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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North Platte Basin

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Acronyms

AF	acre-feet
AFY	acre-feet per year
BLM	Bureau of Land Management
CBEF	Center for Business and Economic Forecasting
CDOW	Colorado Division of Wildlife
CDSS	Colorado Decision Support System
cfs	cubic feet per second
CNHP	Colorado Natural Heritage Program
CRWAS	Colorado River Water Availability Study
CSU	Colorado State University
CU	consumptive use
CU&L	Consumptive Uses and Losses
CWCB	Colorado Water Conservation Board
DMRP	Drought Mitigation and Response Plan
ET	evapotranspiration
GIS	geographic information system
gpcd	gallons per capita per day
HB	House Bill
HUC	Hydrological Unit Code
IBCC	Interbasin Compact Committee
IPP	identified projects and processes
ISF	instream flow
IWR	Irrigation Water Requirement
M&I	municipal and industrial
NEPA	National Environmental Policy Act
NHD	National Hydrography Dataset
SB	Senate Bill
SDO	State Demographer's Office
SRGAP	Southwest Regional Gap Analysis Project
SSI	self-supplied industrial
SWSI	Statewide Water Supply Initiative
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WSL CU	Water Supply Limited Consumptive Use
WSRA	Water Supply Reserve Account

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Section 1
Introduction

1.1 North Platte Basin Roundtable

The North Platte Basin Roundtable was one of the first basins to complete the Phase 1 Nonconsumptive Needs Assessment. Twelve environmental and recreational attributes were identified and mapped individually and as composite stream segment maps with attribute counts per segment. Phase 2 is underway, including a prioritization (rating and ranking) of these attributes. The basin roundtable is now considering how to use this prioritization to define projects, some of which would be mutually beneficial to consumptive and nonconsumptive needs. The only consumptive need for the North Platte Basin identified in the Statewide Water Supply Initiative (SWSI) Report was 100 acre-feet (AF) municipal and industrial (M&I) in Walden. An evaluation was completed in 2008, which recommended a Walden Water Supply Improvement Project. Water Supply Reserve Account (WSRA) basin funds were allocated for this project, which is underway and should address the gap identified in SWSI 1. The basin roundtable is also considering additional consumptive needs and issues to be documented in the forthcoming SWSI updates. Several other projects have been recommended and funded through WSRA grants, including a wetland plant community inventory (completed), a study of the impact of beetle kill forest treatments on the quantity and quality of water produced from that watershed (underway), and a study of North Platte Basin weather that will lead to an improved estimate of the high altitude hay meadow crop coefficient appropriate to this basin (underway).

One of the continuing benefits of the basin roundtable is the ongoing dialogue between the various water interests in the basin.

1.2 Introduction

The North Platte Basin is comprised of all of Jackson County plus a small piece of Larimer County, capturing the Laramie River, a tributary to the North Platte. Jackson County, the main body of the North Platte headwaters, is a high altitude, broad valley approximately 35 miles wide by 45 miles long. The intermountain basin is often called North Park. It is surrounded by four mountain ranges—the Medicine Bow, Never Summers, Rabbit Ears, and Park Range—which are home to four wilderness areas. The mountains contain many high valleys ending at the bases of precipitous glacial cirques. The North Platte headwaters flow out of these mountains, feeding into the major tributaries of the North Platte including the Canadian River, the Michigan River, the Illinois River, Big and Little Grizzly Creek, and the North Fork of the North Platte River. The mainstem of the river flows into the Platte River Wilderness through Northgate Canyon, then across the border into Wyoming.

Jackson County covers 1,613 square miles and is home to fewer than 1,400 full-time residents (2010 Census). Elevations range from 7,800 to 12,953 feet. Approximately 65 percent of the land is public (Bureau of Land Management [BLM], U.S. Forest Service [USFS], U.S. Fish and Wildlife Service [USFWS], State Trust, and State Forest).

The use of water in the North Platte Basin is governed by the Equitable Apportionment Decree (Supreme Court, 1945, amended 1952), which grants to Jackson County the right to irrigate 145,000 acres, store 17,000 AF annually for irrigation, and caps the transbasin diversion to 60,000 AF in 10 consecutive years. The decree was silent regarding uses other than irrigation, storage, and transbasin diversion. The surface waters of the North Platte Basin are further governed by the Three State Agreement, which was entered into by Colorado, Wyoming, Nebraska, and the Department of the Interior to address Endangered Species Act issues on the Platte River in Nebraska (whooping cranes, pallid sturgeon, piping plover, and interior least tern). The associated depletion plan for the first 13 years of the agreement allow for the irrigation of 134,467 acres in Jackson County. Furthermore, it allows for a "one-bucket" approach to decisions by the Jackson County Water Conservancy District on further water development within the decree for all four categories of use (agriculture, municipal, industrial, and environmental) in the North Platte Basin. Neither the decree nor the agreement specifies an amount of water to be delivered to the state line.

Currently, the primary elements of the county's economy are agriculture (high mountain grass hay and cattle), timbering, and tourism (hunting, fishing, hiking, camping, birding, wildlife viewing, boating, and rafting) based on abundant natural resources on public and private land, with a growing contribution by oil development. The valley floor is underlain by Paleozoic and Mesozoic sedimentary rocks that form a structural basin. Petroleum has long been produced from North McCallum and South McCallum anticlines as well as from the Canadian River and Coalmont fields. This "old oil" production started in the 1920s. In 2008, EOG Resources announced great success in drilling and completing horizontal oil wells in the deeper Cretaceous Niobrara Formation. Operators in North Park reported 0.11 million barrels of oil, 4.3 million barrels of water, and 1 billion cubic feet of gas from 107 active wells to the Colorado Oil and Gas Commission in 2010.

The North Platte Basin Roundtable was constituted 5 years ago and is currently comprised of the following membership.

VOTING POSITION	**CURRENT MEMBER**
Appointed by Jackson County	John Rich
Municipal representative	Rick Wyatt
Agriculture representative	Mike Allnutt
Appointed by Jackson County Water Conservancy District	Kent Crowder
Legislature appointment	Ty Wattenberg
10 At-Large members	
5 At-large members representing specific interests	
Environmental representative	Barbara Vasquez
Recreational representative	Randy Miller
Domestic Water Provider representative	James Carothers
Industrial interest representative	*open*
5 At-large members who own water rights in the basin	
1)	Tom Hackleman
2)	Kay Meyring
3)	Jimmer Baller
4)	Scott Fischer
5)	Mike Honholz

NONVOTING LIAISONS

Colorado Water Conservation Board (CWCB)	Carl Trick II
USFWS	Ann Timberman
Colorado Division of Wildlife	Pete Conovitz
BLM	Paula Belcher
Colorado State Forest	Hunter Townsend
USFS	Michael Wright
Natural Resources Conservation Service	Deb Heeney
Colorado State University (CSU) Extension	Debbie Alpe

OFFICERS

Chair	Kent Crowder
Vice Chair	Barbara Vasquez
Representatives to Interbasin Compact Committee (IBCC)	Carl Trick II & John Rich
Secretary/Treasurer/Recorder	Barbara Vasquez

As with any roundtable across the state, it is comprised of people with various interests and perspectives, but what they have in common is a passion to protect the attributes and values that make them glad they live in North Park. One of the continuing benefits of the basin roundtable is the ongoing dialogue between various water interests in the basin.

The discovery of common ground and win-win solutions for the protection and development of water resources for both consumptive and nonconsumptive uses, where possible, is the ongoing challenge for this group.

The North Platte Basin Roundtable has recommended the projects listed in **Table 1-1** to date to the CWCB to support consumptive needs and/or nonconsumptive needs. These projects have been funded and are either completed or in progress.

Table 1-1 North Platte Basin Roundtable WSRA Project List

Projects	Principal	Status	Total WSRA Funds	Basin Funds	State Funds	Matching Funds
Funded Project - Completed						
New Pioneer Ditch Project	Silver Spur/Carl Trick (Jeff Crane)	Completed	$116,000	**$116,000**		$48,000
Identification and Assessment of Import Wetlands in the North Platte River Watershed	Denise Culver - Colorado Natural Heritage Program	Completed	$182,000	**$86,000**	$96,000	
Funded Project - Ongoing						
Town of Walden Water Supply Improvement Project	CDM/Hal Simpson	Ongoing	$385,000	**$385,000**		
Effects of Mountain Pine Beetle and Forecast Management on water quantity, quality, and forest recovery – North Platte and Upper Colorado Basins	Kelly Elder – USFS Rocky Mountain Research Station	Ongoing	$376,923	**$212,306**	$164,618	

Table 1-1 North Platte Basin Roundtable WSRA Project List (continued)

Projects	Principal	Status	Total WSRA Funds	Basin Funds	State Funds	Matching Funds
Monitoring the effects of weather conditions on the evapotranspiration in the North Platte Basin	Nolan Doesken – CSU Climate Center	Ongoing	$100,818	**$50,409**	$50,409	
North Platte Irrigated Meadow Conservation Program	Matt Reddy	Ongoing	$20,000	**$20,000**		$41,338
Solicitation of stakeholder input through production of a North Platte Basin education package	Colorado Foundation for Water Education	Ongoing	$14,040	**$14,040**		
Walden Reservoir Company: Structure for Water Control	Carl Trick II – Walden Reservoir Company	Ongoing	$36,000	**$36,000**		$7,900
		Total Funds Available to date		**$1,299,250**		
		North Platte Basin Funds Allocated to date		**$919,755**	$311,027	

1.3 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 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.

To help the basin roundtables accomplish their major responsibility of developing basinwide needs assessments, they have relied on groundwork completed during the SWSI 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 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 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 North 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 North 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 North Platte Basin Roundtable Needs Assessment Report.

1.4 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 1-1 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 North Platte 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.

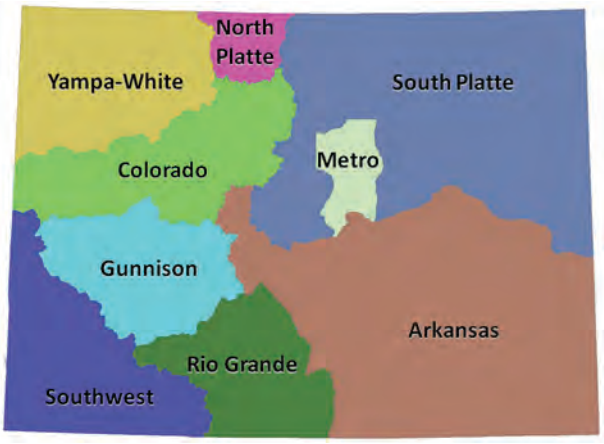

Figure 1-1 Colorado's nine basin roundtables provide a voluntary and collaborative process to help the state address its water challenges

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.

1.5 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 identified projects and processes (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.
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.

1.6 North 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 North Platte Basin. Following is a description of the contents of this Basin Needs Assessment Report:

- **Section 2** is a summary of the **North 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 **North 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 **North 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 North 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 **North 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
North Platte Basin Nonconsumptive Needs Assessment

2.1 Overview of Nonconsumptive Needs Assessments

The North Platte Basin is a very well watered, high altitude park. The mountains surrounding the basin are home to four wilderness areas—Mount Zirkel, Rawah, Never Summer, and a small piece of the Platte River Wilderness Area. The basin has been known for its wildlife throughout human history. When Fremont's men entered North Park in 1844, they encountered immense herds of buffalo, deer, elk, and antelope as well as bears and mountain lions. Moose, reintroduced in the 1970s, have been so successful that Jackson County is known as the "Moose Viewing Capital of Colorado." North Park also supports a very rich variety of bird life including breeding populations of bald eagles, golden eagles, osprey, and a wide variety of hawks. The Arapaho National Wildlife Refuge is situated in the middle of North Park straddling the Illinois River. It was created in 1967 by the U.S. Fish and Wildlife Service (USFWS) to mitigate for wetlands losses of waterfowl breeding areas in the prairies of the Midwest. North Park is the second most important waterfowl breeding habitat in Colorado. Sandhill cranes also use the basin for breeding as well as migration staging. The forests around high mountain lakes surrounding the park support the only known breeding habitat in Colorado for the buffleheads. It is also one of only two counties in Colorado that is home to all three amphibian species of interest: northern leopard frog, wood frog, and boreal toad.

The reintroduction of river otter in Rocky Mountain National Park to the south resulted in migration into North Park and establishment of populations along the major tributaries and the mainstem of the North Platte. The cold waters of the North Platte Basin support wild trout fisheries, with the Northgate Canyon in the North Platte Wilderness meriting "Gold Medal Fishery" designation. It is believed that trout are not native to the basin, but were introduced and have since established self-sustaining wild populations of brown and rainbow trout. As an example of positive impacts of human use with nonconsumptive benefits, irrigated agriculture delays return flows to the streams that, along with releases from reservoirs for agriculture, produce higher late season flows. Lake fishing is also popular, both in natural lakes in the mountains and in the reservoirs at lower elevations in the park. Delaney Buttes has achieved the coveted "Gold Medal Fishery" designation.

It's no surprise that this wealth of animal life is supported by an equally rich and diverse plant community. A study funded by Water Supply Reserve Account (WSRA) conducted by the Colorado Natural Heritage Program (CNHP) in 2009 concluded "Overall, the concentration and quality of imperiled wetland-dependent species and habitats attest to the fact that conservation efforts in the North Platte River Watershed will have both statewide and global significance." In a different study conducted last year by CNHP on close to 100 randomly located sites in wetlands (only) throughout the North Platte Basin and over a wide range of elevation, more than 600 distinct species of plants were identified. This is quite amazing when you consider that the total count of plant species for all habitat types in the entire State of Colorado is approximately 3,000.

Out of all this wealth of natural resources, the Nonconsumptive Committee winnowed out 12 nonconsumptive attributes that were mapped to the landscape with the assistance of the Colorado Water Conservation Board (CWCB) and their contractors.

The Environmental Attributes are:

- Bald Eagle and Osprey
- River Otter
- Amphibians
- Significant Wetland Plant Communities
- Outstanding Waters and Wild & Scenic Eligible
- CWCB Minimum Instream Flows, Minimum Lake Levels
- Lake Chub
- Waterfowl/Shorebird and Crane Habitat

The Recreational Attributes are:

- Important Stream Fishing
- Important Lake Fishing
- Flatwater and Whitewater Boating
- Waterfowl Hunting/Riparian and Wetland Wildlife Viewing

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 2-1**. 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 North Platte Basin Roundtable utilized Method 2, which employed GIS software to summarize information at a stream segment level. The basin roundtable had many data layers that they summarized into "categories," such as threatened and endangered species, riparian communities, and recreational boating areas. Using

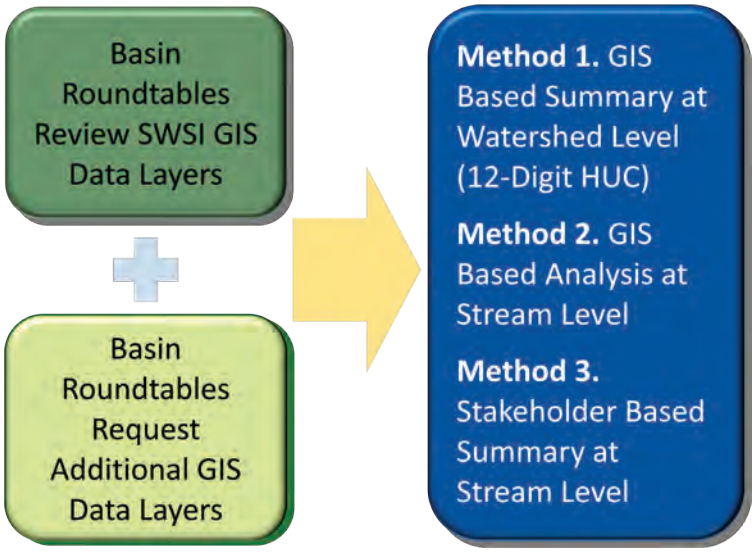


Figure 2-1 Basin Roundtable Focus Area Mapping Methodology

GIS software, the number of categories in each stream reach was counted, and using varying color scales, GIS stream reaches with a higher number of categories were highlighted in a darker color.

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.

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.

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.

2.2.2 Categorization of Data Layers

Once the basin roundtables identified the focus environmental and recreational data layers in their basins, the data layers were grouped into subcategories representing a collective environmental or recreational category. This method had two advantages—1) it moderated redundancy among comparable, geographically overlapping individual data layers, and 2) it allowed for a more comprehensible presentation of the GIS data. For example, Colorado pikeminnow, razorback sucker, humpback chub, and bonytail chub and federal critical habitat individual data layers were all grouped under the subcategory "Federally Endangered Fish," which was included in the overarching environmental category. The North Platte Basin's subcategories are shown as an example below in **Figure 2-2**.

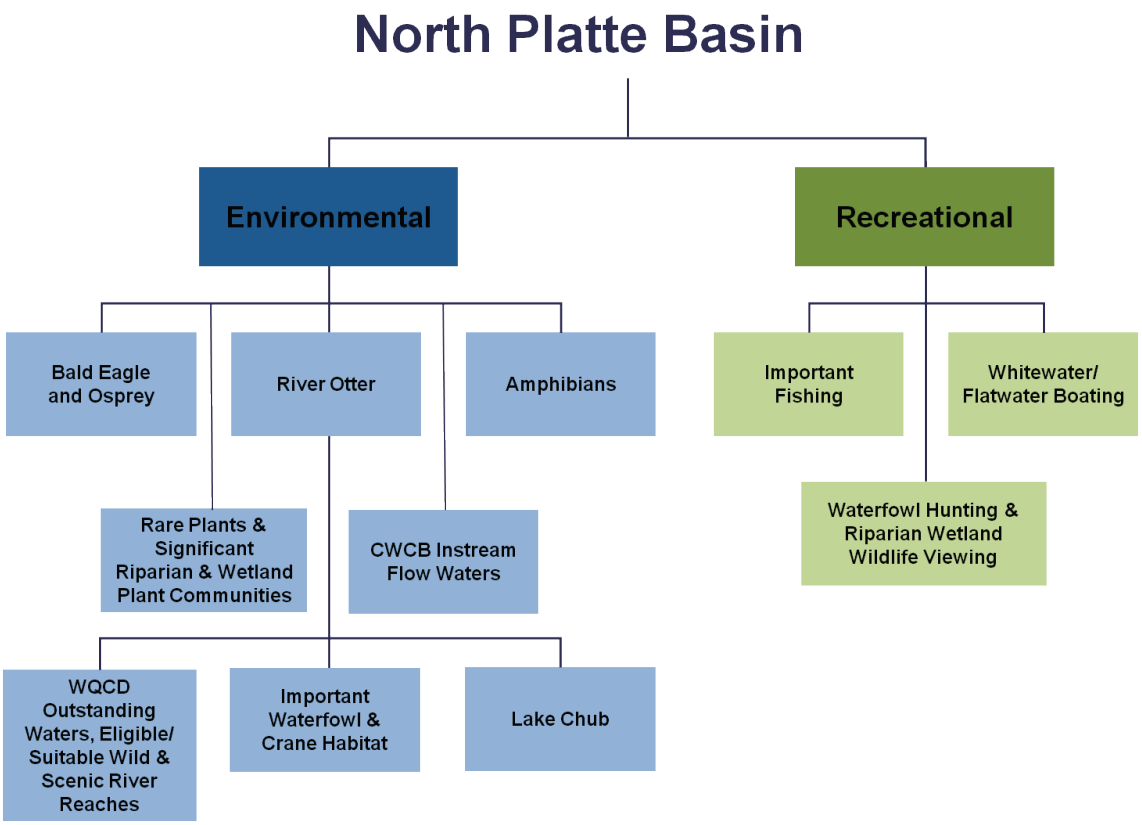


Figure 2-2 North Platte Basin Environmental and Recreational Subcategories

2.2.3 GIS Analysis of Data Layers

The North Platte Basin Roundtable summarized their environmental and recreational attributes on a stream segment basis. This information was also summarized using U.S. Geological Survey (USGS) information for stream segments provided by National Hydrography Dataset (NHD). Each stream segment that was included as a focus area by the basin roundtables was summarized at the NHD segment level and is related to the USGS NHD stream layers using the common identifier for the NHD database.

The North Platte Basin Roundtable summarized information at the stream reach level. Using GIS, the recreational and environmental category layers were summarized and then a buffer was applied to the stream segments. Environmental and recreational category layers within the buffer were summarized by developing a density number of environmental and recreational categories within the buffer. Detailed procedures for this analysis are described in Appendix C of the SWSI 2010 Report.

2.3 Nonconsumptive Focus Area Mapping Results

Using the methodologies and techniques outlined above, the North 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 Hydrologic Unit Code or stream segment. In addition, the presence of specific attributes (e.g., Arkansas 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 map 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 show the environmental and recreational focus mapping for the North Platte Basin. This figure was developed as a GeoPDF that enables the viewer to select the environmental and recreational focus area segment and display the specific attributes associated with that stream segment. The North Platte Basin used eleven environmental and recreational subcategories for its mapping while the North Platte Basin used six. Although eleven subcategories were used for the North Platte Basin mapping, the greatest number of overlap was six, meaning six different subcategories were present within the same segment. Segments with five or six subcategories present are highlighted in red on the map. The highest concentrations of subcategories are located on the following segments: the Big Creek Lakes, a portion of the North Fork Michigan River, and a segment of the Illinois River south of Walden.

2.4 Nonconsumptive Attributes Conclusions

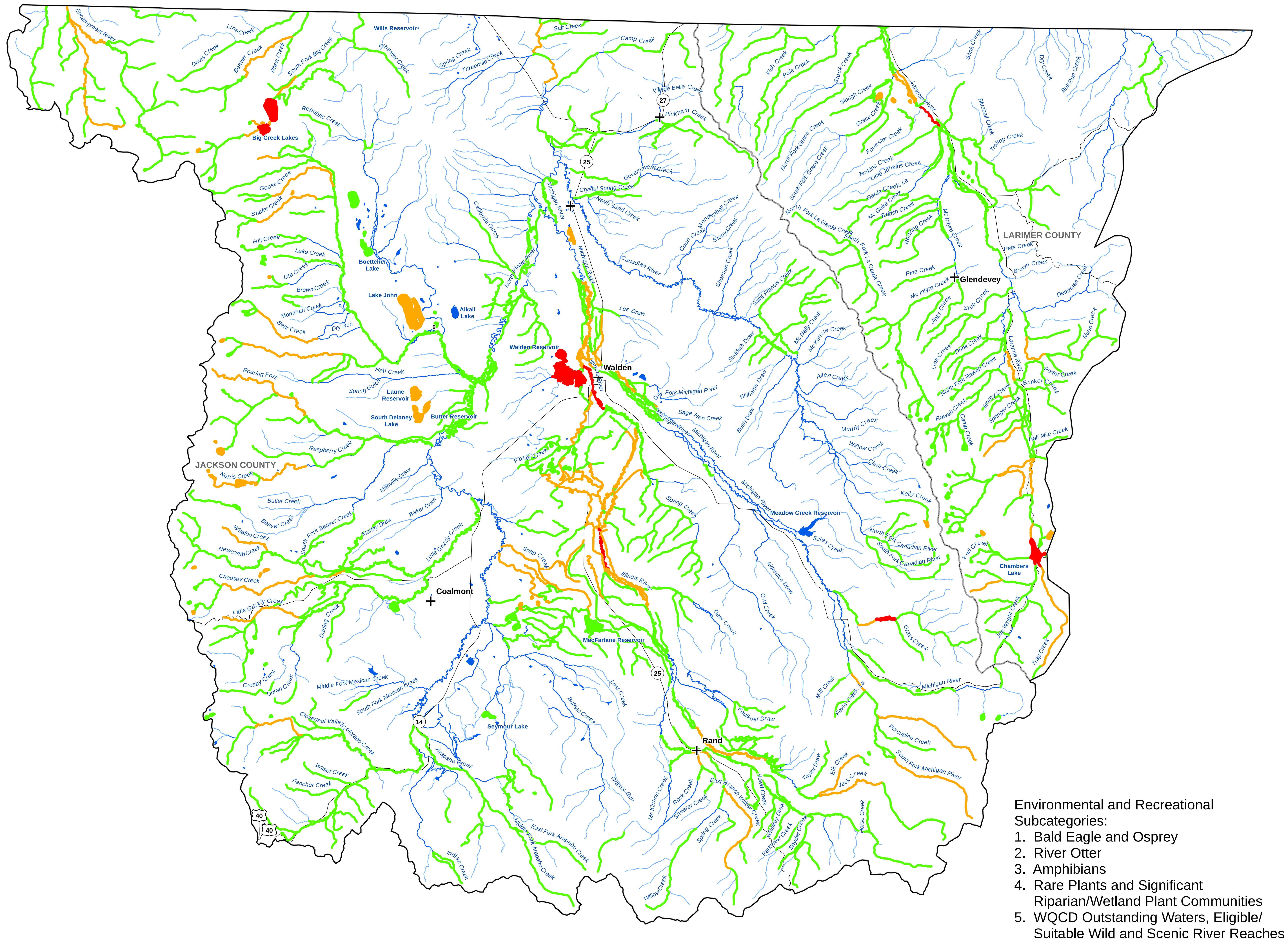
The North Platte Basin Roundtable was one of the first roundtables to complete Phase I of the Nonconsumptive Needs Assessment in the state. The report is included as Appendix A. There were some general conclusions that can be drawn from the mapping exercise. Many of the stream segments with a relatively high density of nonconsumptive attributes (environmental and recreational) occur on public lands or on sites with public access (Colorado Division of Wildlife leases). This is, in part, a function of the source of the data for these attributes. Mobile animal species (such as fish, amphibians, birds, river otters, etc.) and plants that propagate by seed don't respect private/public boundaries. It is therefore likely that, if data were available for private land, some of these attributes would also appear as highlighted stream segments on those private lands. However, many on the roundtable expressed the opinion that the focus of the mapping exercise should be for sites to which the public has access. Furthermore, many members had the opinion that attributes on public lands would be conserved and protected by the agencies managing those lands.

With this mapping exercise as a background, these attributes were subjected to a prioritization exercise by the entire roundtable. The attributes were rated by roundtable members and their comments collected. Based on the ratings, the attributes were ranked, as shown below.

1. Important Stream Fishing
2. Important Lake Fishing
3. Waterfowl hunting/riparian and wetland wildlife viewing
4. Waterfowl/Shorebird and Crane Habitat
5. Amphibians
6. Significant Wetland Plant Communities
7. Whitewater and Flatwater Boating
8. River Otter
9. Bald Eagle and Osprey
10. CWCB minimum Instream Flows, Minimum Lake Levels
11. Class 1 Waters + Wild & Scenic Eligible
12. Lake Chub

The full prioritization analysis, including summarized comments by the raters, is included as Appendix B. The comments provide some insight into the rank order. Many raters underscored that the economic impact of the nonconsumptive attributes was an important consideration to them. In addition, it was offered that an animal such as osprey or bald eagle is very mobile and adaptable to other locations and there may be little the North Platte Basin Roundtable could do to impact whether they continue to use the North Platte Basin for a breeding habitat. Endangered/threatened species, including amphibians and river otter, got mixed responses: high rating to continue to protect them, and low ratings because they might pose a threat to exercise of private property (water and land) rights. The CWCB Instream Flow got the widest range of responses. For some, it's an important tool for ensuring protection of aquatic habitat. For many, it represents a threat to consumptive water rights use and future development. The Lake Chub is a relict species in one location in Larimer County. Again, the raters felt there was nothing in the power of the roundtable to impact the species, positively or negatively.

The challenge and opportunity for the roundtable is to decide how to use this nonconsumptive attribute ranking for solicitation and prioritization of future projects.



Legend

Environmental and Recreational Subcategory Count by Stream Segment

- 1 - 2
- 3 - 4
- 5 - 6
- Roads
- Rivers and Streams
- Lakes and Reservoirs
- Cities and Towns
- County Boundary

0 2 4 8 12

Miles

1 inch = 2 miles

Environmental and Recreational Subcategories:

1. Bald Eagle and Osprey
2. River Otter
3. Amphibians
4. Rare Plants and Significant Riparian/Wetland Plant Communities
5. WQCD Outstanding Waters, Eligible/ Suitable Wild and Scenic River Reaches
6. CWCB Instream Flow Waters
7. Lake Chub
8. Important Waterfowl and Crane Habitat
9. Important Fishing
10. Whitewater and Floatwater Boating
11. Waterfowl Hunting and Riparian/ Wetland Wildlife Viewing

Figure 2-3

North Platte Basin Nonconsumptive Needs Assessment Environmental and Recreational Subcategory Count per Stream Segment

COLORADO WATER CONSERVATION BOARD · STATE OF COLORADO · 1876 · 1937

CDM

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Section 3
North Platte Basin Nonconsumptive Projects and Methods

3.1 Nonconsumptive Projects and Methods Overview

Section 2 of this report summarizes the nonconsumptive needs in the North 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:

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 North 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 2 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 North Platte River Basin, are substantially dependent on the health and viability of the aquatic community. 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 ISF 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.

The CDOW is aware of the inherent conflict between additional development of water resources and its mandate to manage fishery resources for the people of Colorado and its visitors. However, there are also many examples of a beneficial synergy between fishery management objectives and water development, such as below certain dams where enhanced tailwater fisheries develop with augmented summer and fall streamflows; the benefits of certain agricultural practices that divert a relatively small portion of the high volume flows that return slowly through fields and alluvial aquifers to supplement streamflow later in the year; or flow management agreements with water providers that meet multiple objectives. As noted, CDOW is continually engaged in projects and processes that are intended to meet nonconsumptive environmental needs, specifically the management of fisheries statewide. Itemizing only specific projects CDOW is working on at the time of this publication may create a misunderstanding about the direct role CDOW continually plays preserving and protecting nonconsumptive environmental attributes.

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 that 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 include 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 Hydrologic Unit Code (HUC) by a weighted average of each land management status within the HUC.

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:

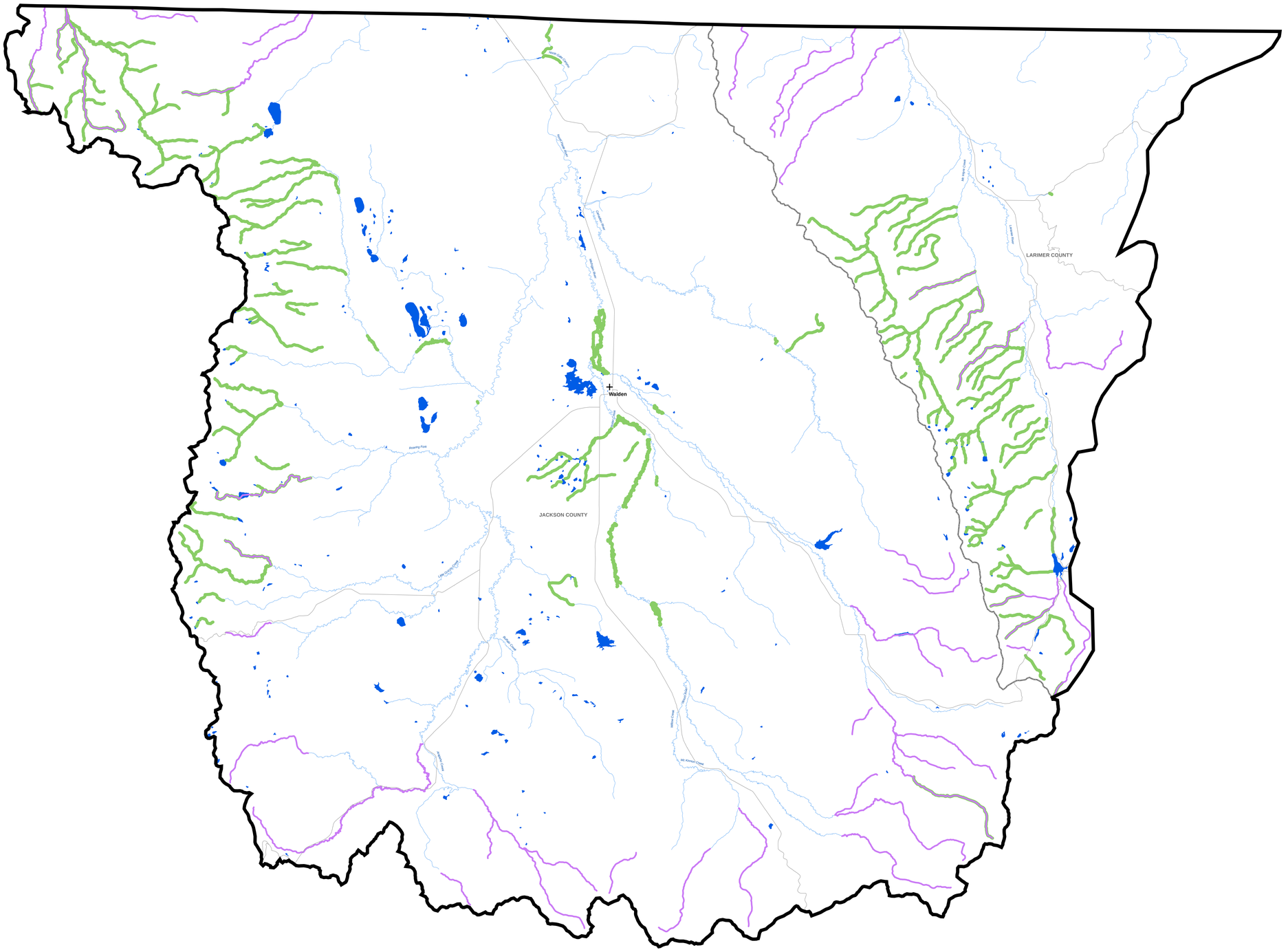
- Project or Method Name
- Project or Method Type (i.e., study, flow protection, or restoration project)
- Project or Method Location
- Comments
- Project or Method Status (i.e., ongoing, planned, or completed)
- Project or Method Identification Number
- Project or Method Contact Name
- Project or Method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

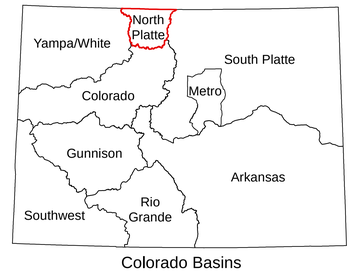


Legend

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

Projects

- CDOW
- CWCB
- ISF
- Stewardship
- WSRA



Colorado Basins

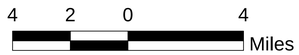


Figure 3-1

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

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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 North Platte Basin, the basin roundtable identified 1,600 miles of water bodies as focus areas. For these focus areas, 40 percent have an associated project or method. **Table 3-5** summarizes the project and method protections identified for the North 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. Important Riparian and Wetland Areas category includes significant riparian areas and rare plant communities. Waterfowl hunting and viewing includes public areas for these activities. Fishing includes areas identified by the roundtable as important fishing areas.

Table 3-5 Summary of Protections for the North Platte Basin 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	0%	25%	0%	25%
Recreation	0%	0%	0%	0%
Waterfowl Hunting/ Viewing	0%	0%	0%	0%
Lake Chub	0%	0%	0%	0%
Important Riparian and Wetland	0%	15%	0%	15%

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

Project Location	Project Name	Project Type	Project Status	Basin Roundtable Attributes Identified	Project Protections
0	Lake John Expansion	Project	Proposed	Ducks Unlimited Projects, Hunting/Viewing Parcels, Lake Fishing, Sandhill Crane Staging/Nesting Areas	
0	Chandler Ranch Ditch Cleaning	Project	Planned	Significant Riparian/Wetland Communities	
Colorado Creek	Colorado Creek Culvert Project	Project	Completed	Boreal Toad, CWCB ISF Water Rights, Stream Fishing, Wood Frog	Rare Plants-D, Waterfowl Hunting / Viewing-D
Crosby Creek	Crosby Creek Culvert Project	Project	Completed	Boreal Toad	Rare Plants-D
East Branch Willow Creek	East Brach of Willow Creek Culvert Project	Project	Completed	Boreal Toad, CWCB ISF Water Rights, Significant Riparian/Wetland Communities, Wood Frog	Rare Plants-D
Hebron Sloughs	Hebron Sloughs - Pipe and Ditch	Project	Completed	Ducks Unlimited Projects, Hebron Slough Ponds, Waterfowl Habitat	Colorado Outstanding Waters-D, Waterfowl Habitat-D
South Fork of Big Creek (from Big Creek Lake outflow to U.S. Forest Service Boundary)	South Fork of Big Creek measurements	Information	Planned	Boreal Toad, Lake Fishing, Osprey Foraging Area, Stream Fishing, Wood Frog	
Government Creek	Government Creek water quality / quantity measurements	Information	Completed	Rare Plant Communities	
Sawmill Creek	Sawmill Creek Gravel Pit	Project	Planned	Boreal Toad, Rare Plant Communities, Significant Riparian/Wetland Communities, Wood Frog	Rare Plants-D
Shafer Creek	Independence Ditch (NP1-16b)	Project	Completed	Boreal Toad, Colorado Outstanding Waters, Rare Plant Communities, Significant Riparian/Wetland Communities, Wood Frog	Colorado Outstanding Waters-D, Waterfowl Habitat-D
Shafer Creek	Pleasant Valley Ditch (NP1-16a)	Project	Completed	Boreal Toad, Colorado Outstanding Waters, Rare Plant Communities, Significant Riparian/Wetland Communities, Wood Frog	Colorado Outstanding Waters-D, Waterfowl Habitat-D
Shafer Creek	Shafer Creek Basin Wet Meadow Assessment	Information	Planned	Boreal Toad, Colorado Outstanding Waters, Rare Plant Communities, Significant Riparian/Wetland Communities, Wood Frog	
Silver Creek	Silver Creek Culvert Project	Project	Completed	Colorado Outstanding Waters, CWCB ISF Water Rights, River Otter Sightings, Wood Frog	
North Fork of North Platte River	North Fork Of North Platte River Water Quality / Quantity Measurements	Information	Completed	Rare Plant Communities, Significant Riparian/Wetland Communities, Stream Fishing, Wood Frog	
South Fork Big Creek	South Fork Of Big Creek Water Quality / Quantity Measurements	Information	Completed	Stream Fishing	
North Fork of North Platte River	North Fork of North Platte River ISF Right	Flow Protection	Planned	Rare Plant Communities, Significant Riparian/Wetland Communities, Stream Fishing, Wood Frog	
Spring Creek	Spring Creek Water Quality / Quantity Measurements	Information	Completed	Boreal Toad, Hunting/Viewing Parcels, Important Wetlands	
Teal Lake	Teal Lake Amphibian Habitat Construction	Project	Planned	Boreal Toad, CWCB Natural Lake Level Water Rights, Flatwater Boating, Lake Fishing, Wood Frog	Rare Plants-D
Tributary to Goose Creek	Grizzly-Helena Trailhead Improvement	Project	Planned	Boreal Toad, Colorado Outstanding Waters, Rare Plant Communities, Significant Riparian/Wetland Communities, Stream Fishing, Wood Frog	Waterfowl Hunting / Viewing-I
Walden Reservoir	Walden Reservoir	Flow Protection	Completed	Audubon Important Bird Areas, Bald Eagle Sites, Hunting/Viewing Parcels, Rare Plant Communities, River Otter Sightings, Sandhill Crane Staging/Nesting Areas	
Wheeler Creek	Wheeler Creek ISF Right	Flow Protection	Planned	Stream Fishing	
Wheeler Creek	Wheeler Creek Water Quality / Quantity Measurements	Information	Completed	Stream Fishing	
South Fork Big Creek	South Fork of Big Creek ISF Right	Flow Protection	Planned	Stream Fishing	
Illinois River (on Arapahoe National Wildlife Refuge)	Willow Exclosure #3	Information	Completed	Boreal Toad, Hunting/Viewing Parcels, Important Wetlands	
Illinois River (on Arapahoe National Wildlife Refuge)	Hubbard #2 Project	Project	Completed	Audubon Important Bird Areas, Boreal Toad, Hunting/Viewing Parcels, Important Wetlands	Rare Plants-I
Hebron Sloughs	Hebron Wildlife Management Area - Wetland Restoration	Project	Completed	Boreal Toad, Ducks Unlimited Projects, Hebron Slough Ponds, Waterfowl Habitat	Rare Plants-D
Illinois River (on Arapahoe National Wildlife Refuge)	Boyce Bro Project	Project	Completed	Hunting/Viewing Parcels, Important Wetlands, Rare Plant Communities	
Illinois River (on Arapahoe National Wildlife Refuge)	Dryer Project	Project	Completed	Boreal Toad, Hunting/Viewing Parcels, Important Wetlands	Rare Plants-I

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

Project Location	Project Name	Project Type	Project Status	Basin Roundtable Attributes Identified	Project Protections
Illinois River (on Arapahoe National Wildlife Refuge)	Hill Of Crouter Project	Project	Completed	Hunting/Viewing Parcels, Important Wetlands	
Illinois River (on Arapahoe National Wildlife Refuge)	Hubbard #1 Project	Project	Completed	Boreal Toad, Hunting/Viewing Parcels, Important Wetlands	Rare Plants-I
North Platte River	Tointon Wetland Complex	Project	Completed	Rare Plant Communities, River Otter Sightings, Stream Fishing	Waterfowl Habitat-D
Illinois River (on Arapahoe National Wildlife Refuge)	Willow Exclosure #2	Information	Completed	Boreal Toad, Hunting/Viewing Parcels, Important Wetlands	
Hebron Sloughs	Hebron Sloughs - Haworth Meadows	Project	Completed	Ducks Unlimited Projects, Hebron Slough Ponds, Waterfowl Habitat	Colorado Outstanding Waters-D, Hebron Slough Ponds -D, Waterfowl Habitat-D
Illinois River (on Arapahoe National Wildlife Refuge)	Willow Exclosure #4	Information	Completed	Boreal Toad, Hunting/Viewing Parcels, Important Wetlands	
Illinois River (on Arapahoe National Wildlife Refuge)	Willow Exclosure #5	Information	Completed	Hunting/Viewing Parcels, Important Wetlands, Rare Plant Communities	
Indian Creek	Indian Creek Water Quality / Quantity Measurements	Information	Completed	CWCB ISF Water Rights, Wood Frog	
Jimmy Creek Wetland	Jimmy Creek Wetland Livestock Fencing Project	Project	Completed	Rare Plant Communities	
Lake John Wetland	Lake John Wetland	Restoration	Completed	Ducks Unlimited Projects, Hunting/Viewing Parcels, Lake Fishing, Sandhill Crane Staging/Nesting Areas	Colorado Outstanding Waters-D, Important Reservoirs, Lakes, and Ponds-D
Lake John Wetland	Lake John Wetland Breeding Habitat Improvements	Project	Planned	Ducks Unlimited Projects, Hunting/Viewing Parcels, Lake Fishing, Sandhill Crane Staging/Nesting Areas	Colorado Outstanding Waters-D, Waterfowl Habitat-D
Newcomb Creek	Newcomb Creek Grazing Reduction Project	Project	Completed	Boreal Toad, Colorado Outstanding Waters, Important Reservoirs, Lakes, And Ponds, Wood Frog	Rare Plants-D
Illinois River (on Arapahoe National Wildlife Refuge)	Oklahoma #1 Project	Project	Completed	Audubon Important Bird Areas, Boreal Toad, Hunting/Viewing Parcels, Important Wetlands, River Otter Sightings, Wood Frog	
Illinois River (on Arapahoe National Wildlife Refuge)	Willow Exclosure #1	Information	Completed	Audubon Important Bird Areas, Boreal Toad, Hunting/Viewing Parcels, Important Wetlands	

Section 4
North Platte Basin Consumptive Needs Assessment

4.1 Overview of Consumptive Needs Assessment Process

The North Platte Basin has a long history of resource extraction by man, starting with seasonal use as a hunting ground by paleo-Indians and, later, by the Utes. The first documented European to brave the Utes arrived in North Park in 1820 to trap fur animals. The basin has been home to ranching for cattle and sheep by European settlers since the 1870s. The first settler wintered in North Park in 1878. The ranchers started developing ditch systems and irrigating their fields in the late 1800s. In addition to ranching, there was considerable coal mining in North Park as well as timbering and precious metal mining (silver, gold, copper) in the surrounding mountains. Today, the large lumber mills are gone. The timber industry is still viable, but has declined. The coal mines are closed. The railroad spur, which ended near Walden and was used to transport these products out of North Park, was abandoned and sold for salvage in the 1990s. Oil was discovered in the 1920s, and major development began in the 1940s, which has seen a recent resurgence due to the interest in national oil independence and because of the commercial interest in the Niobrara shale oil deposits. There are several connections between oil development and water. Water is used to create the drilling mud, and in these recent deep, horizontal wells, to hydrofrack the shale. Finally, water is produced by some of the wells. Its fate is either reinjection, reuse, evaporation, or surface discharge. Only one oil field in Jackson County to-date has a surface discharge permit and it flows close to 2 million barrels of produced water into a small tributary of the North Platte River each year.

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.

The objectives of the consumptive needs part of this North 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. Section 4.2.3 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 North 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.

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.

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 North Platte Basin at the county level. The North Platte River Basin is projected to grow by about 2.1 times between 2008 and 2050, under the medium scenario, with Mesa and Montrose Counties being the most populous in that region. Household basic jobs will grow at the fastest rate of any basic sector and will remain the largest source of employment in the North Platte Basin by 2050, followed by tourism and regional and national services. Other sectors will grow at slower rates, with decreased employment anticipated in the mining sector by 2050.

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**

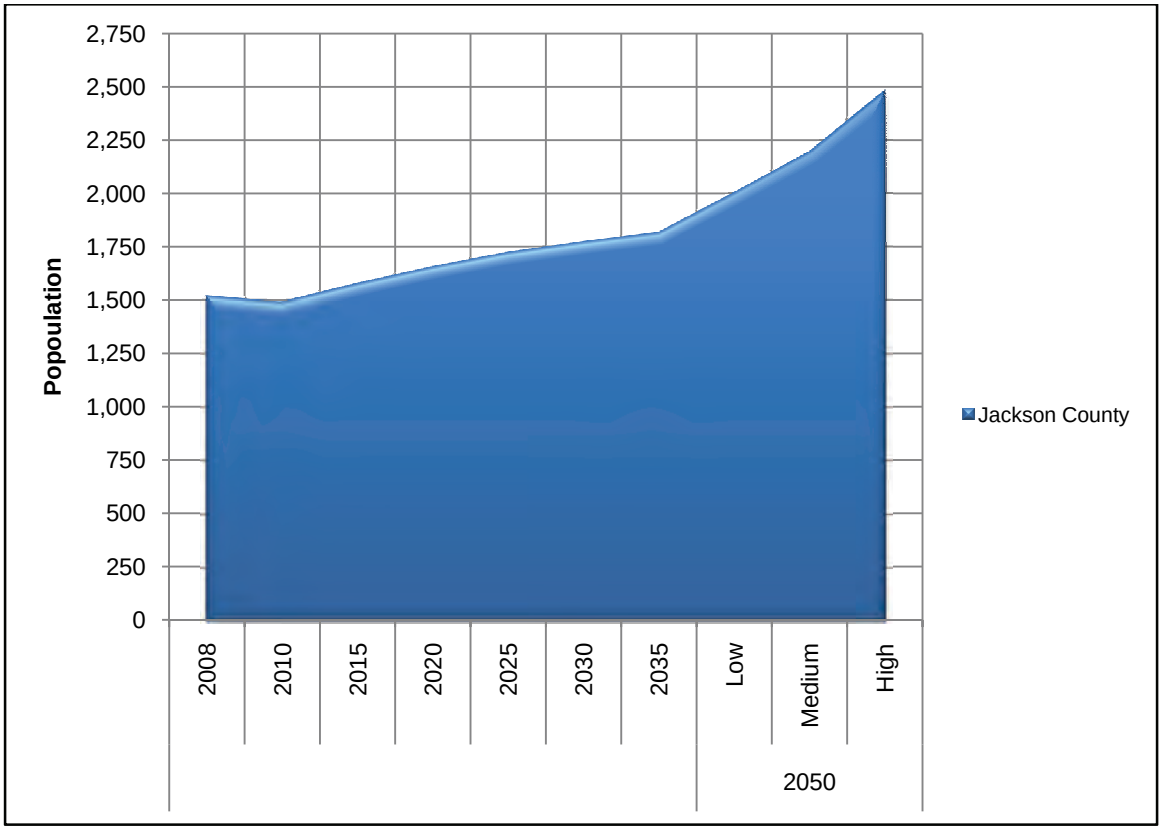

Figure 4-1 North Platte Basin Population Projections through 2050

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.

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.

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.

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.

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.

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 North Platte Basin.

Table 4-3 M&I Forecast by River Basin

	Water Demand (AF)	Baseline Water Demands (AFY)				Water Demands with Passive Conservation (AFY)			
County	2008	2035	2050 Low	2050 Medium	2050 High	2035	2050 Low	2050 Medium	2050 High
Jackson County	530	630	700	760	860	610	670	730	830

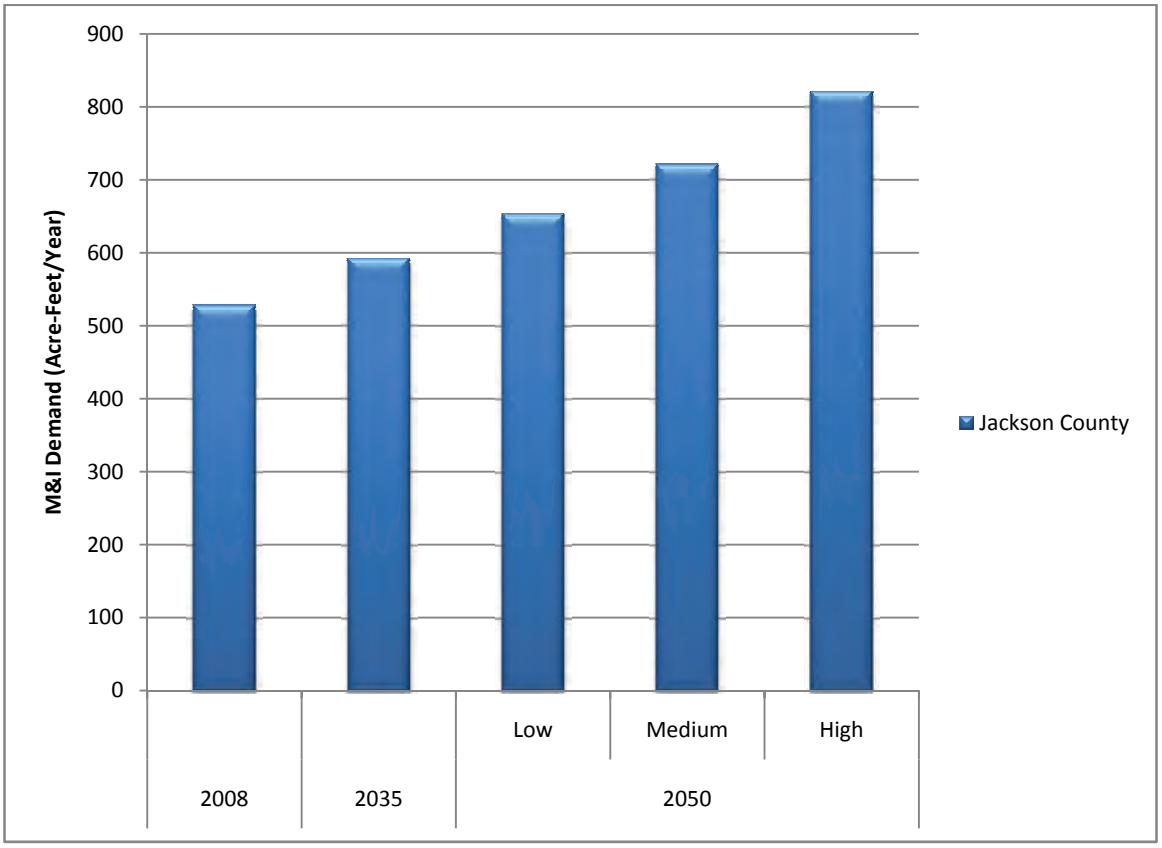

Figure 4-2 North Platte Basin M&I Water Demands

4.2.3 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 4-4** summarizes the North 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.

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

Basin	Demand Type[1,2]	2008	2035	2050 Low	2050 Med	2050 High
North Platte	M&I	500	600	700	700	800
	SSI	—	—	—	—	—
	Total	**500**	**600**	**700**	**700**	**800**
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.

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.

Colorado's water needs for irrigation are characterized in this analysis by the Irrigation Water 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. 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 North Platte 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 was collected.

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 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.

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.

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.

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.

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.

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 4-3** 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.

Table 4-5 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 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 4-5 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 4-6 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.

Finally, Table 4-6 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 4-4** shows the range of potential changes by basin. **Figure 4-5** 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).

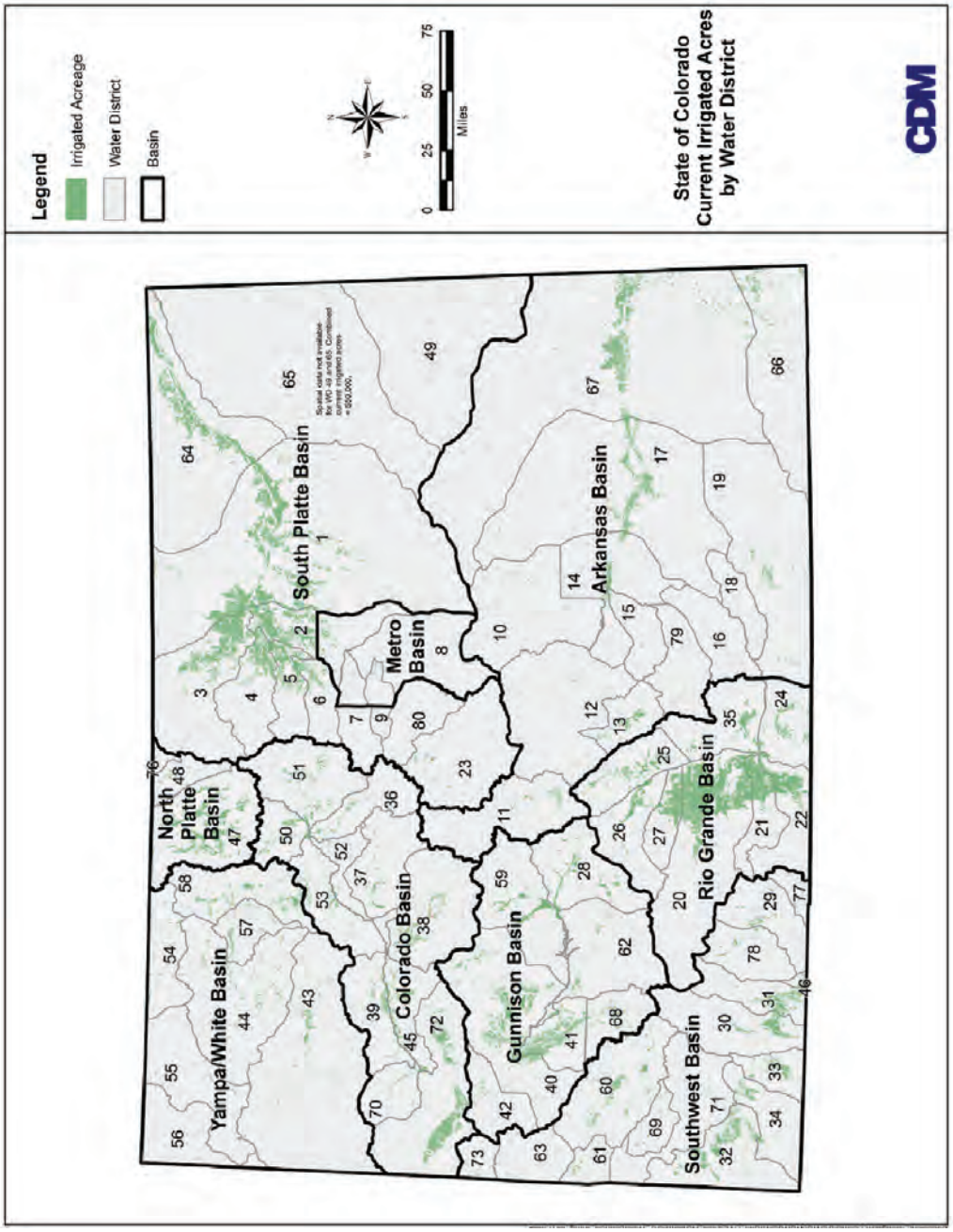

Figure 4-3 State of Colorado Current Irrigated Acres by Water District

Table 4-6 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**	**145,000**
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**	**3,003,700**

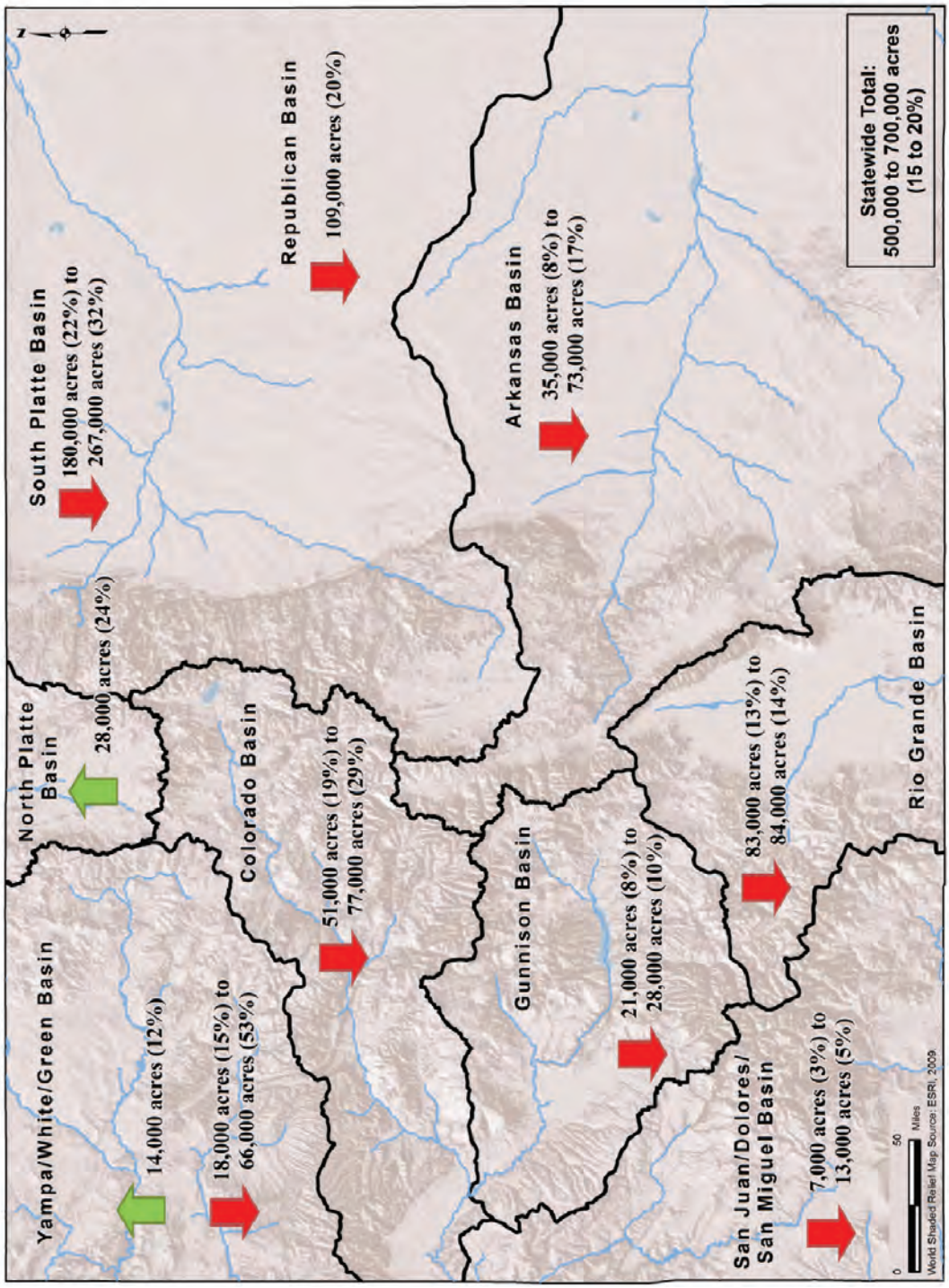

Figure 4-4 Potential Changes in Irrigated Acres by 2050

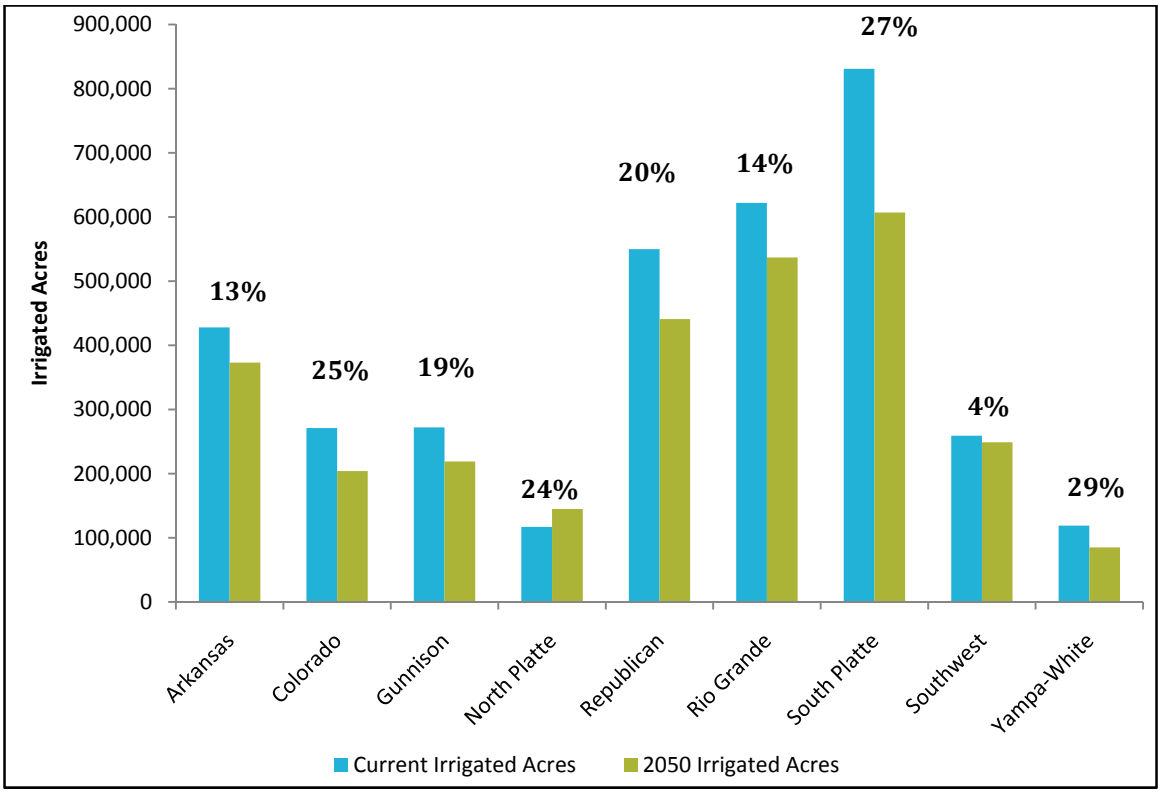

Figure 4-5 Comparison of Current and 2050 Irrigated Acres

4.3.2.3 Current Agricultural Demand Results

Table 4-7 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 4-6** and **4-7** 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 4-7 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**

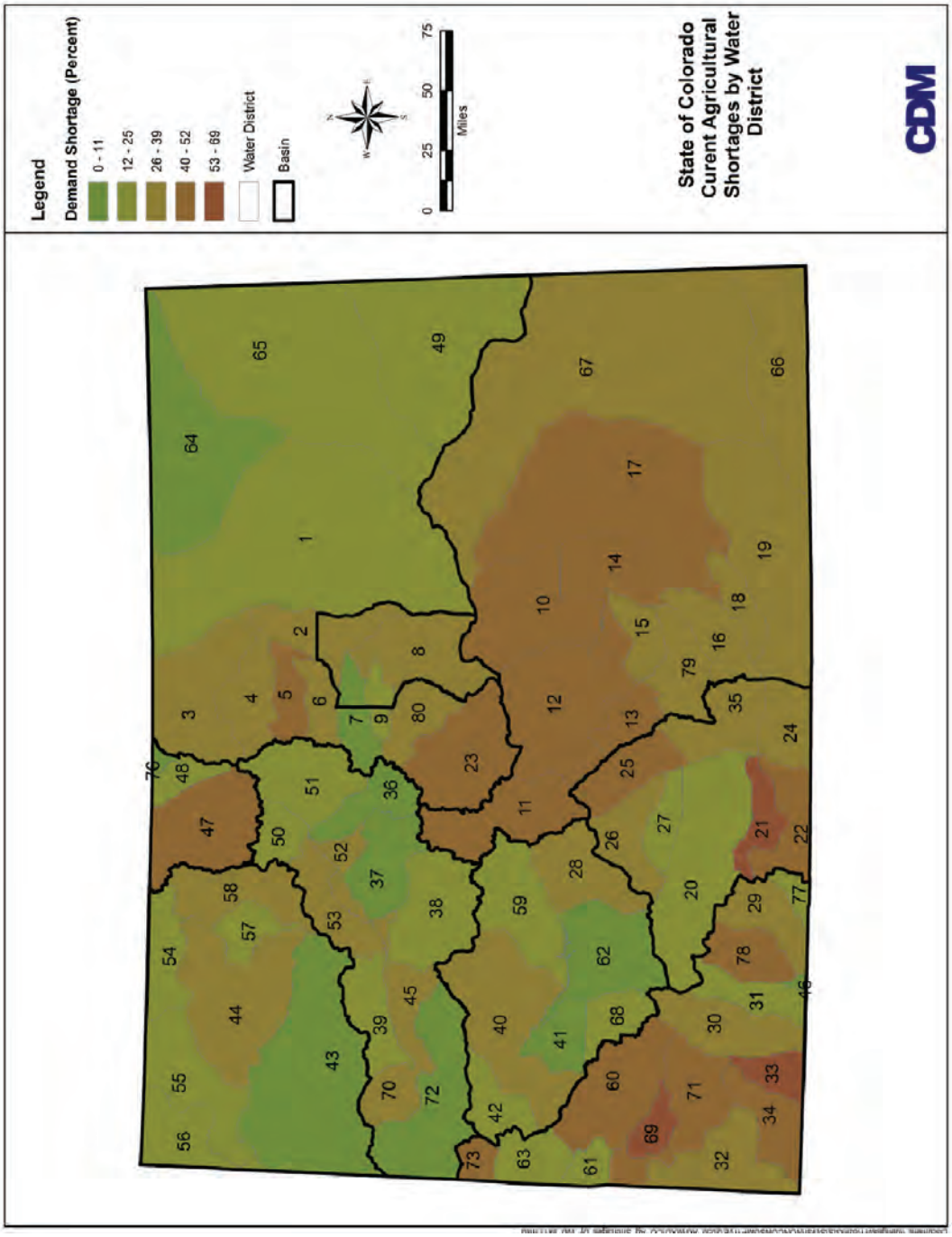

Figure 4-6 State of Colorado Current Agricultural Shortages by Water District

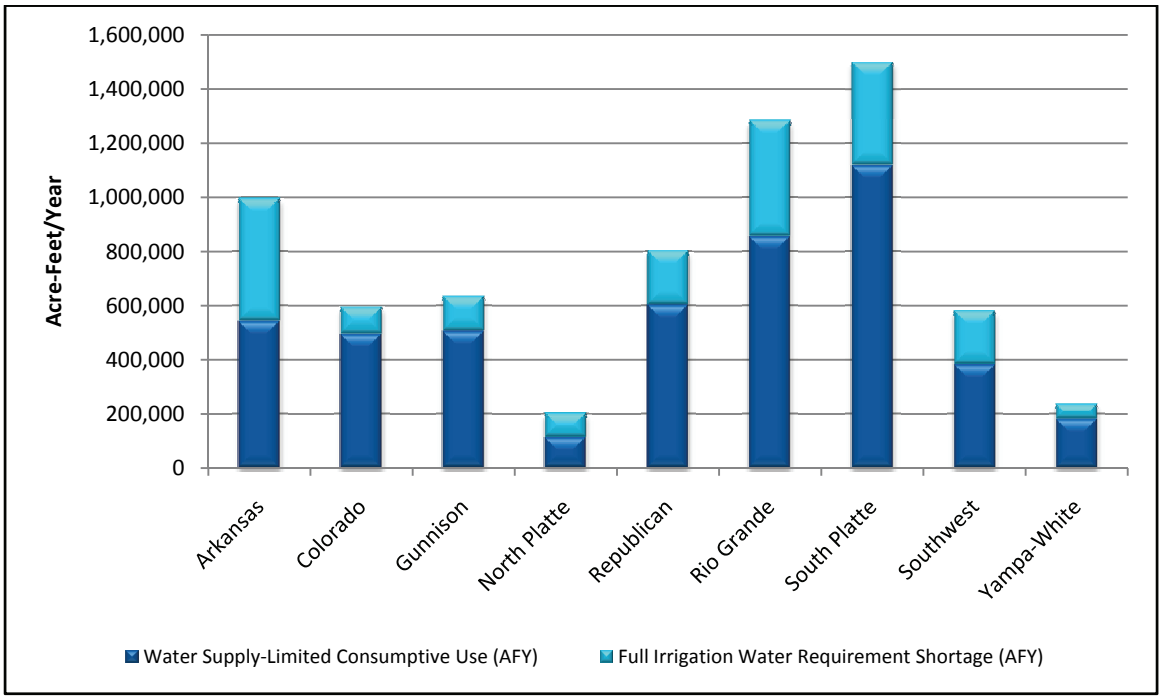

Figure 4-7 Current Agricultural Demands and Shortages

4.3.2.4 Future Agricultural Demand Results

Table 4-8 summarizes the estimated average annual agricultural demand by basin for the year 2050, assuming that historical climate and hydrology continue into the future. It shows irrigated acres, IWR, WSL CU, shortage, and non-irrigation demand. **Figure 4-8** 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 4-8 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**

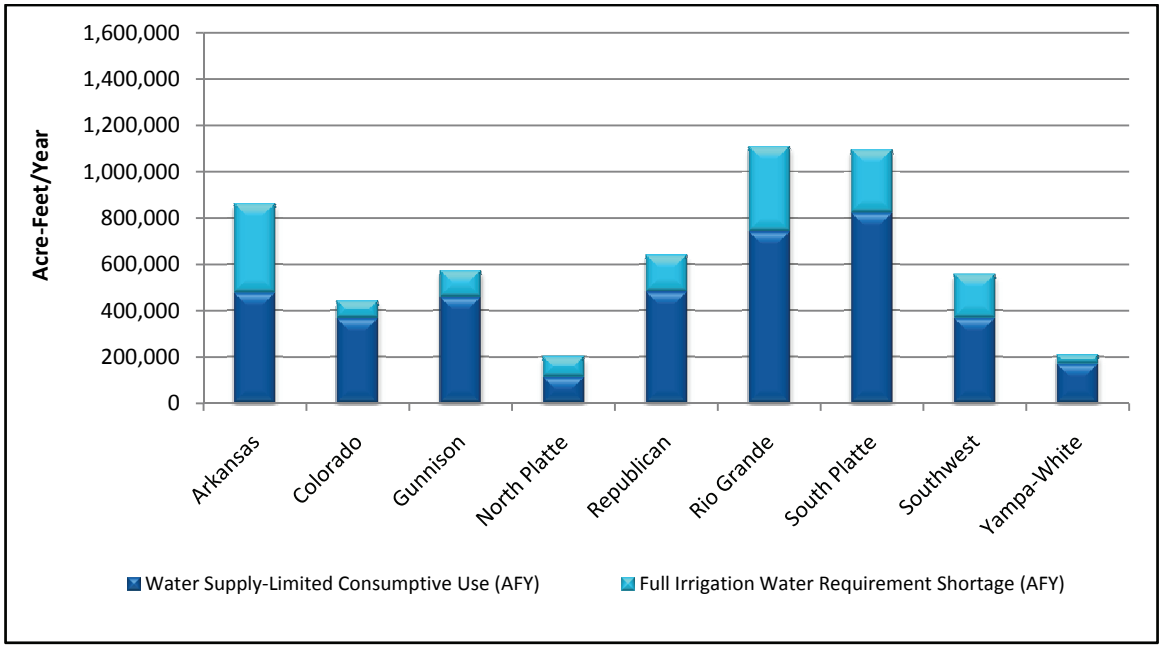

Figure 4-8 2050 Agricultural Demands and Shortages

Section 5
North 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 North 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.

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 self-supplied industrial (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.

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 project 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.

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' IPP 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.

5.2.2.1 Statewide

Statewide, the new water supplies needed for M&I and 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.

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**
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.

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), as shown in **Figure 5-1.**

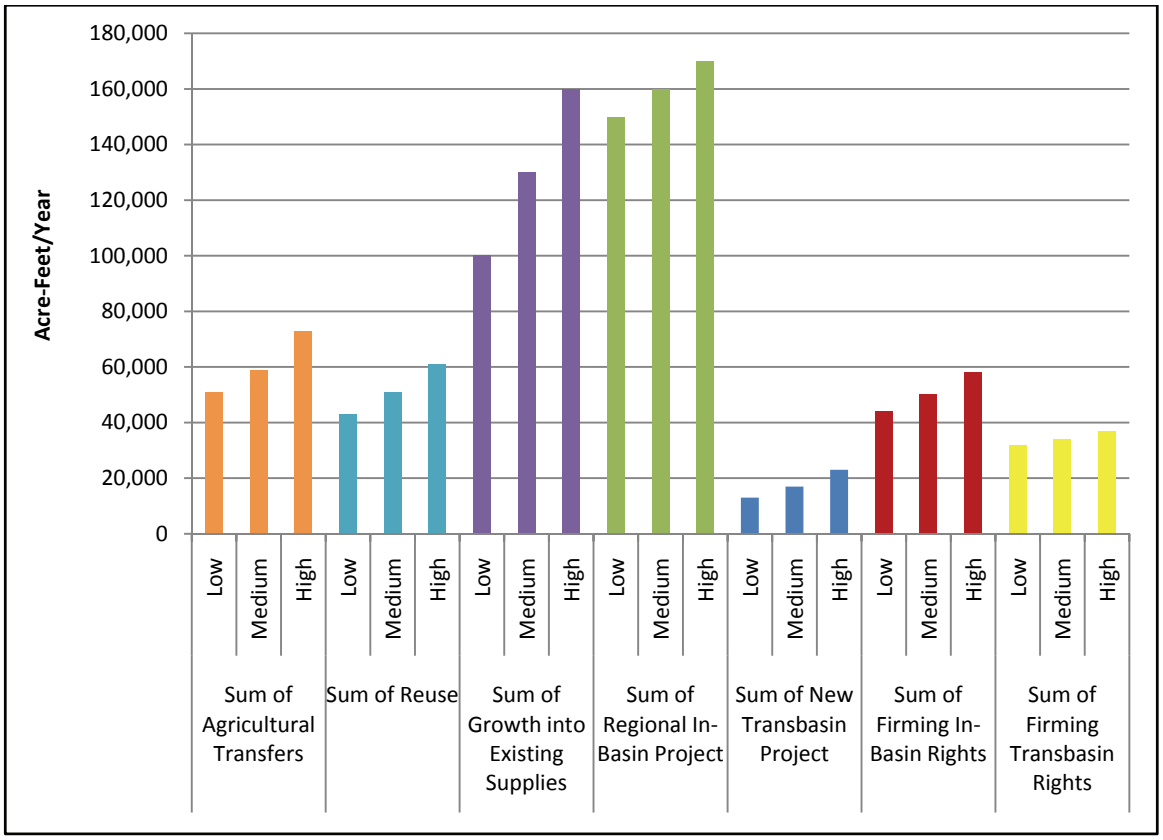

Figure 5-1 Statewide Summary of Yield for IPP Categories at 100% Success Rate

5.2.2.2 North Platte Basin

The North Platte River headwaters in Colorado are a relatively small portion of the overall North Platte Basin. Farming and ranching are the predominant economic base in the area, which includes Jackson County and a small portion of Larimer County. The North Platte Basin is expected to see a relatively small increase in M&I and SSI demands (increase in the range of 100 AFY to 300 AFY between 2008 and 2050). It is anticipated that this increase in demand will be met primarily by the further use of existing supplies and water rights.

For example, the Town of Walden is nearing the completion of a water supply improvement project funded by a Water Supply Reserve Account grant. This project has multiple objectives with the primary objective to eliminate the gap in the North Platte Basin. The project included—1) rehabilitation of the existing surface water diversion structure to allow the Town of Walden to capture its full water right on the Michigan River, 2) the filing of an application for a change of water right to designate the town's wells as alternate points of diversion for their senior water right for times when flows are low, and 3) steps to facilitate maximum beneficial use of the town's ownership in Walden Reservoir.

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

Table 5-2 North 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)
Jackson County	0	0	100 – 300	0	0	0	0	100 – 300
Jackson County IPP • Growth into existing supplies and water rights								
Total[1]	**0**	**0**	**100 – 300**	**0**	**0**	**0**	**0**	**100 – 300**

[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 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.

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.

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 North Platte Basin

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

- The 2050 net new water needs were calculated based on the *Demands to 2050 Report* as described for the general approach.

The primary objective of the Town of Walden project described in Section 5.2.2.2 is to eliminate the gap in the North Platte Basin. Therefore, IPPs at the 100 percent success rate were set equal to 2050 net new water needs, and the information/real gap for Jackson County is zero.

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 5-3, 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 5-2** 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.

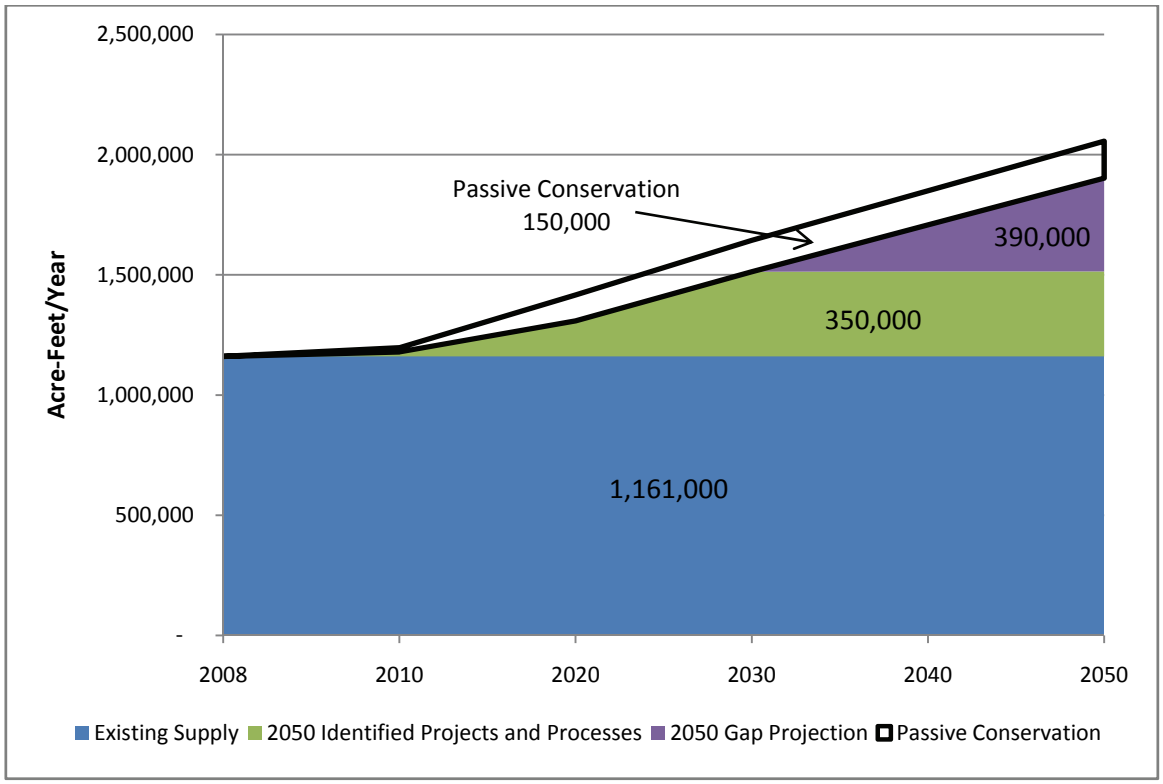

Figure 5-2 Statewide M&I and SSI Gap Summary Medium Scenario (IPPs at 70% Success Rate)

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 of the SWSI 2010 Report.

Figure 5-3 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.

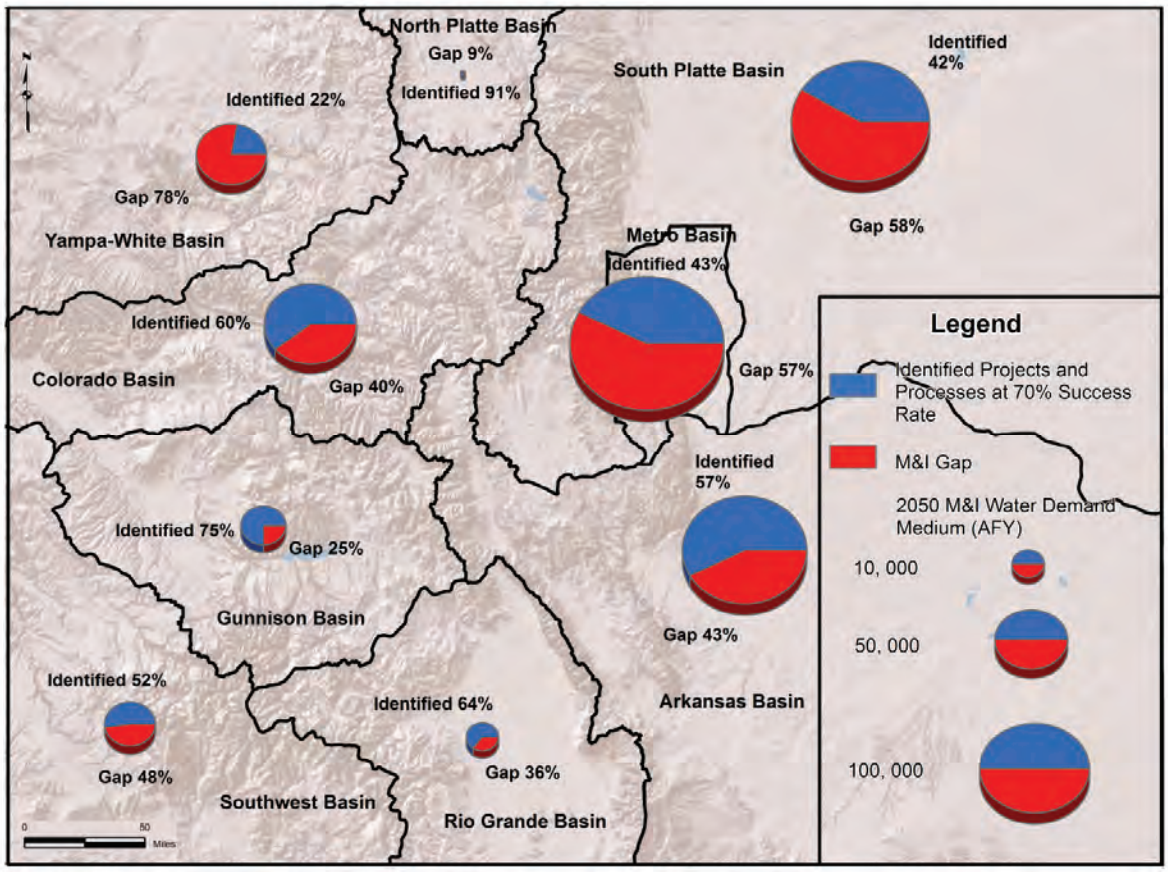

Figure 5-3 2050 M&I and SSI Gap Analysis – Medium Gap Scenario

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 National Environmental Policy Act (NEPA) review 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 Northern Integrated Supply Project, Windy Gap Firming Project, 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 National Environmental Policy Act process—particularly in the South Platte, Metro, and Arkansas Basins—is illustrated in **Figures 5-4** and **5-5**. 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 5-4 and 5-5 the new demand values also include the replacement of nonrenewable groundwater.

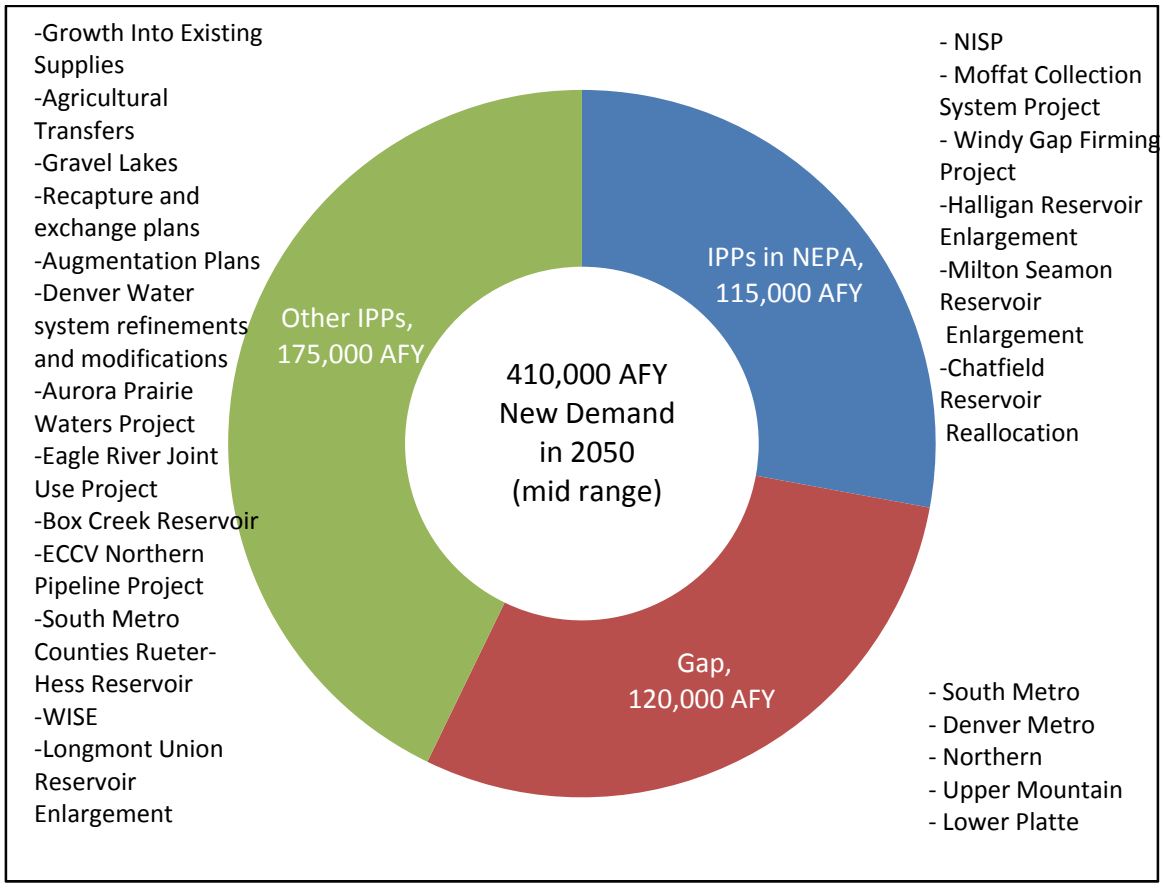

Figure 5-4 Potential Yield of NEPA Projects Relative to 2050 New Demands, Other IPPs, and Gap in South Platte and Metro Basins

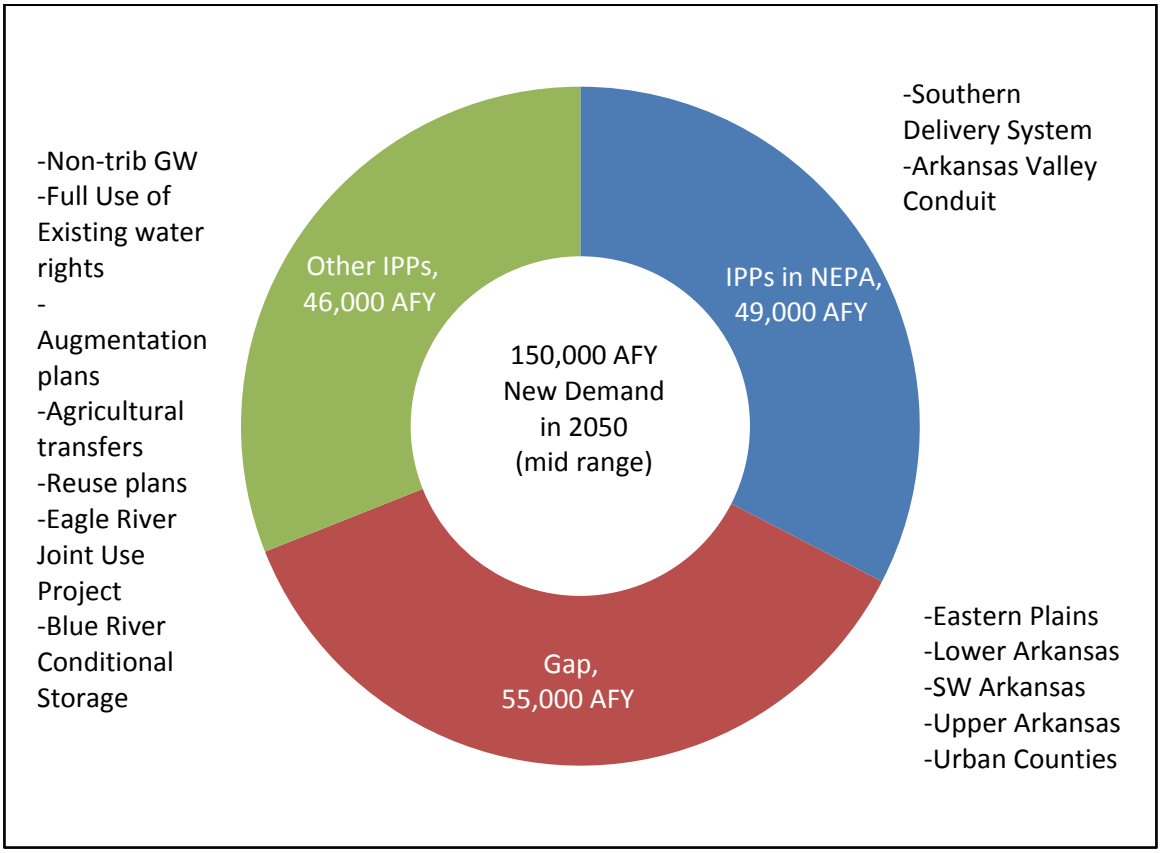

Figure 5-5. Potential Yield of NEPA Projects Relative to 2050 New Demands, Other IPPs, and Gap in Arkansas Basin

5.3.3.2 North Platte Basin

Table 5-5 provides a summary of increased M&I and SSI demands, the amount of new demand that will be met by IPPs, and the results of gap calculations for the North Platte Basin. For the low, medium, and high gap scenarios, the North Platte existing supply is 500 AFY. Demand increases in the North Platte Basin are estimated to range from 100 AFY to 300 AFY, nearly all of which will be met by growth into existing supplies. At 100 percent IPP success (low gap scenario), there is no gap. Alternate scenarios for the medium and high gaps assume a 90 percent success rate for IPPs; thus, the medium and high gaps for the year 2050 are 20 AFY and 30 AFY, respectively. The information is shown graphically in **Figures 5-6 through 5-8**.

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

				Estimated Yield of Identified Projects and Processes (AFY)			Estimated Remaining M&I and SSI Gap after Identified Projects and Processes (AFY)		
	Increase in M&I and SSI Demand (AFY)			100% IPP Success Rate	Alternative IPP Success Rate (90%)	Status Quo IPP Success Rate (90%)	Gap at 100% IPP Success Rate	Gap at Alternative IPP Success Rate (90%)	Gap at Status Quo IPP Success Rate (90%)
Region or County	Low	Med	High	Low	Med	High	Low	Med	High
Jackson County	100	200	300	100	200	300	0	20	30
Total[1]	**100**	**200**	**300**	**100**	**200**	**300**	**0**	**20**	**30**

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

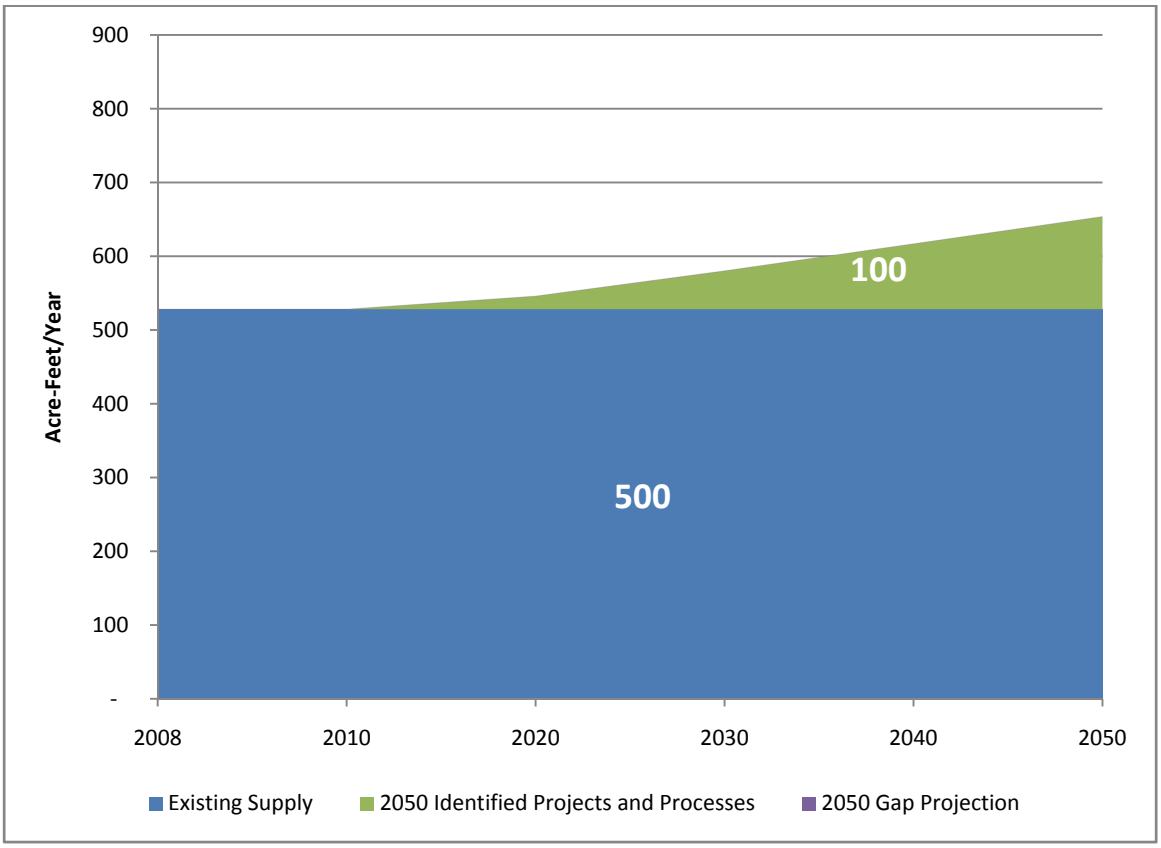

Figure 5-6 North Platte Basin M&I and SSI Gap Summary Low Scenario (IPPs at 100% Success Rate)

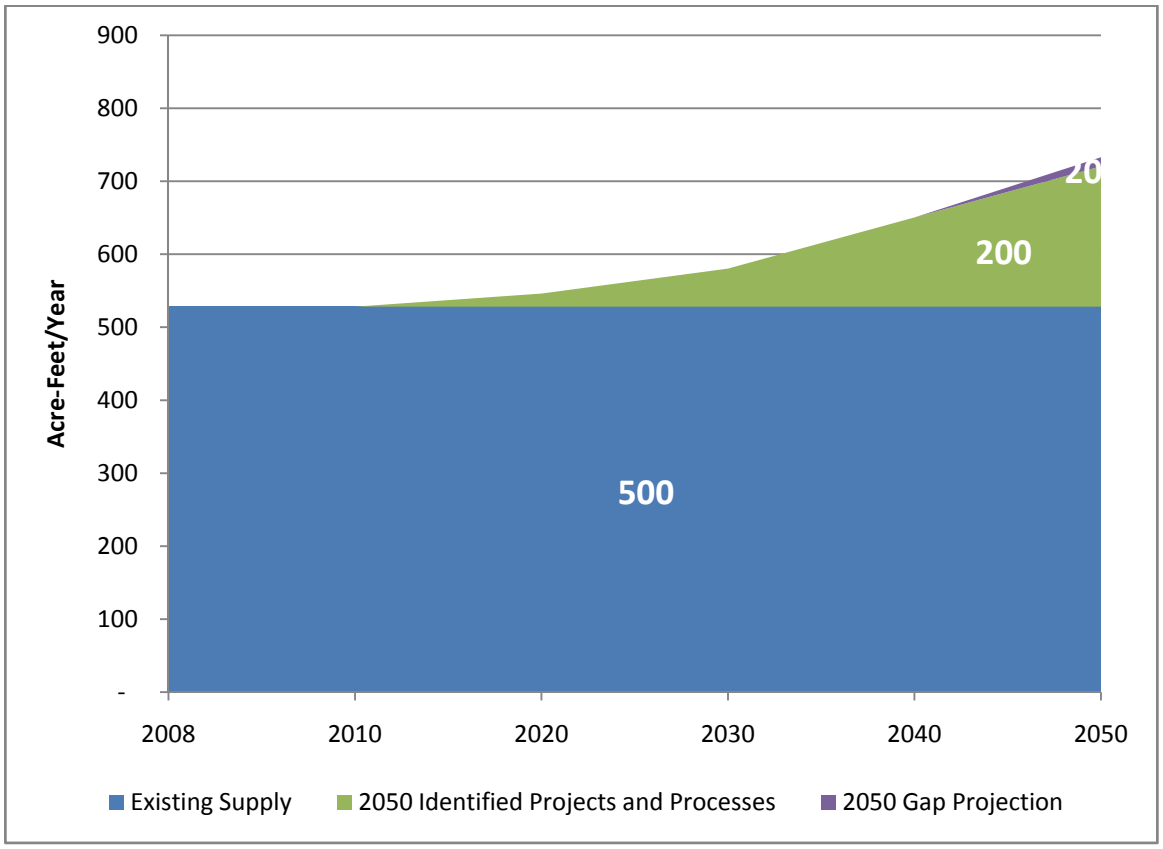

Figure 5-7 North Platte Basin M&I and SSI Gap Summary Medium Scenario (IPPs at 90% Success Rate)

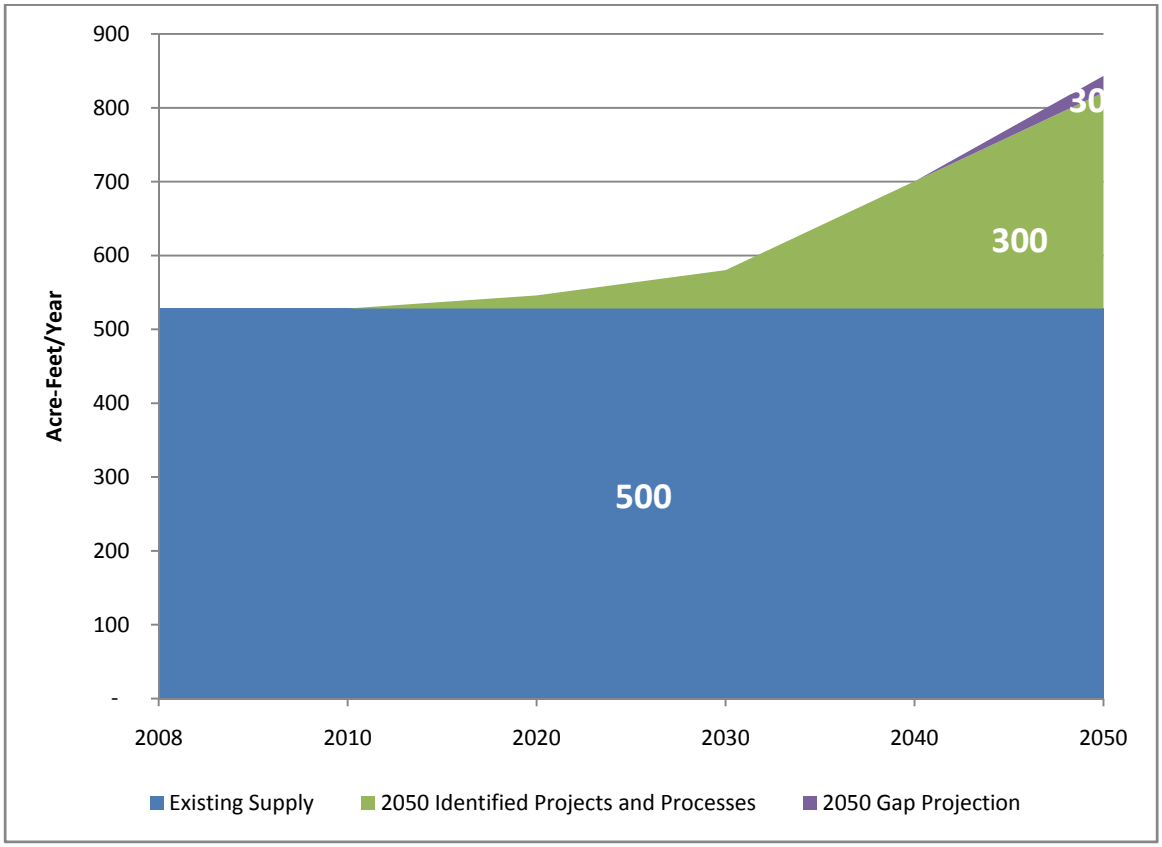

Figure 5-8 North Platte Basin M&I and SSI Gap Summary High Scenario (IPPs at 90% Success Rate)

Section 6
North 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.

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 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 Water Availability

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 below 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
North Platte/ Laramie	✓	Nebraska vs. Wyoming	1945
		Wyoming vs. Colorado	1957
		Platte River Recovery Implementation Program	—

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
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 and nonconsumptive 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.

North Platte River

The North Platte River Basin Decree is a Supreme Court decree that limits the total irrigation in Jackson County to 145,000 acres and 17,000 acre-feet (AF) of storage for irrigation in each season. It also limits total water exports from transbasin diversions from the North Platte River in Colorado to no more than 60,000 AF during any 10-year period. However, there are no explicit limits on other types of uses such as M&I uses.

Currently, Colorado has additional capacity under the decree. However, the amount of capacity available under the North Platte Decree is also limited by the Platte River Recovery Implementation Program. Under this program, the North Platte River depletions plan includes the "one bucket concept." Under this concept, the North Platte Basin has the ability to meet future consumptive water needs associated with municipal, industrial, piscatorial, wildlife, and environmental uses by restricting and foregoing future irrigated acreage below the 134,467 historically irrigated acres.

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 6-1** 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 acre-feet per year (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 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.

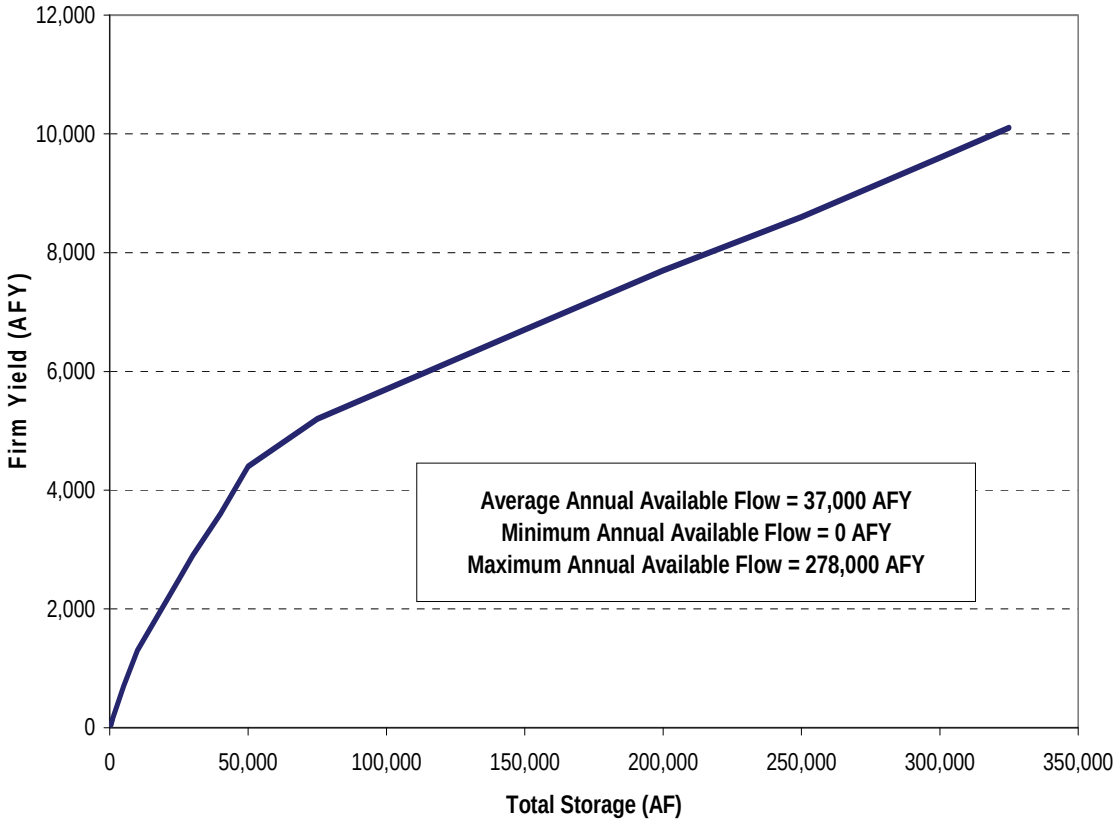

Figure 6-1 Yield Curve, South Platte River below Chatfield

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.

Section 7
North Platte Basin Strategies

7.1 North Platte Basin Consumptive Uses: The Future

Future development of water allowed under the Equitable Apportionment Decree and under the Three State Agreement Depletion Plan was the subject of a brainstorming exercise by the Consumptive Use Committee. The list, with estimates of potential future use, was brought to the full basin roundtable for review. The estimates are acknowledged to be only guesses and, should such future development be considered, would need to be refined. The possible future consumptive uses were then rated and ranked, at which point it was decided that ranking 'fire fighting' was useless, because when the big forest fire appears, nobody will be debating whether to use the water!

The prioritization of potential future consumptive uses resulted in the following rank-ordered list:

1. New storage (37,000 acre-feet [AF])
2. Additional 17,000 acres irrigated land
3. Renewable energy development, including biomass (200 acre-feet per year [AFY])
4. Energy and mineral development, including sand and gravel (300 AFY)
5. Aquaculture (500 AFY)
6. Forest products, including chip board (10,000 AFY)
7. Greenhouse agriculture (5000 AFY)
8. Water bottling/brewery/distillery (50 AFY)
9. Snowmaking as water storage (5000 AFY)
10. Water theme park (100 AFY)
11. Golf course (100 AFY)
12. Feedlot and/or slaughter house (50 AFY)

The full prioritization analysis, including summarized comments by the raters, is included as Appendix D. The additional irrigated land was sized to include all the potential available water based on the Equitable Apportionment Decree. The new storage was sized to double the current storage, and was envisioned to be small reservoirs, preferably off-channel, distributed in multiple subbasins. Such storage can be seen as benefiting consumptive and nonconsumptive needs, but the impact of pulling the water out of the stream on the riparian habitat would have to be considered as well. There could be a mixture of uses, part of which would be increased irrigation and storage, with other uses chosen to diversify the North Platte Basin economic base. The next steps for the North Platte Basin Roundtable would be:

a) To refine the potential future consumptive use volume requirements.

b) Include diversification of North Platte Basin economy in rating process.

c) Include concomitant benefit to nonconsumptive needs in rating process.

d) Decide how the final rank-ordered list might be used in the future for decisions on projects, new businesses, and/or new recreational opportunities in the basin.

Table 7-1 North Platte Basin Roundtable Water Supply Reserve Account (WSRA) Project List

Projects	Principal	Status	Total WSRA Funds	Basin Funds	State Funds	Matching Funds
Funded Project - Completed						
New Pioneer Ditch Project	Silver Spur/Carl Trick (Jeff Crane)	Completed	$116,000	**$116,000**		$48,000
Identification and Assessment of Important Wetlands in the North Platte River Watershed	Denise Culver - Colorado Natural Heritage Program	Completed	$182,000	**$86,000**	$96,000	
Funded Project - Ongoing						
Town of Walden Water Supply Improvement Project	CDM/Hal Simpson	Ongoing	$385,000	**$385,000**		
Effects of Mountain Pine Beetle and Forest Management on water quantity, quality, and forest recovery – North Platte and Upper Colorado Basins	Kelly Elder – U.S. Forest Service (USFS) Rocky Mountain Research Station	Ongoing	$376,923	**$212,306**	$164,618	
Monitoring the effects of weather conditions on the evapotranspiration in the North Platte Basin	Nolan Doesken – Colorado State University Climate Center	Ongoing	$100,818	**$50,409**	$50,409	
North Platte Irrigated Meadow Conservation Program	Matt Reddy	Ongoing	$20,000	**$20,000**		$41,338
Solicitation of stakeholder input through production of a North Platte Basin education package	Colorado Foundation for Water Education	Ongoing	$14,040	**$14,040**		
Walden Reservoir Company: Structure for Water Control	Carl Trick II – Walden Reservoir Company	Ongoing	$36,000	**$36,000**		$7,900
	North Platte Basin Funds Allocated To Date			**$919,755**	$311,027	

A summary of each of these projects is included below.

7.2 WSRA Grant Summaries

New Pioneer Ditch Diversion Reconstruction Project

APPLICANT: Silver Spur Land and Cattle

APPROVED: March 2008

STATUS: Complete

WSRA FUNDS: $116,000 (Basin Account)

MATCHING FUNDS: $48,000

DESCRIPTION:
This project involved the reconstruction of the diversion structure for the New Pioneer Ditch. The ditch irrigates up to 950 acres with multiple senior water rights from the Canadian River. However, due to degradation of the diversion structure, the diversion structure could not seal off the river resulting in difficulties meeting its deliveries and regulating flows. Extreme bank erosion at the diversion location had degraded agricultural land and added a large amount of sediment to the river resulting in water quality issues and potential listing on the Clean Water Act Section 303(d) list of impaired waters. The current structure did not allow fish passage to upstream spawning areas. This project constructed a low-head diversion structure capable of diverting the entire river, if necessary to implement a call, while allowing for more accurate and efficient regulation of diversions. Streambank improvements upstream and downstream of the structure stabilized the structure, reduced bank erosion, and acted as a fish and recreational boat passage.

Town of Walden Water Supply Improvement Project

APPLICANT: Town of Walden

APPROVED: July 2008

STATUS: In Progress

WSRA FUNDS: $385,000 (Basin Account)

MATCHING FUNDS: None

DESCRIPTION:
The Town of Walden Water Supply Improvement Project includes multiple components to enhance the physical and legal reliability of the system. The project will enable full diversion of the town's senior 1.0 cubic feet per second (cfs) right (the Hi Ho Ditch water right) via a new collection gallery adjacent to the Michigan River, along with rehabilitating the existing dam and diversion structure in the Michigan River. The project also includes decreeing the town's two junior municipal wells as alternate points of diversion of the Hi Ho Ditch water right and changing the use of the town's Walden Reservoir shares to include municipal and augmentation use. Due to degradation, the current diversion structure cannot divert the full 1.0 cfs water right, and results in seasonal water quality issues that impact the water treatment system and water taste. The collection gallery would allow natural filtering of the water to improve water quality. The town had to restrict water use significantly in the drought year of 2002 because water was not physically available from the river and the wells, even though its Hi Ho Ditch right was in priority.

Effects of Mountain Pine Beetle and Forest Management on Water Quantity, Quality, and Forest Recovery

APPLICANT: U.S. Forest Service, Rocky Mountain Research Station

APPROVED: September 2008

STATUS: In Progress

WSRA FUNDS: $376,923 ($212,306 - Basin Account; $164,618 - Statewide Account)

MATCHING FUNDS: In-kind Staffing and Equipment

DESCRIPTION:
The proposed research addresses the effects of disturbance and management of the Mountain Pine Beetle on North Platte and Upper Colorado River water resources, both quantity and quality. This study will compare how four management alternatives commonly used in beetle-killed pine forests influence snow accumulation, streamflow, water quality, soil productivity, and forest recovery. The management alternatives result in distinct amounts of aboveground structure, surface roughness, and soil disturbance. The No Action option retains standing snags, downed wood, and maximum surface roughness. Logging conducted using the Watershed Protection option retains logging residue to maintain roughness and avoid soil disturbance. In contrast, the Fuel Reduction option removes slash, and the Forest Regeneration option combines slash reduction and mechanical scarification to enhance seedling establishment. Assessment of these management alternatives will improve decisions on how to sustain delivery of clean water and forest productivity from lands impacted by mountain pine beetle. The project promotes collaboration in forest and water management activities between the USFS, Colorado State Forest Service, and basin interests statewide where beetle infestation is occurring and management strategies are needed.

Identification and Assessment of Important Wetlands in the North Platte River Watershed

APPLICANT: Colorado State University

APPROVED: September 2008

STATUS: In Progress

WSRA FUNDS: $182,000 ($86,000 - Basin Account; $96,000 - Statewide Account)

MATCHING FUNDS: $10,000

DESCRIPTION:
This project will provide the North Platte Basin Roundtable with data to support the nonconsumptive needs assessment with regard to its wetland resources. The North Platte Basin has large, contiguous wetlands that are important to threatened species (e.g., boreal toads, cutthroat trout), migratory animals, and several globally rare riparian and wetland plant communities. The project will identify and assess the health of the North Platte's watershed as indicated by the condition of its wetlands. Survey areas will be prioritized by the roundtable with a focus on private lands. Surveys will take place on private lands only with written permission of the landowner. The wetlands surveyed will be mapped based on ecological criteria, not jurisdictional criteria as defined by the U.S. Army Corps of Engineers. The proposed project will provide an increased understanding of the watershed's wetlands leading to more effective protection of the area's waters.

Monitoring the Effects of Weather Conditions on Evapotranspiration in the North Platte River Basin

APPLICANT: Colorado Climate Center, Colorado State University

APPROVED: September 2008

STATUS: In Progress

WSRA FUNDS: $100,818 ($50,409 - Basin Account; $50,409 - Statewide Account)

MATCHING FUNDS: Volunteer Data Collection

DESCRIPTION:
This is a data collection project intended to give the North Platte Basin Roundtable, as well as the Colorado Water Conservation Board (CWCB) and Colorado's water resource community, a better idea of how the weather conditions of North Park affect evapotranspiration (ET) from irrigated hay meadow grasses. Currently there have been several years of data collection in the basin using a Class A evaporation pan in the Town of Walden and a lysimeter at the refuge south of town. This project will considerably enhance the initial monitoring effort by establishing a network of complete year-round weather stations to continuously monitor and report weather conditions from three distinctly different locations in the basin. Using well-documented physically-based techniques, the weather data will be used to compute grass reference ET on a daily and potentially hourly basis. Three "atmometers" (small low-cost instruments that directly measure ET) will also be acquired to provide independent measurements at these same locations. The results will be displayed, compared, and posted continuously on a crop water use website managed and maintained by the Colorado Climate Center at Colorado State University. The results will be integrated with the ongoing lysimeter and pan evaporation measurements to give a much more comprehensive assessment of ET in the basin than what is currently available. In addition, seven additional atmometers will be acquired and provided to volunteers in additional areas of the basin.

North Park Irrigated Meadow Conservation Program – Phase I

APPLICANT: Ducks Unlimited, Inc.

APPROVED: May 2010

STATUS: In Progress

WSRA FUNDS: $20,000 (Basin Account)

MATCHING FUNDS: $41,338

DESCRIPTION:
The North Park Irrigated Meadow Conservation Program is a multi-partner effort to restore and enhance irrigated meadows in Jackson County, Colorado. The program addresses both consumptive and nonconsumptive needs by rehabilitating water-delivery systems in North Park. Irrigators benefit by increasing efficiencies and the acreage under irrigation allowed under the North Platte Decree. Waterfowl will benefit by increasing the quantity and quality of breeding habitats in the North Platte Basin. This application is for the first phase of the program, which will assess candidate projects. This assessment will detail water availability, irrigation infrastructure condition, wetland habitat condition, wildlife value, project impact assessments, and the necessary project permitting in order to provide the information subsequently required by potential funders of project construction.

Solicitation of Stakeholder Input through Production of a North Platte Basin Education Package

APPLICANT: Colorado Foundation for Water Education

APPROVED: January 2011

STATUS: In Progress

WSRA FUNDS: $14,040 (North Platte Basin Account)

MATCHING FUNDS: Not Applicable

DESCRIPTION:
The North Platte Basin Roundtable's Education Action Plan focuses on developing a speaker's bureau and providing high-quality tools for speakers to use. In order to assist in the implementation of the plan, this proposal aims to develop both a written educational resource document and a related public outreach PowerPoint presentation to be used by roundtable members and posted online.

Walden Reservoir Structure for Water Control

APPLICANT: Walden Reservoir Company

APPROVED: January 2011

STATUS: In Progress

WSRA FUNDS: $36,000 (North Platte Basin Account)

MATCHING FUNDS: $7,900

DESCRIPTION:
This project seeks to replace a deteriorated Structure for Water Control on the current Reservoir Delivery Ditch. The structure plays a critical role in controlling the flow of water into the reservoir, as well as preventing water from back flowing out of the reservoir during peak storage levels. Currently, the existing structure is incapable of regulating water to the control level needed. A new check structure will effectively and efficiently control the water entering into the reservoir and prevent back flow from occurring. This higher degree of control and efficiency will benefit all consumptive and nonconsumptive uses of the reservoir water.

7.3 Road Forward for the North Platte Basin Roundtable

The North Platte Basin Roundtable will continue the important dialogue and discussion between various interests in the water of the North Platte Basin. The roundtable is committed to using current resources strategically and in a prioritized manner.

Members will work together to identify those projects that they can support and the projects and methods that meet the basin's nonconsumptive and consumptive needs. This may include advance work with project proponents to determine if there are ways the roundtable can help move the project or method forward and get them "shovel ready." The basin roundtable will approve WSRA grant applications in a timely manner, focusing on projects that meet our identified consumptive or nonconsumptive needs. Priority will be given to projects that are multi-purpose and/or regional (multiple water-provider, basin-wide, and/or across basins and states) and also, where possible, to "shovel ready" projects.

The roundtable will guide water project planning with an interbasin approach when it's applicable. The roundtable will continue to work toward building trust between basins and stakeholders and will increase the level of engagement with the public, permitting agencies, and other stakeholders.

Where the North Platte Basin Roundtable can assist, we will participate in the development of a statewide water plan that integrates solutions arising from basin roundtables, water providers, agricultural users, environment and recreation focused entities, the Interbasin Compact Committee (IBCC), and the CWCB.

The roundtable will engage in dialogue and cooperate with other basins, the IBCC, and the CWCB on specific issues of regional and/or statewide concern. Three areas of concern/opportunity are addressed below.

1. Agriculture is an important economic base and use of water in the North Platte Basin. Agriculture dry-up and loss of agricultural land in other basins has a cascading effect on statewide markets and economies that in turn will impact this basin. For that reason, the roundtable supports education of the public that addresses the connection between agriculture (agricultural land and water use) and food production on the regional and national level.

   Suggestions include:

   - Refer to agriculture in terms of "food security."
   - Reestablish the connection between people and the land, highlighting the value of agriculture.
   - Address globalization and outsourcing; the cost of transportation directly impacts the price of food and food security.
   - Highlight the beneficial connection and impacts of agricultural water on nonconsumptive values (environment and recreation). Focus on creating a shared "win-win" mentality.
   - Explain factors beyond our control that lead to dry-up.

2. Conservation is important in all areas to address a diminishing supply in the face of an increasing demand. However, conservation targets should be location-specific; a one-size-fits-all approach will not work. In some areas, there may not be an advantage to specific water conservation targets. For example, agricultural conservation in rural areas could have a greater overall impact than municipal conservation. And conservation in one area may not help meet statewide needs. For example, conservation in the North Platte Basin will not help make up shortages in the Colorado River system.

3. Addressing nonconsumptive needs is a focus for the state and for this basin. High function watersheds, clean water, and healthy aquatic and riparian environments support productive agriculture as well as the wildlife that underpins tourism-based economies. The North Platte Basin Roundtable is committed to the preservation and conservation of nonconsumptive attributes in North Park. Where possible, win-win solutions that simultaneously address consumptive and nonconsumptive uses will be favored.

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