,000 - Metro Basin Account
- $700,000 - Statewide Account

MATCHING FUNDS: $325,000

DESCRIPTION:

Membrane treatment for municipal drinking water supply (including reverse osmosis and nanofiltration) is the best technology for producing potable water from lower quality/impacted sources that will meet, and often exceed, regulatory requirements. Currently, many sources of water in the Arkansas and South Platte River Basins exceed the regulatory water quality requirements and/or have high levels of total dissolved solids that are unacceptable to consumers. Due to the uncertainty about the availability of feasible disposal options for the membrane concentrate in Colorado many utilities have been reluctant to undertake membrane projects. Zero liquid discharge is a sustainable disposal option that represents a long-term solution to concentrate disposal for utilities that need membrane treatment to produce safe drinking water. The proposed project includes two pilot projects at two sites (Brighton and La Junta) with two different water quality issues (nitrate and selenium, respectively). The pilot projects will develop site-specific cost and performance data to help alleviate current technical and financial uncertainties. Deliverables include various technical memorandum, an experimental plan, design drawings, pilot plant equipment, capital and operating costs under multiple conditions, analysis of water samples, analysis of solids sampling, process schematics and water and energy balances, and a final report. Though the Colorado Department of Public Health and Environment (CDPHE) was the original applicant, the application specified that the contracting entity and project management would be provided by the non-profit American Water Works Association Research Foundation (AwwaRF) in addition to $100,000 of matching funds. Due to AwwaRF's funding problems, they are no longer able to participate in the project or provide matching funds. In its place the CDPHE has secured an identical commitment of participation and matching funds from the WateReuse Foundation (WateReuse). WateReuse is an educational, nonprofit public benefit corporation (501(c)(3)) that conducts applied research on behalf of the water and wastewater community for the purpose of advancing the science of water reuse, recycling, reclamation, and desalination.

Lost Creek Aquifer Recharge and Storage Study

APPLICANT: Lost Creek Groundwater Management District

APPROVED: January 2009

STATUS: In Progress

WSRA FUNDS: $160,000 - Joint Application:
$80,000 - Metro Basin Account
$80,000 - South Platte Basin Account

MATCHING FUNDS: $13,000

DESCRIPTION:
This study seeks to compile, collect, and analyze hydrologic, aquifer property, and water quality data to characterize the groundwater resources in the Lost Creek alluvial aquifer. The study will also evaluate geographic, infrastructure, and land ownership/use information for the purposes of assessing the potential for aquifer recharge and storage implementation. To address the needs of in-basin water rights holders and assist the management district in their decisionmaking processes, the study will: 1) characterize the configuration and extent of the alluvial aquifer within the Lost Creek basin; 2) compile and present current and historic groundwater levels and water level trends; 3) characterize the amount of natural recharge and estimate the available storage capacity in the alluvial aquifer; 4) determine hydraulic and storage properties of the alluvial aquifer; 5) present the spatial relationship with the underlying Denver Basin bedrock aquifers; 6) characterize the land use and ownership; and 7) identify the existing water delivery infrastructure.

Central South Platte Wetland Partnership

APPLICANT: Ducks Unlimited, Inc.

APPROVED: March 2009

STATUS: In Progress

WSRA FUNDS: $150,000 (Basin Account)

MATCHING FUNDS: $565,000

DESCRIPTION:
The Central South Platte Wetland Partnership (CSPWP) creates high-quality recharge wetlands in the South Platte River Basin of Weld and Morgan Counties. Members of the partnership will provide direct diversion rights designated for recharge to meet a variety of beneficial uses corresponding to the objectives and recommendations identified in both SWSI 1 and 2. Recharge wetlands as part of a program to augment South Platte River flows through the alluvial aquifer have become a widely accepted and dependable technique for meeting the demands of water users along the river. The partnership includes the Central Colorado Water Conservancy District, the U.S. Fish and Wildlife Service, the U.S. Department of Agriculture, and private landowners. The CSPWP has identified three sites that will provide both quality wetland habitat for waterfowl and other wildlife species and strong river augmentation sources. The three wetland sites include: the Welker Augmentation Project, the Haren Wetland Development, and the Peckham Augmentation Site.

Fort Morgan Reservoir and Irrigation Company Recharge and Wetlands Project

APPLICANT: Fort Morgan Reservoir and Irrigation Company

APPROVED: September 2009

STATUS: In Progress

WSRA FUNDS: $670,000 ($250,000 - Basin Account; $420,000 - Statewide Account)

MATCHING FUNDS: Up to $2,000,000

DESCRIPTION:
This is a structural water project to both divert water under a junior water right when available for recharge and augmentation use, and to re-divert and re-time augmentation credits that result from more senior recharge projects at certain times when these credits are not needed for direct augmentation use. It is estimated that this project will develop and use approximately 500-1,000 acre-feet per year of new water and 1,500 acre-feet of re-timed augmentation credits. The applicant believes that this project will yield approximately 2,000 to 2,500 acre-feet of additional water available for beneficial use in the basin. While conducting these water supply operations, this project will also benefit waterfowl in the basin by providing additional wetland habitat. To assist in the design and installation of the wetlands and operations, the applicant has teamed up with DU. Initial investigation has led DU to conclude that this project will be very beneficial to wintering and migrating waterfowl in the South Platte Basin.

Data Logger and Telemetry Installation Project

APPLICANT: Northern Colorado Water Conservancy District

APPROVED: July 2010

STATUS: Contracting

WSRA FUNDS: $46,000 (Basin Account)

MATCHING FUNDS: In-kind Services

DESCRIPTION:
This project installs stage discharge data loggers and cell phone modems on diversion structures and return flow augmentation structures to provide real time flow information. In addition, the project will allow the installation of combined meter/data loggers on wells close to the river that are pumped as ditch alternate points or to recharge during free river periods or when credits are available in the river. The well meters have data loggers built in and can be paired with telemetry in the future . The principal focus will be on structures on the Big Thompson drainage, District 4, and the main stem of the South Platte downstream of Kersey and upstream of the state line, District 1 and 64. Data loggers and telemetry allow for continuous information for users and water administrators concerning flows. Even users not directly benefiting from obtaining equipment on their diversions will be benefited because these users will have real time information concerning other diversions. The project provides an excellent complement to the state's existing diversion and stream gage satellite program and is also complimentary to the work being done for the Colorado Decision Support System in obtaining better data concerning river flows and diversions.

Colorado Agricultural Meteorological Network (CoAgMet)

APPLICANT: Colorado Climate Center, Colorado State University

APPROVED: July 2010

STATUS: Contracting

WSRA FUNDS: $20,000 (Basin Account)

MATCHING FUNDS: Yes, unspecified

DESCRIPTION:
This project supports both new and ongoing efforts to better understand and track consumptive use of water resources in northeastern Colorado through the careful monitoring of weather conditions. The Colorado Climate Center (CCC) and Northern Colorado Water Conservancy District operate a network of weather stations in Colorado to help schedule irrigation applications, more accurately track evapotranspiration and crop water use, and observe long-term trends and variations in crop water use in Colorado. In this one-year project, the CCC will identify the 10 best weather stations in the South Platte and Republican River basins that best complement the existing network. These 10 stations located from the foothills eastward to the Nebraska border will be fully serviced, calibrated, and maintained to assure a rich dataset accessible to both agricultural and water professionals, research scientists, and the general public.

Lower South Platte Water Cooperative Organizational Analysis

APPLICANT: Lower South Platte Water Conservancy District

APPROVED: September 2010

STATUS: Contracting

WSRA FUNDS: $260,977 ($60,977 - Basin Account; $200,000 - Statewide Account)

MATCHING FUNDS: Approximately $100,000

DESCRIPTION:
This project will research, analyze, and formulate best fit alternatives for the organizational structure of a potential Water Cooperative in the area of the Lower South Platte River. The initial formation of a new organization would encompass water users within Water Districts 1 and 64 (Kersey to the Colorado-Nebraska Stateline). The Water Cooperative, if successfully implemented, would help manage and retime excess augmentation water available within the area via leases and exchange operations (using current water law, existing water rights, and new water right applications). In addition, the Water Cooperative could potentially serve as an organization to help manage members' direct flow and reservoir water, via leases and exchange operations (using alternative agriculture transfer methods and existing and new change of use water rights) without injury to other water rights. This grant will help analyze water law and water rights issues related to the Water Cooperative in order to identify and prevent injury to other water rights within the basin from the operations described above. This project will also research and determine the best fit for operational planning for the Water Cooperative.

Development of a Decision Support Model for Identifying and Ranking Waterfowl and Wildlife Related Recharge Projects along the South Platte River

APPLICANT: Ducks Unlimited, Inc.

APPROVED: September 2010

STATUS: Contracting

WSRA FUNDS: $99,821 (Statewide Account)

MATCHING FUNDS: Approximately $20,000

DESCRIPTION:

This project seeks to develop a strategic approach to the development of multipurpose wetland recharge projects. It is anticipated that this approach will serve as a model that can be applied to other river basins or geographic areas in Colorado. This project will develop a process and tool (or decision support model) that will be used in locating future water conservation wetland projects in the South Platte Basin between Denver and the Colorado-Nebraska Stateline. There are many factors that influence decisions regarding the most favorable locations for future wetlands. Some of these factors are more important than others and they vary geographically. These are factors that DU has considered in previous projects and will consider in the context of the decision support model. In addition, the project will use the new tool to produce a map showing areas in the South Platte Basin targeted for future water conservation wetlands. Finally, the project will lay the foundation for a program to provide financial and technical assistance to agricultural producers who are interested in constructing water conservation wetlands.

Alluvial Aquifer Accretion/Depletion Analysis Tool

APPLICANT: Colorado Division of Water Resources and the Colorado Water Conservation Board

APPROVED: March 2011

STATUS: Contracting

WSRA FUNDS: $200,000 (Statewide Account)

MATCHING FUNDS: $50,467 (In-kind Services)

DESCRIPTION:

This project proposes to develop a tool to be used by the Division Engineer's Office, water commissioners, and water users to quickly determine an augmentation plan's excess accretions or depletions on a daily basis. This will allow one to assess quickly if excess accretions are available for diversion or if other water rights are being impacted by the out-of-priority diversions associated with the augmentation plan. The Alluvial Aquifer Accretion/Depletion Analysis Tool will use HydroBase as the primary source of input data but will store any additional information that is not currently maintained in Hydrobase.

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Section 8
Strategies for Future Water Supply Development

In the introduction, the South Platte Basin Roundtable's key priorities were listed as follows:

- Ensuring adequate water for future needs for municipal and industrial (M&I), agricultural, environmental, and recreational uses.
- Developing new water storage facilities.
- Minimizing the dry-up of irrigated land.
- Addressing agricultural supply shortages for both surface and groundwater users.
- Addressing potential impacts of agricultural transfers and finding alternatives to permanent agricultural dry-up.
- Successfully implementing endangered species program to protect existing and future in-basin uses.
- Identifying opportunities to optimize existing and future water supply infrastructure.

The basin roundtable strongly believes that no one strategy will achieve all of these key priorities, or adequately provide additional water supply to cover the projected gap described above. Multiple strategies must be pursued simultaneously in order to have any hope of achieving these goals. This section describes the strategies that the basin roundtable has identified to-date that will need to be pursued, to the extent they can be described at this time. Fundamentally, this is a work in progress and revisions to the strategies described below will evolve as future work continues.

Poudre River

8.1 Addressing the Gap

The South Platte Basin Roundtable believes that achieving the first three of the key priorities listed above is tied to developing adequate water supplies to cover the gap defined above. Four individual strategies have been identified by the Interbasin Compact Committee (IBCC) as essential to covering the gap, and the basin roundtable embraces that list, as stated below:

- Maximize the success of identified projects and processes (IPPs)
- Implement appropriate levels of water conservation measures
- Develop new water supply and water storage projects
- Implement appropriate levels of agricultural transfers, without allowing these to become the preferential source for meeting the gap

8.1.1 Identified Projects and Processes

Section 5 describes each basin roundtable's IPPs in detail. IPPs, if successfully implemented, have the ability to meet some, but not all, of Colorado's 2050 M&I water needs. Maximizing the implementation of these local projects and processes is critical to meeting Colorado's future water supply needs, and is especially critical to meeting those needs in the South Platte Basin.

The South Platte Basin Roundtable strongly believes that maximizing success of IPPs is a critical strategy for meeting its future water supply goals.

The basin roundtable strongly believes that maximizing success of IPPs is a critical strategy for meeting its future water supply goals. The same is true for IPPs to supply the Metro Basin Roundtable area. If Metro Basin Roundtable IPPs are not successful, then those water suppliers will be looking for agricultural water supplies located in the South Platte Basin, which will further impair the South Platte Basin's future success in meeting the water supply gap.

8.1.2 Water Conservation

Water conservation will be an important strategy for meeting future M&I demands, but is only one strategy in a group that must all be developed simultaneously. The Colorado Water Conservation Board (CWCB) developed the *Statewide Water Supply Initiative (SWSI) 2010 Municipal and Industrial Water Conservation Strategies Report*. That document contains estimates of conservation levels that might be technically possible up to the year 2050. Although it is one useful step toward estimating potential water savings from conservation, additional work needs to be done before reliable, quantitative estimates of future conservation will be available.

Passive conservation has already been included in the projected water supply gap, and has been assumed to reduce future water demands one-for-one in the amount of 154,000 acre-feet per year (AFY). Although the basin roundtable does not dispute these numbers, it believes that this may be an unduly optimistic quantitative estimate of passive conservation's future contribution to the overall water supply picture. To the extent that passive conservation in the future reduces return flows that have been available to users in the lower portion of the basin, it may add to the water supply gap.

Additionally, the *CWCB Conservation Strategies Report* contained three levels of estimated active conservation savings – low, medium, and high. Although a potentially helpful first step in the analysis of projected active conservation savings, the basin roundtable believes that achieving conservation at the levels noted in the medium and high scenarios in the real world will be challenging, at best. The CWCB study specifically did not analyze the economic, political, or social feasibility of implementing the steps needed to achieve higher levels of active water conservation. It also specifically did not analyze several key variables that will be important in obtaining a reliable estimate of future water conservation for water supply planning purposes, which include:

- Whether saved water can and will be applied toward serving new demand, or whether it will be devoted to drought reliability or other local needs.
- Whether conservation savings achieved since the 2002 drought are permanent, and therefore a reliable baseline for future planning purposes.
- The impacts of climate change were not considered.

While there is no question that water conservation will be one essential element of our water supply future, additional and detailed studies are needed before a reliable, quantitative estimate of its reliable contribution to water supply planning will be available. The basin roundtable hopes that the IBCC, all of the

basin roundtables, and the CWCB can work together with municipal water suppliers to develop the currently missing data, perform these needed additional studies, and obtain more reliable estimates of achievable water conservation savings. This statement should not be misunderstood – the basin roundtable endorses and encourages the future development of active M&I conservation practices. However, the projected levels of such practices must fit with economic, political, and social reality, and be developed appropriately to match the needs and circumstances of local water suppliers.

8.1.3 New Supply

The basin roundtable strongly believes that there is some available water to be developed from the Colorado River Basin, and that all of Colorado needs to work together to successfully develop it. The basin roundtable supports the CWCB's ongoing studies to try to estimate the amount of available water. It also endorses the concept that such development must occur in a fair and balanced manner and benefit both the West Slope and the East Slope and incorporates appropriate risk management strategies. At this time, the basin roundtable has not developed a quantitative estimate of the potential amount that it believes will be available from such new supply projects. However, as soon as the revised portfolio tool is developed by the CWCB and its consultants, the basin roundtable plans to actively participate in the development of portfolio-based estimates for the new supply strategy.

8.1.4 Appropriate Agricultural Transfers with Minimized Dry-Up of Irrigated Land

The basin roundtable understands that some level of agricultural transfers will be one tool in addressing the M&I water supply gap. A portion of this conversion will take place where cities grow over irrigated agricultural lands. However, as documented in other parts of this report, irrigated agriculture is a large contributor to the economic vitality of the South Platte Basin and the State of Colorado. For this reason the roundtable firmly believes that the dry-up of irrigated land should be minimized. Additionally, the roundtable wishes to emphasize the fact that many of the nonconsumptive needs and values located within the South Platte Basin are the result of return flows from irrigated agricultural land. The widespread dry-up of this land will seriously impact both economic and environmental needs and values. A common argument against the development of new water supplies on Colorado's West Slope is the adverse impact on the environment there. However, without development of available supplies on the West Slope, the inevitable result will be the increased dry-up of agricultural land and negative impacts to environmental values in the South Platte Basin. These are critical factors in the roundtable's conclusion that the dry-up of irrigated land should be minimized.

The basin roundtable understands that some level of agricultural transfers will be one tool in addressing the M&I water supply gap.

8.1.5 Developing New Water Storage Facilities

In recent years, it has become increasingly difficult to develop any new water storage capacity. Such projects have been a popular target for opposition by numerous special interest groups. The basin roundtable wants to remind readers that many new storage facilities are not built only for developing new water rights, but also for the purposes of firming the dry year yield of existing water portfolios and already-changed agricultural rights. Changed irrigation rights, including ATMs, that can divert only during the summer season need to be stored when available for year-round use. Additionally, the need for new storage will become increasingly important if the water supply gap is coupled with the effects of potential climate change.

The following are the assertions that could portend a potential climate change:

- A larger percentage of total precipitation may fall as rain, rather than snow.
- Earlier runoff patterns that may be developing do not match the timing of summer irrigation needs in both cities and on farms.
- Increasing temperatures would increase the consumptive needs of both municipal landscapes and farm fields.
- Large variations in precipitation patterns.

Storage also provides management options to better meet nonconsumptive needs. Therefore, additional water storage facilities will need to be constructed, in a timely fashion, in order to meet existing and future demands. The basin roundtable firmly believes that the future need for new water storage facilities cannot be understated, and that Colorado urgently needs to develop new strategies that will facilitate the construction of new water storage.

8.2 Alternative Transfer Methods

One of the outcomes of SWSI 2 was the recognition that the State of Colorado might be able to provide incentives for M&I providers to consider alternative methods for their water supply options. In response, the Legislature passed Senate Bill 07-122 authorizing the CWCB to develop a grant program to facilitate the development and implementation of alternative agricultural water transfer methods (ATMs).

Since its inception in 2007, the CWCB's Alternative Agricultural Water Transfer Methods Grant Program has awarded $1.5 million to various water providers, ditch companies, and university groups for the funding of six unique projects, five of which have been underway during 2009 –2011. As illustrated in SWSI 2, rotational fallowing, interruptible supply agreements (ISAs), water banks, purchase and leasebacks, deficit irrigation, and changing crop type are the kinds of options that are available as alternatives to permanent agricultural transfers.

North Platte Basin Agricultural Linkages to the South Platte and Arkansas Basins

Members of the North Platte Basin Roundtable acknowledge agricultural economic linkages to the South Platte and Arkansas Basins. While we do not offer quantitative data, the following general economic indicators represent potential areas that could be quantified for further economic analysis. In the broadest sense, agricultural dry up in the South Platte and Arkansas basins will result in an industry-wide domino effect, negatively impacting Colorado agriculture. The general public does not seem to grasp the significant negative impacts that agricultural dry up would likely have on food security in Colorado and beyond.

- Generally, the deterioration of the agricultural infrastructure due to agricultural dry up in the South Platte and Arkansas basins would significantly increase the cost of doing agricultural business in the North Platte River basin. The situation is further exacerbated by the increasing cost of fuel.
- North Platte producers would need to travel significantly further distances west and east to do business. Cattle and hay markets would be impacted by increasing cost of production due to the increase in transportation costs if agricultural auctions and sale barns were to close their doors.
- Feed lots that currently purchase North Park commodities may decline, thus negatively impacting the lesser quality hay market.
- North Platte producers' costs of doing business would increase significantly if ranch feed and supply stores declined in Front Range counties.
- Profit margins of local ranch feed, supply and service businesses would likely decline in the face of increased transportation and shipping costs to maintain adequate local inventories.
- The number of veterinarians serving the cattle producers would likely decline in our region and it would be difficult to maintain herd health at a reasonable cost.

With the exception of purchase and leasebacks and some limited occurrences of short-term leasing, these ATMs are just beginning to be explored as viable options for meeting M&I water demands in Colorado. While promising, there are technical, legal and institutional, financial, and other issues associated with ATMs. Through the ATM Grant Program, CWCB and others 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.

8.2.1 ATM Grant Recipients

The recipients of funding from the ATM Grant Program are identified in **Table 8-1** below, along with the amount of grant funding awarded to each by the CWCB.

Table 8-1 Recipients of CWCB Alternative Agricultural Water Transfer Methods Grants

Name	Grant Funding
Parker Water & Sanitation District (PWSD) and Colorado State University (CSU)	$477,500
Colorado Corn Growers Association (CCGA)	$349,650
Lower Arkansas Valley Water Conservancy District (LAVWCD) Super Ditch Company	$320,000
Farmers Reservoir & Irrigation Company (FRICO)	$202,500
CSU Extension Office	$80,350
High Line Canal Company	$70,000
TOTAL	**$1,500,000**

Of the projects listed in the table, three are located in the South Platte Basin – PWSD and CSU, CCGA, and FRICO. The following sections provide a brief synopsis of each entity's approach to identifying viable ATMs.

8.2.1.1 Parker Water & Sanitation District and Colorado State University

In its evaluation of the reduced consumptive use (CU) ATM concept, SWSI 2 reported that "Determination of the transferable amount would be complicated…To date limited research has been conducted in Colorado to assess crop [evapotranspiration (ET)] under deficit irrigation schedules." The Lower South Platte Irrigation Research and Demonstration Project (LSPIRDP) is a 4-year study that is seeking to remedy this data shortfall by quantifying potential consumptive water use savings resulting from the use of deficit irrigation practices. By reducing the CU of irrigated crops, an incremental volume difference between historic and future CU can be computed. With approval of the State Engineer's Office (SEO), it is believed that this volume of water could be transferred to municipal use. In addition to field-scale research, the test program is being implemented on three demonstration farms to ensure that working farmers understand the proposed practices and that the practices are operationally and economically practical. Phases 1 through 3 of the project are complete and were documented in a report submitted to CWCB in January 2010.

As described by Hansen et al., Phase 1 of the study sought to identify "[c]ropping systems with potential to reduce consumptive use by at least 20 percent compared to continuous corn with full irrigation." The following cropping systems were selected as alternatives to permanent dry-up of irrigated land:

- **Limited Irrigation** – A form of deficit irrigation that seeks to maximize water productivity through timing of irrigation applications at critical crop growth stages and through managed soil depletions for systems with less than adequate capacity or limited quantities of water.
- **Rotational Cropping** – Rotations that combine annual crops under full irrigation with fallow periods or with non-irrigated crops.

- **Partial Season Irrigation** – Irrigation to meet full demand of the crop for a portion of the growing season in combination with periods of no irrigation. This approach has particular relevance to perennial forage crops like alfalfa.

Phase 2 involved an extensive field study to test the alternative irrigation practices identified above. Hansen et al. reported the following findings related to crop CU savings, presented here as ET reductions:

> Rotational cropping systems were effective at reducing ET, with average ET reductions of 30 to 40 percent compared to continuous corn. Rotating irrigated crops with dryland crops was a more water efficient approach than rotating with non-cropped fallow land because of high water loss during fallow to evaporation and drainage. Corn produced after a fallow period or dryland crop had a higher yield and water use efficiency [crop yield per acre per inch of ET] than continuous corn, illustrating the benefits of crop rotation to maximize water use efficiency.
>
> Both rotational cropping and limited irrigation of sugarbeet in rotation with an annual forage crop saved 40 percent of the reference crop ET. Sugarbeet is drought tolerant and shows good adaptability to limited irrigation. Soybean had moderate yield but is a lower water use crop than corn even under full irrigation. Under limited irrigation, soybean had higher water use efficiency…Its growth and performance suggested it may be a good alternative crop for water conserving cropping systems in the South Platte River Basin.

Sugar beet research in Fort Collins, CO

To summarize, both limited irrigation and rotational cropping systems are effective at reducing crop CU, with average reductions of 30 to 40 percent compared to continuous corn. The remaining phases of the LSPIRDP are in progress.

8.2.1.2 Colorado Corn Growers Association

Working with Ducks Unlimited and the City of Aurora, the CCGA is investigating a variety of ATMs. The transfer methods are being applied to three demonstration projects – the DT Ranch ISA, the Lower South Platte Co-op, and a Private Water Market – two of which involve wetlands. These wetlands provide a number of benefits, including recharge to the South Platte alluvial aquifer, which can be used in an augmentation plan for out-of-priority groundwater pumping. The third demonstration project is exploring a marketing mechanism for facilitating ATMs.

The study will also produce a business plan, which will be made available to other water users to help facilitate practical utilization of alternative transfer methods. As of June 2010, technical and legal analyses associated with the CCGA project are complete, as is one of the demonstration projects. The remaining two demonstration projects and other analytical aspects of the project are underway.

8.2.1.3 Farmers Reservoir & Irrigation Company

FRICO is investigating a number of ATMs, including rotational fallowing, ISAs, lease back agreements, and changes in cropping patterns. Much like the PWSD/CSU study, the objective of these methods is to reduce CU for purposes of transferring the "saved" CU to municipal or industrial users. The project also includes the evaluation of a water bank concept that would utilize existing FRICO infrastructure to store excess municipal supplies in FRICO surface or groundwater storage and then convey it to other agricultural and municipal users when needed. SWSI 2 identified two key hurdles to water bank success:

- A trading hub, such as a large regional reservoir and distribution/delivery system, is necessary to provide for storage and distribution of banked water to a large, regional customer base.
- Developing a water bank in a location that does not either have the necessary infrastructure to deliver water to new demands or where such infrastructure cannot be cost-effectively installed is likely futile.

Water banking may not be feasible at the basin level. However, there appears to be more potential success for large irrigation companies located at or near the urban-rural interface, particularly those with existing storage facilities and infrastructure in place to facilitate the efficient wheeling of water throughout the system. Located in the North Metro area, FRICO would seem well positioned to take advantage of these factors.

Another issue that may influence FRICO's and possibly other irrigation companies' approaches to ATMs is the Colorado Supreme Court opinion in 09SA133 issued on May 31, 2011. This opinion decided the appeal of Case No. 02CW403 in Water Division 1, which involved an application for water rights filed by FRICO; Burlington Ditch, Reservoir, and Land Company (Burlington); Henrylyn Irrigation District (Henrylyn); East Cherry Creek Valley Water and Sanitation District (ECCV); and United Water and Sanitation District (UWSD). The co-applicants filed for several water right claims in 2002. There were 47 statements of opposition filed to the application, and a 16-day trial was held in April and May of 2008.

The application included a claim for decreed rights of exchange on the South Platte River and for alternate points of diversion and places of storage for FRICO, Burlington, and Henrylyn. It also included a claim by FRICO, UWSD, and ECCV for approval of a plan for augmentation and for changes in use of Burlington and FRICO shares used in FRICO's Barr Lake Division. The change in use included a system-wide analysis for quantification of the FRICO and Burlington shares.

The Findings of Fact, Conclusions of Law, and Decree signed on May 11, 2009 by Judge Roger Klein approved the application but with use and volumetric limitations on the changes in use that were far more restrictive than the co-applicants requested. As a result, the co-applicants appealed the decision to the Colorado Supreme Court and oral arguments were presented in January 2011.

Key features of the decree included:

- Reducing the Burlington 1885 direct flow water right from 350 cubic feet per second (cfs) to 200 cfs and restricting its use to lands above Barr Lake, based on historical use of the Burlington shares during a study period of 1885 to 1909, which was the period before FRICO acquired an interest in the Burlington system;
- Limiting releases from Barr Lake under the Burlington 1885 storage right to lands under the Hudson and Burlington extension laterals, irrigated prior to FRICO's involvement in the system, at an annual average of 5,456 AFY;
- The historical CU attributed to water collected through the Barr Lake toe drains and from seepage into the Beebe Canal was disallowed;
- The historical CU of water diverted by the Metro Pumps as undecreed points of diversion for the Burlington Canal was also disallowed.

The Supreme Court unanimously upheld the water court's judgment and decree in its entirety. One result of this ruling has been increased concern by some agricultural water rights holders that they could also have their historical practices altered and historical consumptive use limited if they subject their water rights to a change in use to facilitate ATMs.

8.2.2 Overview of Agricultural Transfers in the South Platte River Basin

The following sections discuss the present state of agricultural transfers throughout the South Platte River Basin and identify water districts in which ATMs have a greater likelihood of success.

8.2.2.1 South Platte River, Water District 2, Commerce City to Kersey

In this reach of the South Platte River, there is considerable activity to acquire water rights and related historical CU for municipal purposes. **Figure 8-1** shows the boundaries of Water District 2 and identifies the locations of major diversion structures. This reach of the river has over 2,270 cfs of water rights decreed for irrigation with priorities equal or senior to November 20, 1885. The upper canal is the Burlington Canal with 377 cfs equal or senior to November 20, 1885. The lower canal is the Lower Latham Canal with 287 cfs equal or senior to October 24, 1881. In between the canals are 13 other canals with priorities as senior as April 1, 1860 and as junior as April 29, 1882. This area irrigates around 90,000 acres using a duty of water of 1 cfs per 40 acres.

Many of the canals or ditches have priorities in the 1860s and 1870s and there are three dry-up points on the river identified by the Division of Water Resources (DWR) below senior canals and include the Burlington Canal, Jay Thomas Ditch (June 1, 1865), and Lower Latham. These dry-up points create impediments to exchanges of water upstream and would require some local storage of CU water from dry-up until exchange conditions develop with higher stream flows.

Some of the water rights associated with the 15 canals and ditches in Water District 2 have been acquired and the use changed to municipal use in previous water court actions; others have been acquired and are presently going through change in use proceedings. Additionally, some of the water rights that have been purchased are being leased back to farmers until a change in use to municipal use is needed to meet growing demands. The more senior water rights have received over $20,000 per AF of historical CU based on information related to recent sales.

In this reach of the South Platte River, there is infrastructure in place to deliver water from below Barr Lake to the area served by ECCV, located south of Aurora and east of Cherry Creek Reservoir. ECCV has also entered into an agreement with Arapahoe County Water and Wastewater Authority (ACWWA) to sell excess capacity in its pipeline to the authority for delivery of water to its service area in Centennial. ACWWA will purchase water from UWSD, which will acquire the necessary senior water rights and change them to municipal use. UWSD will also provide water to ECCV from changed irrigation rights.

Prairie Waters Project in Aurora, CO

As of early 2011, the City of Aurora has nearly completed its Prairie Waters Project (PWP) that will pump water from the South Platte River near Brighton to Aurora Reservoir. This project will recover reusable effluent controlled by Aurora that is in the South Platte River but also could be used to pump water acquired from senior water right owners in this reach of the South Platte. To facilitate these operations, Aurora has purchased water rights from a number of canals or ditches in Water District 2.

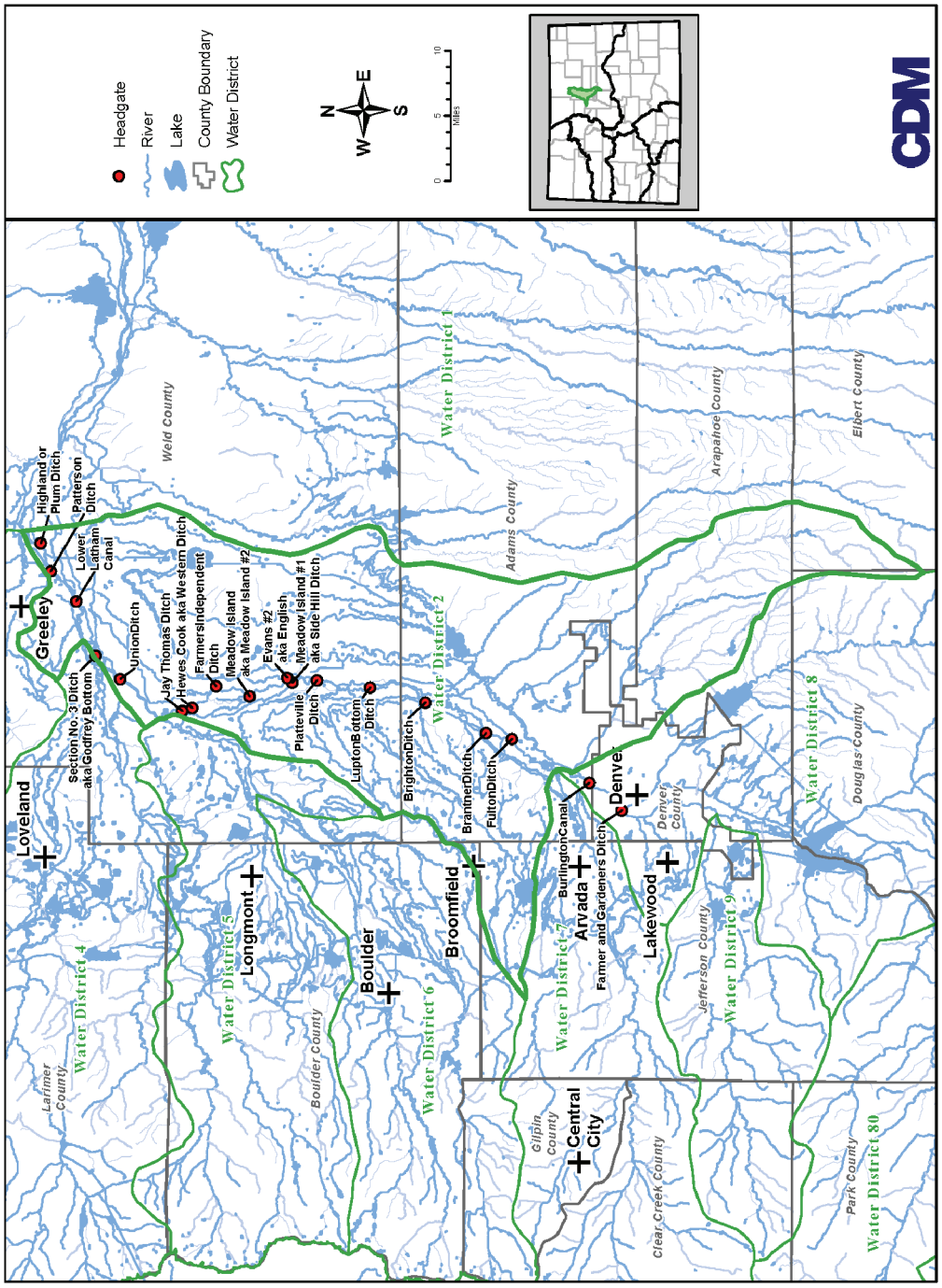

Figure 8-1 Major Irrigation Diversions in Water District 2

There are other entities looking to purchase water rights in the area including the South Metro Water Supply Authority (SMWSA). It is anticipated that this reach of the South Platte River will be subject to several traditional water right changes in use—resulting in permanent dry-up—and is therefore not very amenable to ATMs for use of irrigation water rights for municipal use. The land irrigated would be useful for gravel pits or subdivision since it is in the growth corridor of the Front Range. On the other hand, the FRICO Barr and Milton systems are located in Water District 2, and depending on FRICO's reaction to the opinion in 09SA133 and the ongoing FRICO ATM study described in Section 8.2.1.3, ATMs in the form of a water bank or other ISAs may yet prove to be viable in this reach of the South Platte River.

Another significant activity occurring in this part of the basin is the Water Infrastructure and Supply Efficiency (WISE) Partnership where over the last several years, Aurora Water, Denver Water, and the SMWSA have been discussing and negotiating terms to enhance the reliability of water supplies for the Denver Metro area by using excess system capacities and unused reusable water. Denver Water and Aurora Water have identified interruptible, though significant, amounts of available reusable water in both systems as well as excess capacity in Aurora's PWP to convey and treat those supplies. If the WISE Partnership comes to fruition, the project could provide revenue to Aurora to defray costs of the PWP to the city's customers, to provide a strategic reserve supply to Denver Water, and ultimately provide as much as 60,000 AFY in average annual yields to SMWSA entities in normal and wet years.

8.2.2.2 Cache la Poudre River Basin (Water District 3) and Big Thompson River Basin (Water District 4)

In the Cache la Poudre (Poudre) and Big Thompson River Basins (see **Figure 8-2**) there are considerable water rights acquisition activities that have been completed by Greeley, Thornton, Fort Collins, and Loveland as well as some smaller rural water districts. In some acquisitions, the water is being leased back to the farmers until the municipal providers grow to the point where water needs require the land to be removed from irrigation. Some of the water rights have been changed to municipal use already—such as the Thornton purchase of the Water Supply and Storage Company (WSSC) shares—and the land was irrigated for several decades (or is still being irrigated) under leases to farmers before permanent dry-up and revegetation with native plant species. Some previous change-in-use cases were able to use ditch-wide change procedures and this has encouraged the sale of remaining shares in these canals since the historical CU has been established. As long as the farmer has been using the owned shares efficiently and as historically identified in the initial change case, the sale of remaining shares is more attractive and will Company (Home Supply Ditch) in the Big Thompson Basin (Andrew Jones, personal communication, December 9, 2010). Again, this area is thought to be more amenable to traditional agricultural change in use cases resulting in permanent dry-up rather than ATM. The value of the irrigated land for subdivision development is also quite attractive due to the location in the growth area in the Loveland, Greeley, and Fort Collins area.

Poudre River

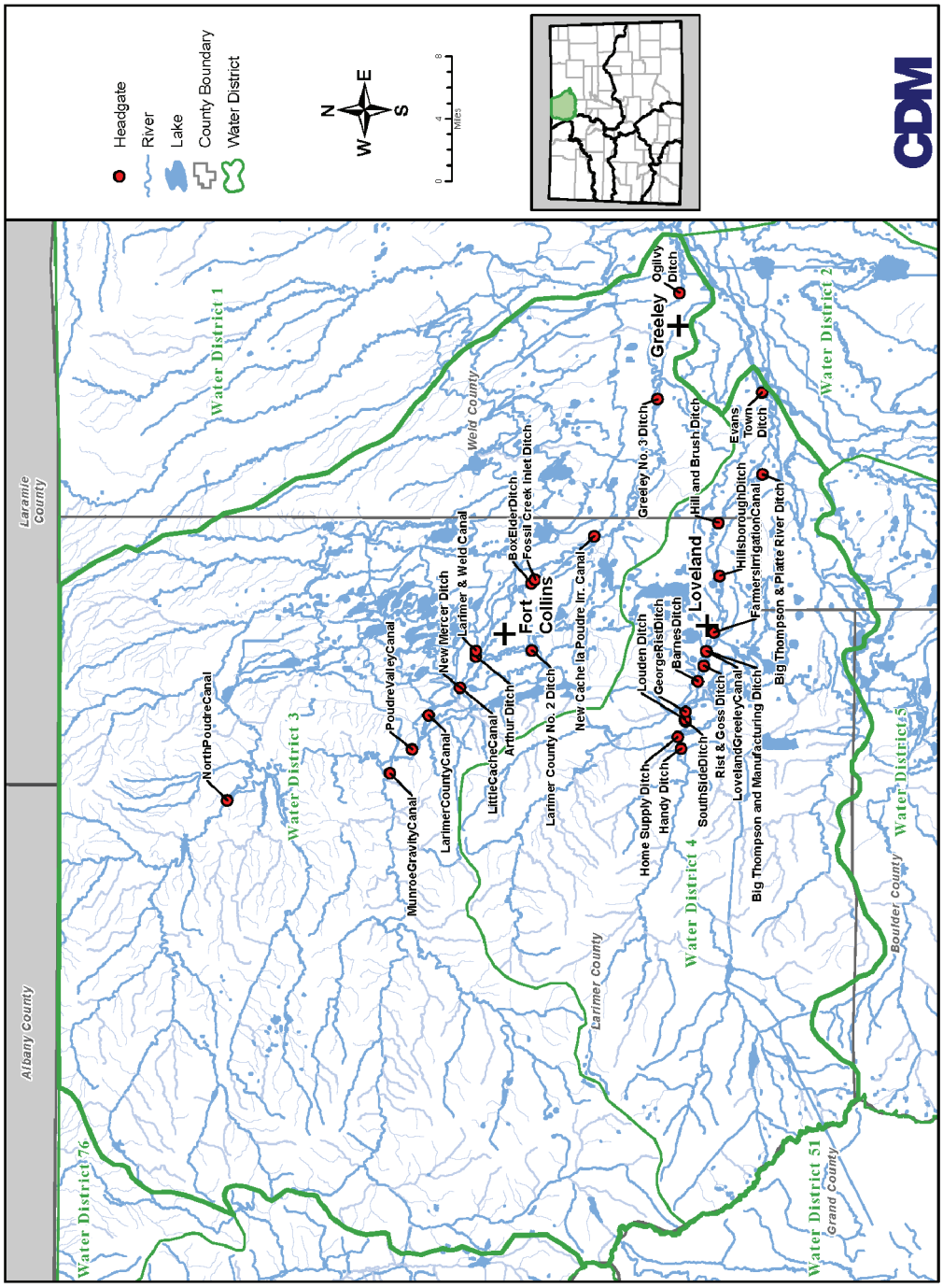

Figure 8-2 Major Irrigation Diversions in Water Districts 3 and 4

8.2.2.3 South Platte River, Water District 1, Kersey to Hillrose

This reach has 12 canals and ditches that divert water to irrigation use and 5 canals that divert water to off-channel storage for irrigation use. Some of these structures are shown in **Figure 8-3**, which also illustrates the boundaries of Water District 1. The earliest priority is one small right from 1868; the majority of the larger rights have priorities in the early- to mid-1880s. The DWR has identified three administered dry-up points in this reach:

- Below the Bijou Canal
- Below the Upper Platte and Beaver Canal
- Below the Lower Platte and Beaver Canal

The acquisition of irrigation water rights for municipal use is occurring at a slower pace in Water District 1 than in the areas previously described, according to available information. This is likely related to several factors, including water rights more junior than those in upstream water districts; diminished water quality (i.e., higher total dissolved solids concentrations) relative to upstream reaches; and the lack of existing infrastructure to deliver water from the Lower South Platte River to centers of demand. Nonetheless, UWSD has purchased land and water rights on the 70 Ranch near Hardin and has obtained a change in use for some of the water rights. UWSD, ECCV, and ACWWA have also filed for conditional water rights for municipal use, recharge, and irrigation on the South Platte River near the 70 Ranch. Water would be exchanged upstream to diversions on the South Platte River near Brighton; conditional exchange rights have been filed by these entities and many others in this reach. The water would be pumped from the South Platte River to Barr Lake for use by UWSD, ECCV, and ACWWA in the ECCV Northern Project.

This reach of the South Platte is more likely to be included in ATMs such as rotational fallowing since the land is not as desirable for subdivision and due to the rural character of the area. SWSI 2 reached a similar conclusion previously, stating the following:

> [T]he areas that may have a high probability for implementing a successful rotational fallowing program would be areas that are not facing urbanization or other development pressures or acquisition by other water providers. [The required] amount of acreage in the South Platte…is located in the lower reaches of [the] basin…The most likely geographic areas for a rotational fallowing program in the South Platte appear to be in Water Districts 1 and 64.

Water District 1 also has several large reservoirs that may be feasible to use for the storage of water from rotational fallowing under the canal systems served by the reservoirs. These include Riverside Reservoir that serves the Riverside Canal, Jackson Reservoir that serves the Ft. Morgan Canal, and possibly Empire Reservoir that serves the Bijou Canal. There are also recharge projects under all three canal systems that are used to augment well depletions from wells under the canals. If they can be used to store the CU from rotational fallowing or other ATM projects, these reservoirs would greatly improve the exchange efficiency and the prospects for successful ATM implementation.

Water from the ATM projects and water stored in the reservoirs identified above could be exchanged upstream when conditions permit to storage in gravel pit reservoirs owned by several municipal entities along the South Platte River in Water District 1. These gravel pit reservoirs are lined and are not in hydraulic connection with the river. Water from these gravel pit reservoirs is either pumped or exchanged by the municipalities to points of diversion, treatment, and use.

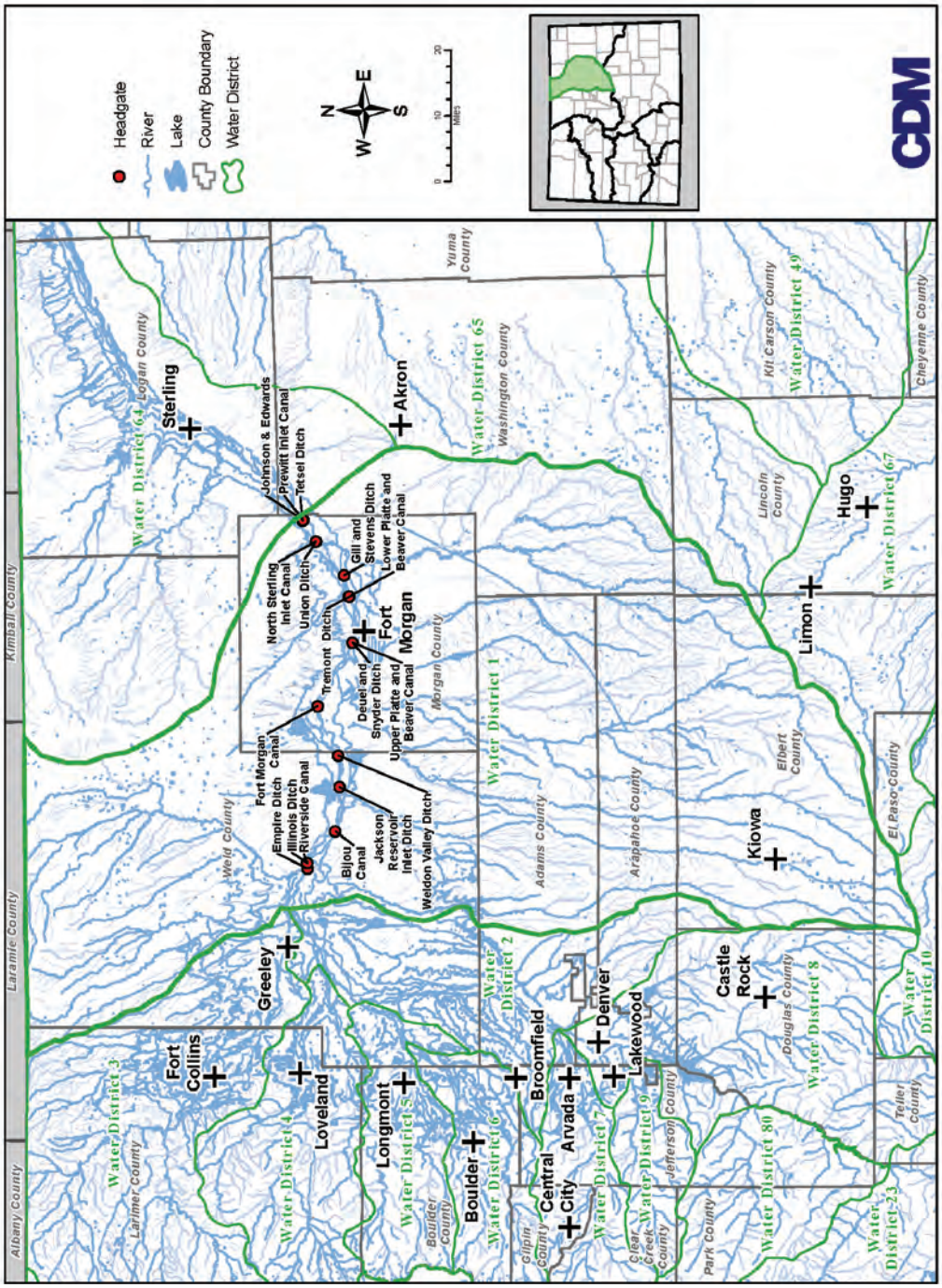

Figure 8-3 Major Irrigation Diversions in Water District 1

8.2.2.4 South Platte River, Water District 64, Hillrose to Stateline

This reach has 16 canals and ditches, most of which are not as large as those in Water District 1, that divert water for irrigation use; many of these structures are shown in **Figure 8-4**. The priorities are mostly in the mid to late 1880s with the exception of the Sterling No. 1 Canal, which has a right for 114 cfs with a priority of July 15, 1873 and often places a call on the river. There are nine administered dry-up points within Water District 64. These dry-up points would make exchanges upstream from changed irrigation rights difficult and would require reservoir storage to improve the yield of a rotational fallowing program or a traditional "buy-and-dry" transfer.

There are two ATM grant-funded projects in this reach that provide useful information on various ATM concepts and include the PWSD and CSU LSPIRDP (see Section 8.2.1.1) and the CCGA, Ducks Unlimited, and City of Aurora Project (see Section 8.2.1.2).

The inability to exchange water from this reach to municipal growth areas upstream have been identified by project proponents and discussions are underway to see if there may be ways to overcome some of the dry-up point limitations. One example is the Lower South Platte Co-op concept being studied by CCGA. There also has been the recognition that pump back infrastructure may be required to increase the effectiveness of ATMs or traditional changes in use of irrigation water rights. These conclusions are again consistent with the SWSI 2 report, which states:

> Significant infrastructure would be required to deliver agricultural water from the lower South Platte…to the gap areas of the south metro area or northern El Paso County. As identified in the SWSI Report, there is very limited new exchange potential that would allow this water to be diverted upstream using existing infrastructure. This infrastructure would be needed even if a traditional agricultural transfer were to be implemented from the same geographic areas…[A]pproximately 60 to 100 miles of pipeline would be required to convey water from the agricultural areas to a centralized location near two major gap areas. Pumping facilities would also need to be constructed to lift the water 1,500 to 3,500 feet.

There are three off-channel reservoirs in Water District 64 – North Sterling, Prewitt, and Julesburg Reservoirs. North Sterling Reservoir is too far away from the South Platte River to be of much value in storing water to assist an exchange. Prewitt Reservoir is located near the South Platte River at the upper end of Water District 64 and would therefore be a potential facility to store changed water rights for exchange or pump back to the metro area. New storage could be built if a site can be found for storing changed direct flow irrigation rights.

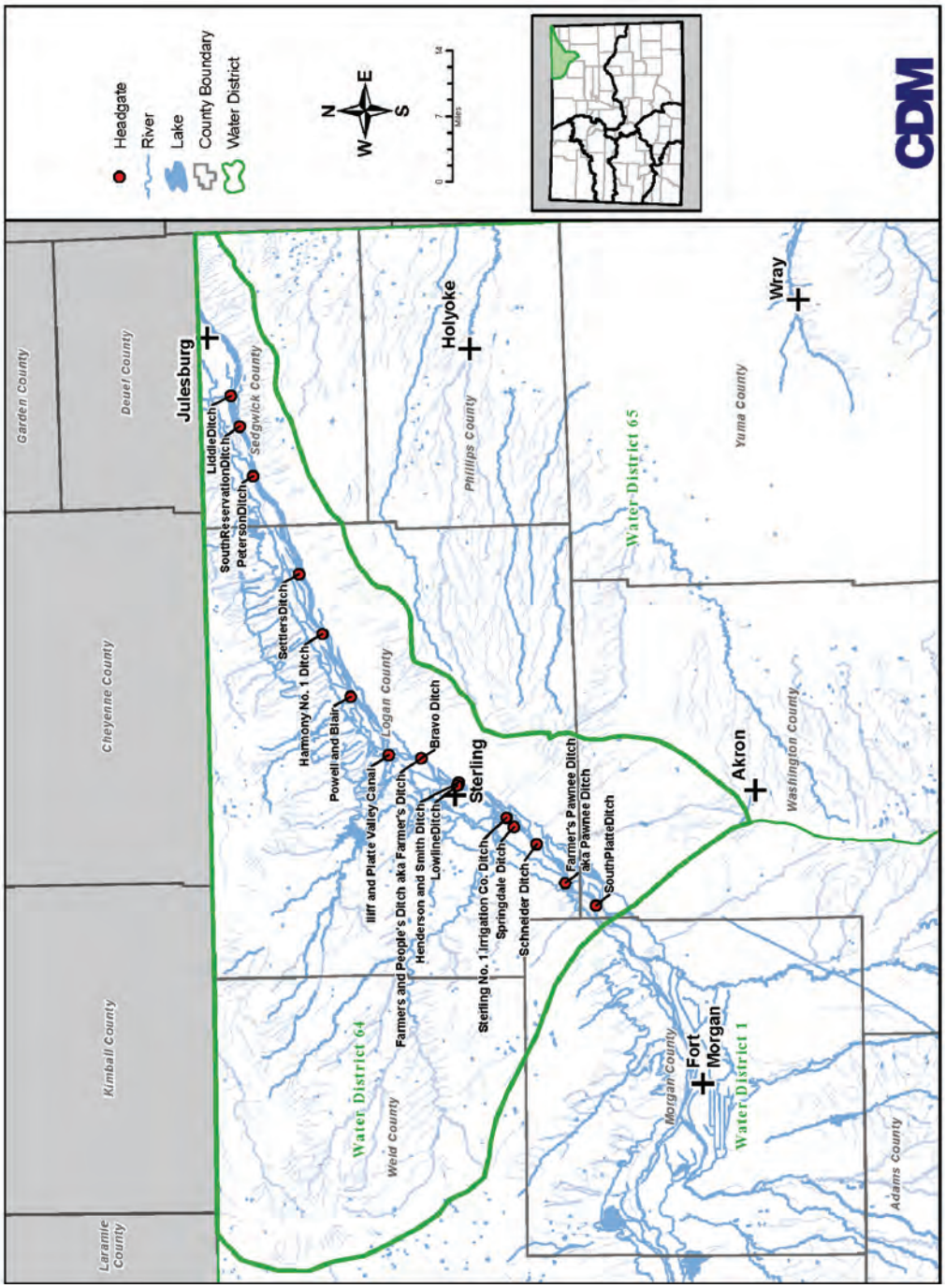

Figure 8-4 Major Irrigation Diversions in Water District 64

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Section 9
Conclusions

In summary, the South Platte Basin is a region that is rapidly developing. A gap scenario using medium demand and a 60 percent success rate of the identified projects and processes (IPPs) ("status quo scenario") is presented in **Figure 9-1**. This leaves the basin with a projected 110,000 acre-foot (AF) gap. A 100 percent success rate on the IPPs in one medium demand scenario meets part of the demand, but still leaves a projected 64,000 AF gap.

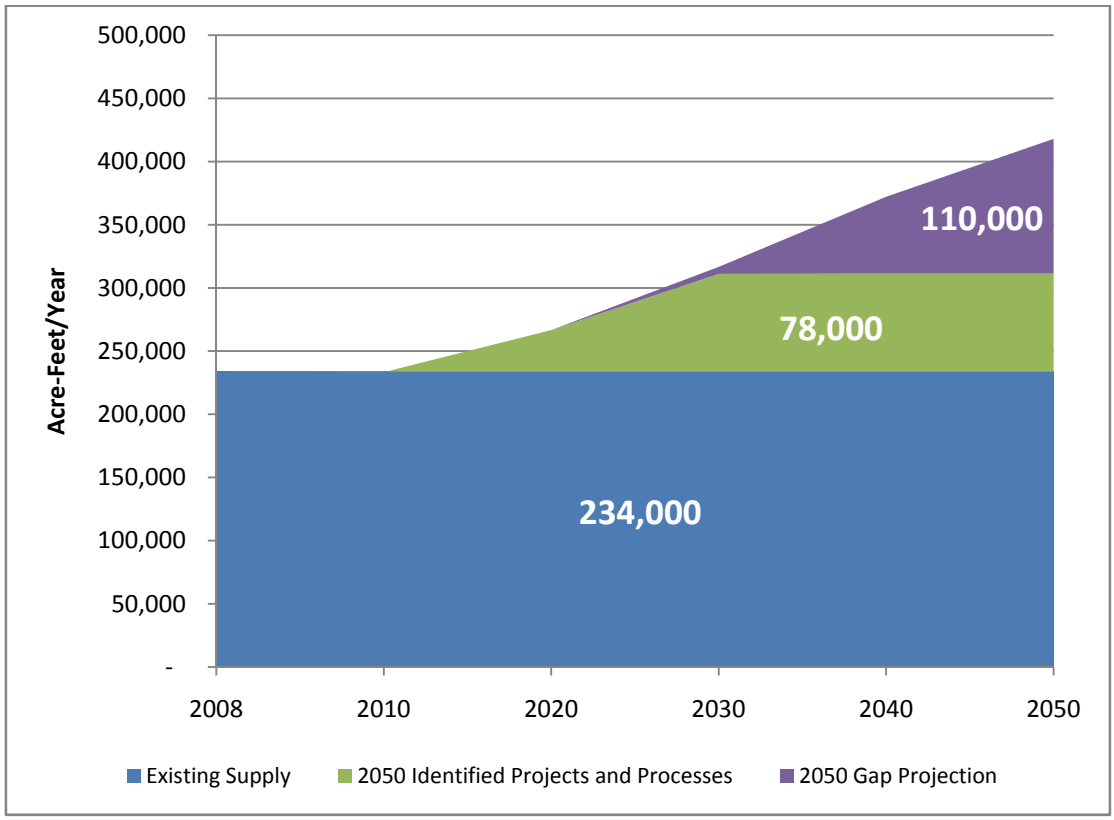

Figure 9-1 South Platte Basin M&I and SSI Gap Summary Medium Scenario (IPPs at 60% Success Rate)

Competing Water Supply Projections: The South Platte Basin Roundtable believes that there is a significant overlap in the projection of available future water supplies by many municipal water providers within the basin. In other words, there is competition for the same sources of available water supplies.

Little Unappropriated Water: In general terms, the South Platte Basin is one of the most highly developed river basins in Colorado. Much of the water is used and reused approximately 6 to 7 times between the Front Range headwaters and the state line. Therefore, additional development of unappropriated water is simply not going to be a significant source of water to meet future consumptive needs within the basin, and especially not municipal and industrial (M&I) needs located higher in the basin. The water supply that is unappropriated is typically available only in wet years during the runoff period, and often lower in the basin.

Changing River Administration: As a general matter, changes in river administration in recent years have tightened and decreased the availability of water from both existing water rights and the development of junior conditional water rights.

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. The amount that may be available for future reuse has not been reliably estimated, but the basin roundtable believes that it is unlikely to be large enough to meet the projected gap. Additionally, to the extent that upstream M&I users begin to reuse water that has historically been allowed to flow downstream, it will diminish supplies available to other users. So, reuse does not necessarily diminish the total water supply gap for all uses.

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.

Water Conservation: Most municipalities within the basin have developed or are developing water conservation plans. Following the drought of 2002, water conservation has been prominent, and more conservation is expected to be implemented in the future. Although conservation will undoubtedly reduce the future water supply gap by some increment (the amount of which has not been reliably estimated), the basin roundtable strongly believes that it will not alone be sufficient to meet additional future water demands. Additionally, similar to reuse, when upstream M&I users conserve more water, one effect is to diminish return flows that have historically flowed downstream, which will diminish supplies available to other users. So, water conservation does not necessarily diminish the total water supply gap for all uses.

The future water supply gap in the basin is large, and growing. However, this roundtable is firmly convinced that the future water supply gap in the basin is an urgent problem that must be addressed with all due speed.

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

As has been depicted in this report, the South Platte serves as the primary agricultural economic engine for Colorado, with Weld County being one of the highest producing agricultural counties in the country. In addition, the South Platte serves all other basins by furnishing agricultural products and providing value added agricultural services (e.g., dairy production, meat processing, and feedlot operations).

The roundtable firmly believes that the status quo is not acceptable because it will likely lead to the dry-up of 180,000 to 267,000 acres of irrigated farmland in the South Platte Basin. Although alternatives to traditional buy and dry may provide some valuable supplies for M&I use, these methods also cannot met the water supply gap alone.

The South Platte Roundtable firmly believes that successfully addressing the gap will require simultaneous implementation of all of the following strategies:

- Appropriate levels of active and passive M&I water conservation
- Maximized implementation of all IPPs
- Appropriate levels of agricultural transfers (traditional and alternative)
- Development of additional Colorado River supplies for use on both the West and East Slopes
- Construction of new water storage facilities to assist in implementation of all strategies and to maintain the yield of existing water rights

Sugar beets in the South Platte Basin

The South Platte Basin Roundtable understands that future water supply planning is a complex undertaking, and that many different interests and perspectives come into play. Over the past several years, the roundtable has worked hard to fully consider all of these interests and perspectives and to develop a fair and balanced set of strategies that have a sound technical basis, are practical and achievable in the real world, and will realistically provide adequate water supplies to meet the rapidly growing needs of the basin's diverse M&I, agricultural, environmental, and recreational water uses. The South Platte Basin Roundtable looks forward to working with the other roundtables, the Interbasin Compact Committee, and the Colorado Water Conservation Board to continue this important work to help provide for the future vitality of the basin and the entire state.

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