Executive Summary

Colorado faces significant and immediate water supply challenges and should pursue a mix of solutions to meet the state's consumptive and nonconsumptive water supply needs.

Preface

Colorado faces significant and immediate water supply challenges. Despite the recent economic recession, the state has experienced rapid population growth, and Colorado's population is expected to nearly double within the next 40 years. If Colorado's water supply continues to develop according to current trends, i.e., the status quo, this will inevitably lead to a large transfer of water out of agriculture resulting in significant loss of agricultural lands and potential harm to the environment.

Providing an adequate water supply for Colorado's citizens, agriculture, and the environment 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. With this Statewide Water Supply Initiative (SWSI) 2010 update, the Colorado Water Conservation Board (CWCB or Board) has confirmed and 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.

In 2003 the Colorado legislature recognized the critical need to understand and better prepare for Colorado's future water supply needs, and authorized the CWCB to implement SWSI 1. Approved by the Board in 2004, SWSI 1 comprehensively identified Colorado's current and future water needs and 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. The basin roundtables established a grass roots effort for education, planning, and collaborating on water planning 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.

Enacted in 2005, the Colorado Water for the 21st Century Act (Act) institutionalized the nine basin roundtables and created the 27-member Interbasin Compact Committee (IBCC) to facilitate conversations within and between basins. Together, these new bodies create a voluntary, collaborative process to help the state of Colorado address its water challenges.

The Act charges the basin roundtables to develop their consumptive and nonconsumptive needs assessments (NCNAs) and to propose projects and methods to meet those needs. These needs assessments are the basis for the CWCB's SWSI 2010 update, making SWSI 2010 the first comprehensive update to incorporate the needs assessment work of the basin roundtables.

SWSI 2010 is intended to enhance the available information and can be used for regional water planning.

SWSI 2010 is intended to enhance the available information and can be used for regional water planning. SWSI is a compilation of information to be used for developing a common understanding of existing and future water supplies and demands throughout Colorado, and possible means of meeting both consumptive and nonconsumptive water supply needs.

Key elements of this update include:

- Analysis of the water supply demands to 2050, including consideration of the effect of passive conservation on those demands
- Analysis of nonconsumptive needs in each basin, as recommended by the basin roundtables
- Analysis of water availability in the Colorado River basins
- Implementation elements associated with identified projects, water conservation, agricultural transfers (both permanent and nonpermanent), and development of new water supplies
- Development of representative costs for water supply strategies

SWSI 2010 is a comprehensive picture of Colorado's water needs, now and in the future. The Board intends SWSI to be updated and refined every few years. Also, to assure the local perspective in this report, each basin roundtable will supplement this report with individual basin reports later in 2011. Used as a statewide planning tool, SWSI 2010 provides comprehensive information to water providers, state policy makers, and the General Assembly as they make decisions for accomplishing our next step: to work together on implementing the necessary strategies to meet our near and long-term water supply challenges.

CWCB History and Mission

As the lead agency for SWSI, the CWCB plays a critical role in establishing water policy in Colorado. Created in 1937, the CWCB's Mission is to:

> ***Conserve, Develop, Protect and Manage Colorado's Water for Present and Future Generations***

The CWCB furthers this mission by developing and implementing programs to:

- Conserve the waters of the state for wise and efficient beneficial uses
- Develop waters of the state to:
  - Preserve the natural environment to a reasonable degree
  - Fully utilize state compact entitlements
  - Help ensure that Colorado has an adequate water supply for our citizens and the environment by implementation of CWCB adopted mission statements and the findings and recommendations identified in SWSI 1
- Protect the waters of the state for maximum beneficial use without waste
- Manage the waters of the state in situations of extreme weather conditions—both for floods and droughts

Structure, Authority, and Role of the Board

The CWCB consists of 15 members. The Governor appoints one representative Board member from each of the state's eight major river basins and one representative member from the City and County of Denver. All appointees are subject to Senate confirmation and serve 3-year terms. The

With more than 40 staff members, the CWCB functions under eight major program areas:

1. Administration and Management
2. Finance
3. Interstate and Federal
4. Office of Water Conservation and Drought Planning
5. Stream and Lake Protection
6. Water Information
7. Water Supply Planning
8. Watershed and Flood Protection

Executive Director of the Department of Natural Resources (DNR) is an ex-officio, voting member of the Board. The Director of the CWCB, the State Engineer, the Attorney General, the Director of the Colorado Division of Wildlife (CDOW), and the Commissioner of the Colorado Department of Agriculture are ex-officio, nonvoting members.

CWCB is part of Colorado's DNR, which administers programs related to the state's water, forests, parks, land, wildlife, and minerals. CWCB's overarching goal for SWSI is to help water providers, stakeholders, and state policymakers maintain an adequate water supply for Colorado's citizens, agriculture, and the environment.

To the greatest extent possible, Board appointees are persons experienced in water resource management; water project financing; engineering, planning, and development of water projects; water law; irrigated farming; and/or ranching. No more than five appointees can be members of the same political party. By statute, six voting members constitute a quorum for the conduct of business, with six affirmative votes needed for the Board to take a position on any matter.

Introduction to the Interbasin Compact Process

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 and the environment. In 2003, the Colorado General Assembly authorized CWCB to implement SWSI 1. SWSI 1 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. Nine basin roundtables were institutionalized in the 2005 Colorado Water for the 21st Century Act, which creates 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.

The role of the Board is defined in statute (C.R.S. 37-60) and includes:

- Establishing policy to address state water issues
- Exercising the exclusive authority of the Board to hold instream and natural lake level water rights to protect and improve the environment
- Mediating and facilitating resolutions of disputes between basins and water interests
- Maintaining and upholding fiduciary responsibilities related to the management of state resources including, but not limited to, the Construction Fund and the Severance Tax Trust Fund
- Representing citizens within individual basins
- Identifying, prioritizing, and implementing water development projects to be funded using its funds and when necessary, recommending such projects for approval by the General Assembly
- Making Findings and Recommendations concerning applications for water rights for Recreational In-channel Diversions and defending its decisions in water courts
- Making decisions regarding Watershed Protection Fund grants, upholding fiduciary responsibilities related to the fund and implementing its own river restoration projects designed to help the CWCB accomplish its mission
- Provide technical support for the Water for the 21st Century Act
- Administering the Water Supply Reserve Account Grant Program

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

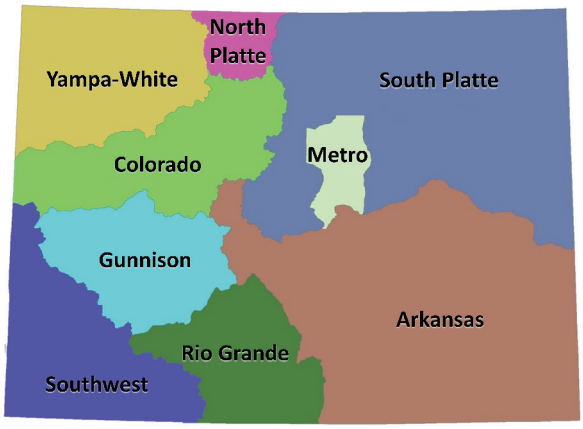


Figure ES-1 Colorado's nine basin roundtables provide a voluntary and collaborative process to help the state address its water challenges

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

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

Overview of the Water for the 21st Century Act

As described previously, in 2005 the Colorado General Assembly passed the Colorado Water for the 21st Century Act (House Bill [HB] 05-1177). The Act 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 SWSI 1. 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 Water Supply Reserve Account (WSRA). The WSRA appropriates money to the CWCB to help implement the consumptive and nonconsumptive water supply projects and methods identified by the basin roundtables. These bills and other relevant legislation are summarized in Figure ES-2.

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.

Figure ES-2 Legislation Related to the Water for the 21st Century Act

Basin Roundtable Process

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 to represent the basin roundtables' interests.

The most extensive substantive responsibility assigned to each basin roundtable is to develop a basinwide water needs assessment and projects and methods to meet those needs. These efforts are performed in cooperation with local governments, area water providers, and other stakeholders. The 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 is largely based on basin roundtables' water needs assessments. This report is summary in nature and is intended to summarize water needs at a statewide level. The basin roundtable needs assessment reports will be

more detailed and provide information at a finer level of detail than the contents of this report.

During the first part of 2011, CWCB will work with the basin roundtables to use information from this report and other basin roundtable needs assessments studies to develop individual basin roundtable needs assessments reports.

Interbasin Compact Committee

The other structure created by the Colorado Water for the 21st Century Act is the IBCC. This is a 27-member committee established to facilitate conversations between basins and to address statewide issues. The IBCC brings the issues of each basin roundtable to a statewide forum.

The Act gives the IBCC a series of responsibilities. These include establishing bylaws, developing a charter, helping oversee the WSRA program, and creating a Public Education and Outreach Working Group.

During 2005 and 2006, the IBCC established bylaws to govern its operations and actions. In addition, during this timeframe the IBCC developed a Charter to "govern and guide compact negotiations between basin roundtables." The Charter includes:

- A framework and principles to guide negotiations between basin roundtables, including policies to ensure that individual compacts do not conflict with one another.
- Procedures for ratification of compacts, including a mandatory provision that every affected basin roundtable must approve the draft compact.
- Authorities and procedures to ensure that approved compacts are legally binding and enforceable.
- Procedures for integrating the Interbasin Compact processes with other water planning and development processes, except that no provision may supersede, impair, or modify any local government's "authority, jurisdiction, or permitting powers."

The IBCC also established a Public Education and Outreach Working Group to ensure public education and participation concerning both the activities of the IBCC and compact negotiations between basin roundtables.

Overview of Colorado's Water Supply and Demand

Colorado's river systems generate, on average, 16 million AFY of renewable water. On average about two-thirds of this water leaves the state under Colorado's compacts and decrees. Figure ES-3 shows Colorado's population, irrigated acres, and flows. Of the 16 million acre-feet/year (AFY) of renewable water, about 80 percent is on the West Slope and 20 percent is on the East Slope. However, about 80 percent of Colorado's population is on the East Slope and 20 percent is on the West Slope and most of Colorado's irrigated agricultural lands are on the East Slope.

Colorado also has significant groundwater resources including alluvial aquifers, Denver Basin aquifers, High Plains aquifers, and San Luis Basin aquifers (see Figure ES-4). Colorado's renewable groundwater in the alluvial aquifers is considered part of the surface water system. Colorado's non-renewable groundwater is primarily in the San Luis Basin, High Plains (which is part of the Ogallala system) and the Denver Basin aquifers. The use of non-renewable groundwater, particularly for municipal use, creates reliability and sustainability concerns.

Water is vital to all aspects of Colorado's economy, including municipalities, businesses, industries, rural communities that are dependent on agriculture, West Slope communities that depend on industry and tourism, and statewide environmental amenities.

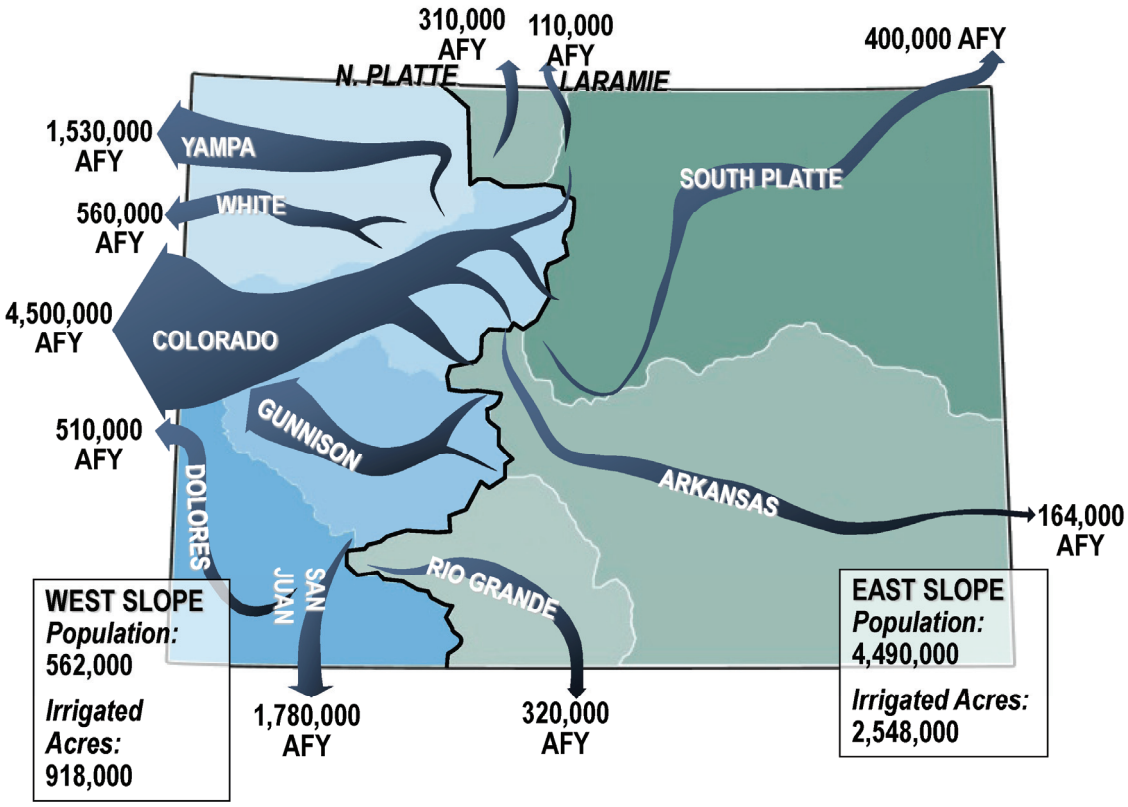


Figure ES-3 Colorado Population, Irrigated Acres and Flows

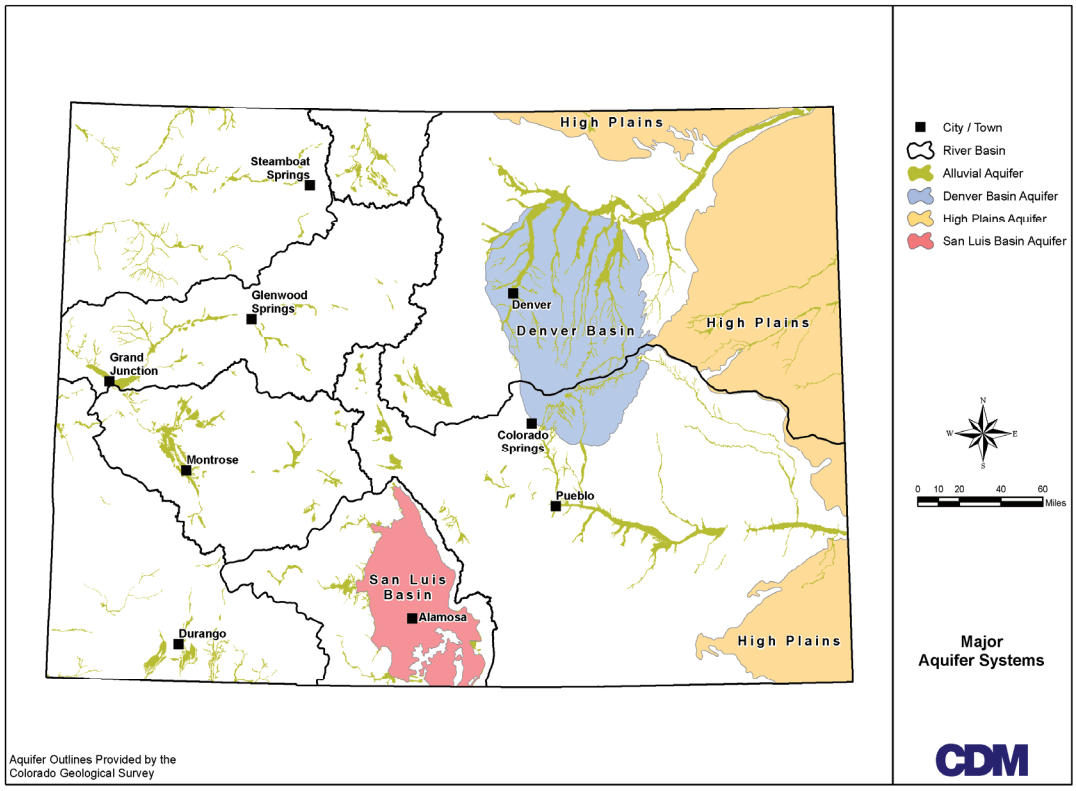


Figure ES-4 Colorado's Major Aquifer Systems

Colorado's agricultural and food industry supports about 4 percent of Colorado's jobs, and many of Colorado's counties are "ag dependent." In more than half of Colorado's counties, one in every ten jobs is tied to the agriculture and food industry, and in 13 of Colorado's 64 counties, one in every three jobs is tied to the agriculture and food industry.

Each basin faces continued shortages associated with existing agricultural demands. There are upward economic pressures to keep agriculture viable, however Colorado could also face a significant decline in irrigated acres by 2050 due to urbanization and water transfers.

Recreation and tourism injected about $8.6 billion into the state's economy during 2009 and employed about 9 percent of the total workforce. In certain regions, most notably headwaters communities, environmental and recreational amenities drive the local economy. Water-related activities comprise a significant component of Colorado's tourist activities including flatwater and river-based activities, fishing, boating, rafting, and snowmaking. The basin roundtables have spent significant time and effort identifying nonconsumptive focus areas in their basins and CWCB programs, most notably its instream flow program and watershed protection program, are critical to meeting these nonconsumptive needs.

Water for Colorado's growing cities and industries is a major issue. Colorado surpassed 5 million people in the summer of 2008. Colorado's population is expected to nearly double by 2050. About half of this growth is expected from net migration into the state and about half will be due to birth rates higher than death rates. This population increase is driven by available jobs.

On a percentage basis, the fastest growth will take place on the West Slope—between 2008 and 2050 the Colorado Basin will grow by about 140 percent, the Southwest Basin by about 115 percent, and the Gunnison Basin by about 115 percent. The Arkansas and South Platte Basins will have a slower growth rate (about 80 percent and 70 percent, respectively), but combine to add almost 3.3 million people by 2050. By 2050, over 6 million people will live in the South Platte Basin. This population growth will drive a significant need for additional water to meet future municipal and industrial (M&I) demands. Colorado also has a significant need for self-supplied industrial (SSI) water uses, including snowmaking, breweries, and other large industry, and our energy sector. By 2050, Colorado will need between 600,000 and 1 million AFY of additional M&I and SSI water. These needs are depicted in Figure ES-5.

Nonconsumptive Needs Assessments

The basin roundtables are required to complete NCNAs. This effort has included an extensive inventory, analysis, and synthesized mapping effort that built upon SWSI 2 environmental and recreational attribute mapping as a common technical platform for the basin roundtables. Figure ES-6 shows the process that was utilized by the CWCB and basin roundtables in completing their NCNAs. The basin roundtables have utilized environmental and recreational attribute mapping to identify nonconsumptive focus areas in their basins. In addition, the Arkansas, Colorado, and Yampa-White Basin Roundtables utilized WSRA funding to conduct further studies in their basins focused on quantifying environmental and recreational flow needs. The basin roundtables' nonconsumptive focus areas and further study efforts are intended to facilitate the identification of projects and methods to address environmental and recreational needs.

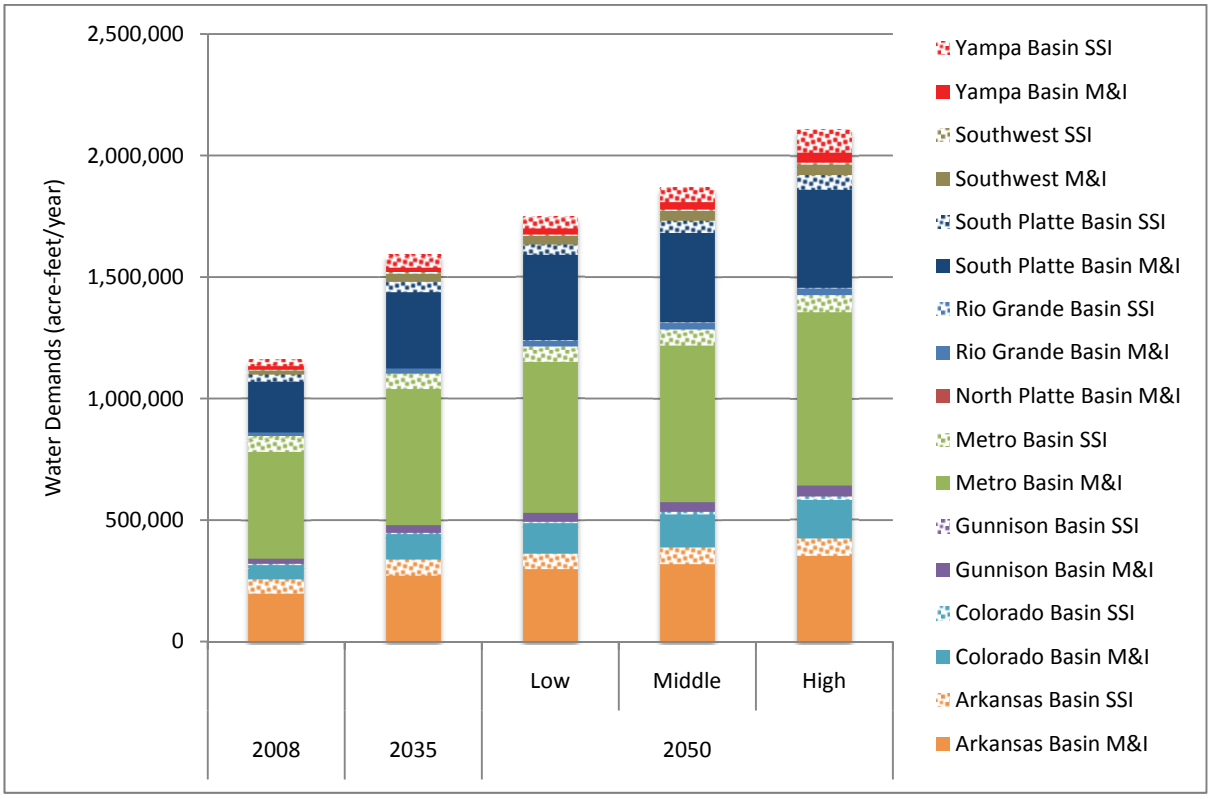


Figure ES-5 2050 M&I and SSI Demands by Basin

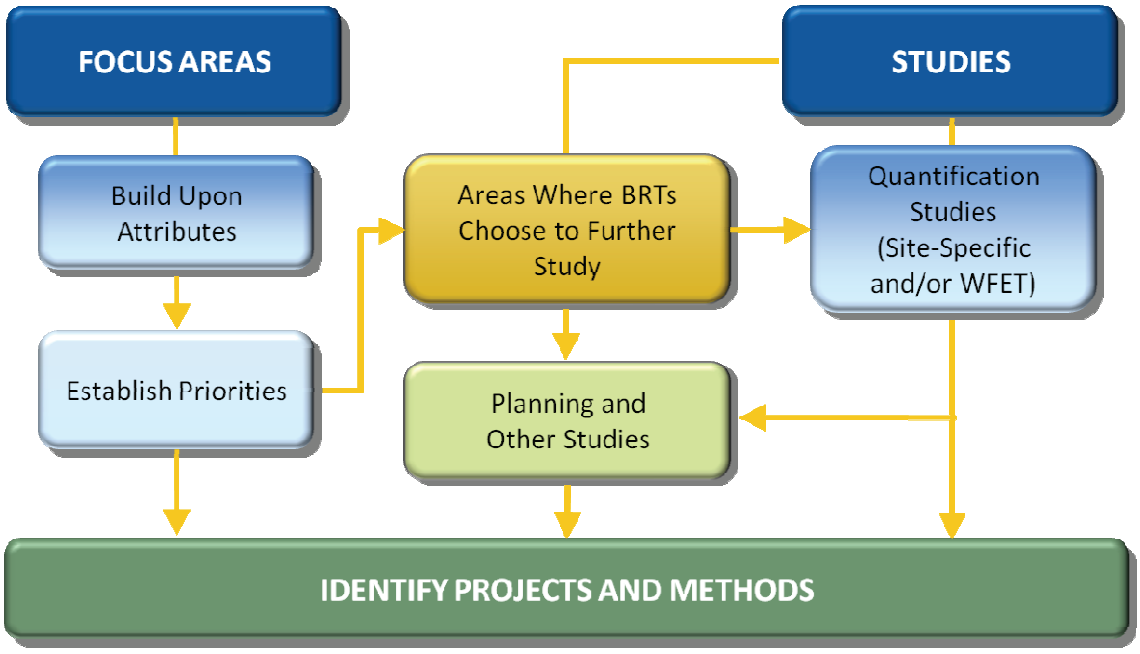


Figure ES-6 Nonconsumptive Needs Assessment Methodology

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

The environmental and recreational focus area maps can be used for the following purposes:

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

Each basin developed a unique map showing focus areas with nonconsumptive environmental and recreational water needs.

Each basin developed a unique map showing focus areas with nonconsumptive environmental and recreational water needs. The resulting statewide compilation map is represented in Figure ES-7.

Consumptive Needs Assessments

The objectives of the consumptive needs part of this SWSI 2010 update effort are to:

- Update population projections and extend them to 2050
- Update M&I per capita estimates including passive conservation
- Extend the SWSI 1 consumptive water use projections to 2050 for the M&I sector
- Update the 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 and forecast 2050 agricultural demands

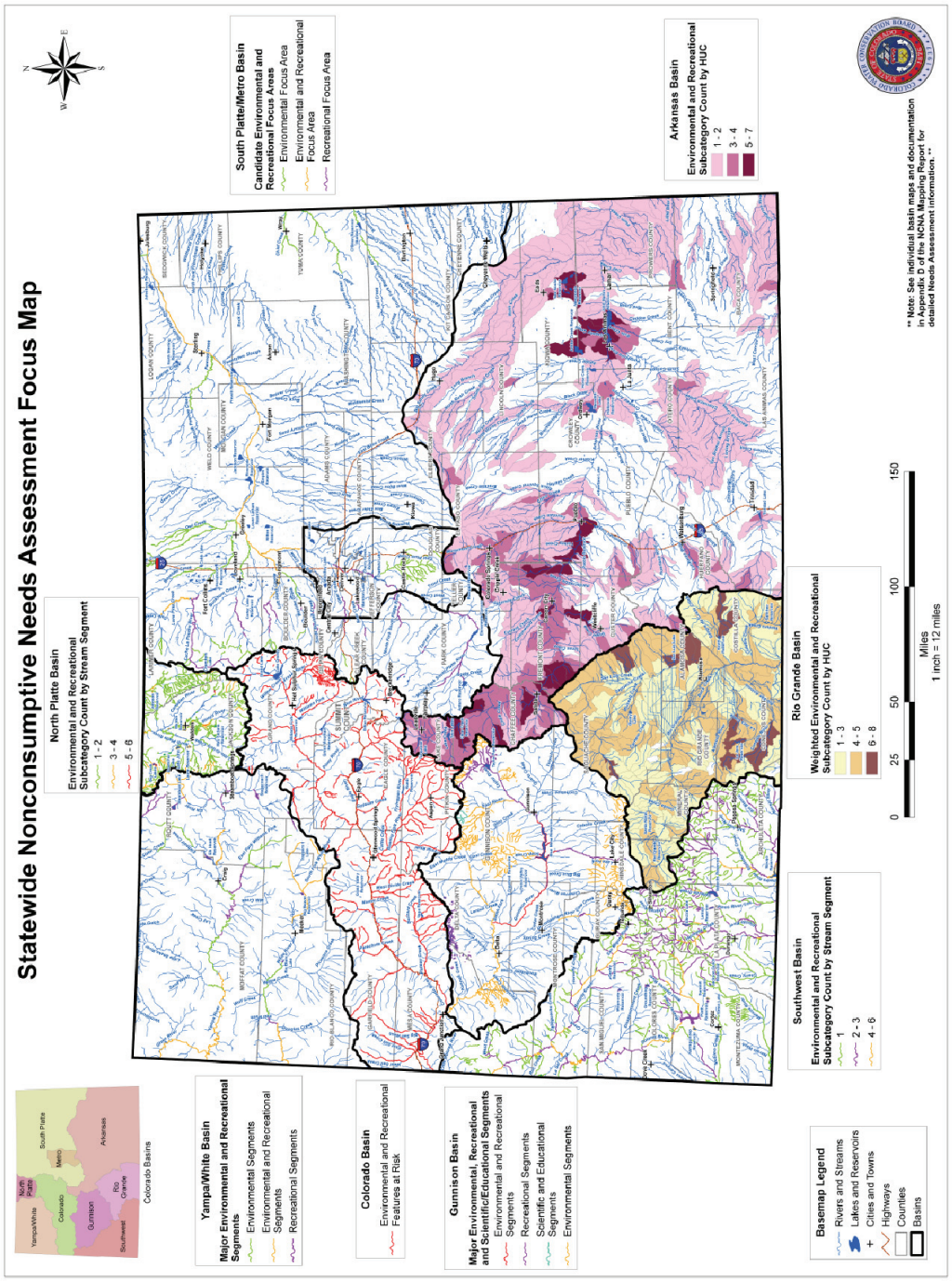


Figure ES-7 Nonconsumptive Needs Assessment Focus Map

M&I and SSI Consumptive Needs

Projected Water Use

The relative proportions of surface diversions for agricultural, M&I, and SSI gross water use in 2050 are depicted in Figure ES-8. By 2050 agriculture will continue to use the majority of Colorado's water supply. It is projected to decline from 89 percent today to 82 percent in 2050. M&I is projected to account for 15 percent of surface water diversions in 2050 and SSI about 3 percent.

2050 Population Projection Results

Between the year 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, the state's population is projected to grow to about 8.6 million people, or by about 70 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 the year 2008. On average, statewide population projections from 2008 forward indicate an increase of about 1.4 million people every 15 years.

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

Table ES-1 and Figure ES-9 show 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.

Future M&I Water Demands

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.

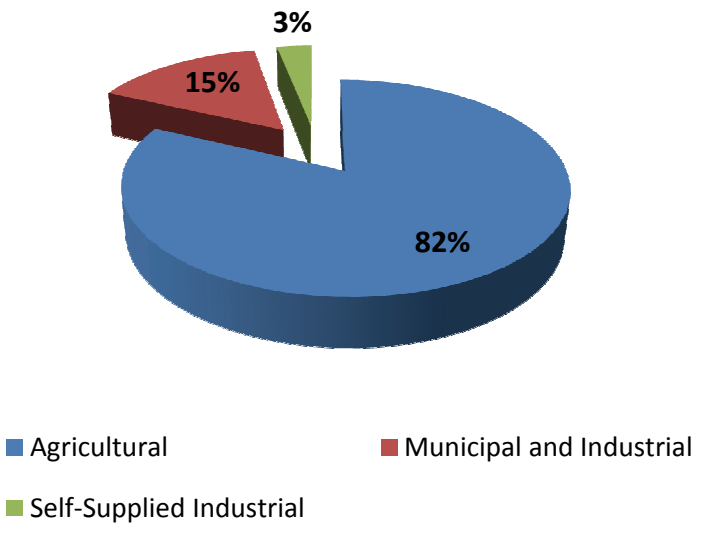


Figure ES-8 In 2050, Agriculture is still projected to utilize the majority of Colorado's water

Table ES-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**

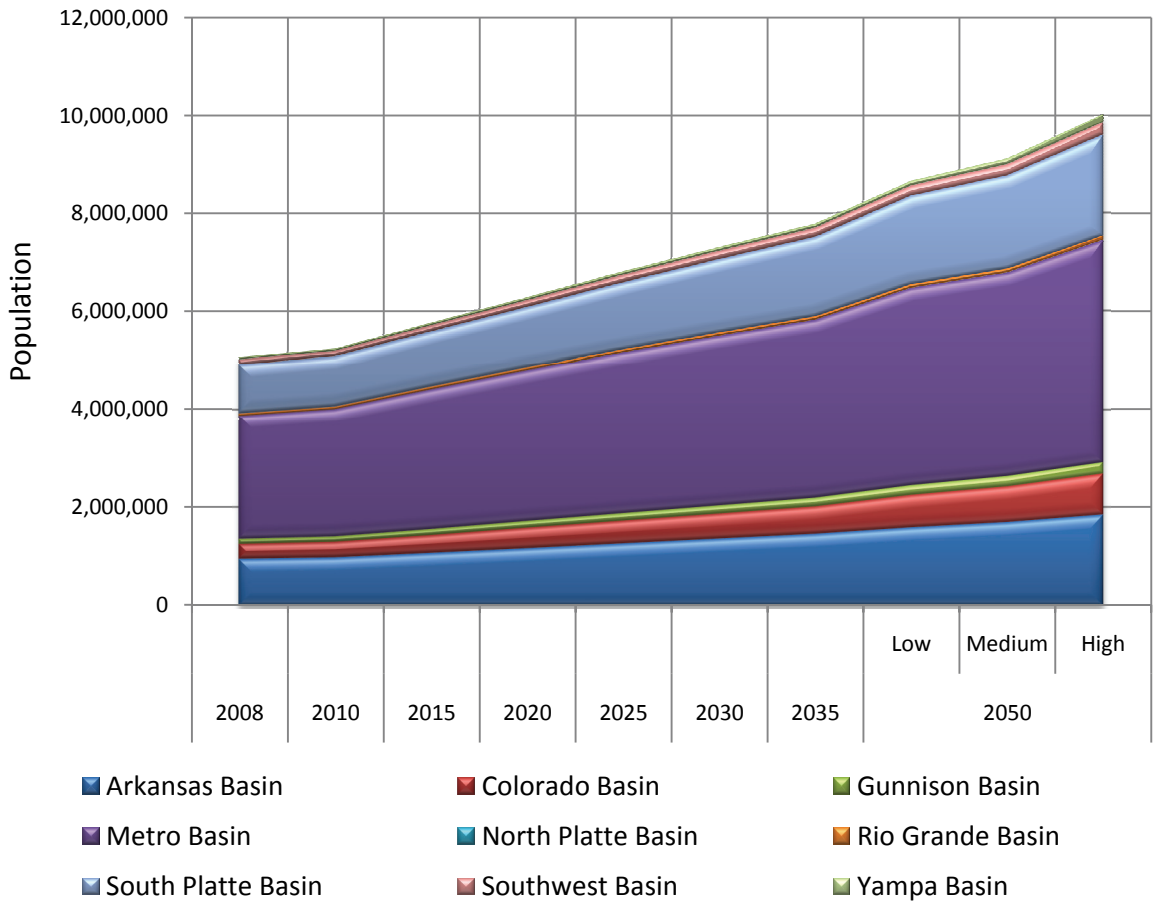


Figure ES-9 State of Colorado Population Projections through 2050

By 2050, Colorado will need between 538,000 and 812,000 AFY of additional water to meet municipal demands. Passive conservation savings are accounted for in these estimates and will result in approximately 150,000 AFY reduction or just over 8 percent decrease in M&I water demands by 2050 for the medium demand scenario relative to baseline conditions without passive conservation. The statewide current (2008) and future (2035 and 2050 low, medium, and high) water demands for baseline conditions and with passive conservation are summarized in Figure ES-10.

Colorado will need between 600,000 and 1 million acre-feet per year of additional M&I and SSI water by 2010.

Statewide SSI Demand Summary

Table ES-2 presents results of the SSI demand projections by basin. As shown, Moffat County could experience a significant increase in water demands, attributable to the electricity needed for energy development. Rio Blanco County could also experience a significant increase in water demands if the oil shale industry experiences significant growth. Both of these counties are located in the Yampa-White Basin. For the remaining counties and basins, increased demands are attributable to increases in thermoelectric power generation.

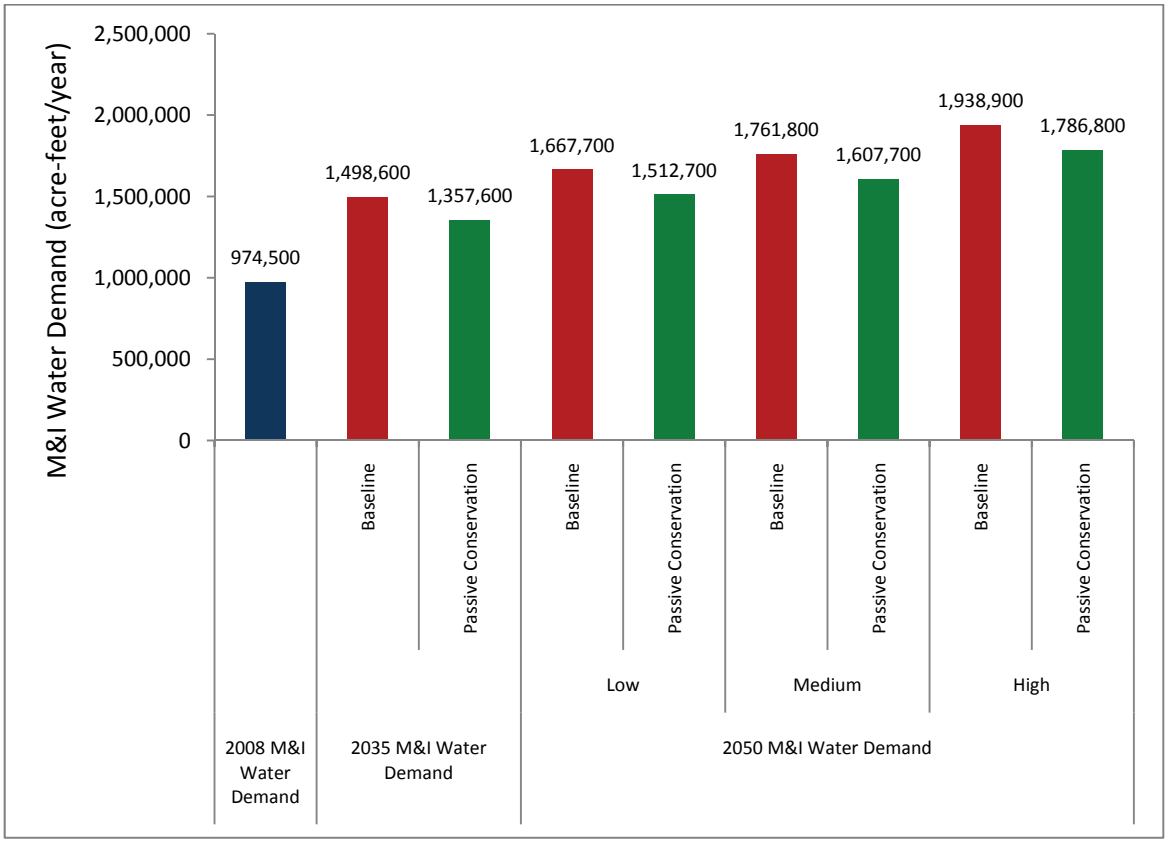


Figure ES-10 Comparison of M&I Demands for Baseline and with Passive Conservation

Table ES-2 Summary of Self-Supplied Industry Demands by Basin (AFY)

Basin	Sub-Sector	2008	2035	2050 Low	2050 Med	2050 High
Arkansas	Energy Development	—	—	—	—	—
	Large Industry	49,400	49,400	49,400	49,400	49,400
	Snowmaking	—	—	—	—	—
	Thermoelectric	9,000	14,700	15,400	18,400	22,100
	Total	58,400	64,100	64,800	67,800	71,500
Colorado	Energy Development	2,300	500	200	4,700	10,700
	Large Industry	—	—	—	—	—
	Snowmaking	3,180	4,740	4,740	4,740	4,740
	Thermoelectric	—	—	—	—	—
	Total	5,480	5,240	4,940	9,440	15,440
Gunnison	Energy Development	—	—	—	—	—
	Large Industry	—	—	—	—	—
	Snowmaking	260	650	650	650	650
	Thermoelectric	—	—	—	—	—
	Total	260	650	650	650	650
Metro	Energy Development	—	—	—	—	—
	Large Industry	52,400	52,400	52,400	52,400	52,400
	Snowmaking	—	—	—	—	—
	Thermoelectric	12,000	12,000	12,600	15,000	17,900
	Total	64,400	64,400	65,000	67,400	70,300
Rio Grande	Energy Development	—	600	1,200	1,500	2,000
	Large Industry	—	—	—	—	—
	Snowmaking	—	—	—	—	—
	Thermoelectric	—	—	—	—	—
	Total	—	600	1,200	1,500	2,000
South Platte	Energy Development	—	—	—	—	—
	Large Industry	6,600	6,600	6,600	6,600	6,600
	Snowmaking	320	320	320	320	320
	Thermoelectric	21,400	35,400	37,200	44,400	53,100
	Total	28,320	42,320	44,120	51,320	60,020
Southwest	Energy Development	—	—	—	—	—
	Large Industry	—	—	—	—	—
	Snowmaking	410	410	410	410	410
	Thermoelectric	1,900	3,900	4,100	4,900	5,900
	Total	2,310	4,310	4,510	5,310	6,310
Yampa-White	Energy Development	2,000	6,000	3,900	7,500	41,800
	Large Industry	6,100	9,500	9,500	9,500	9,500
	Snowmaking	290	570	570	570	570
	Thermoelectric	20,200	38,300	36,700	40,500	44,000
	Total	28,590	54,370	50,670	58,070	95,870
Total All Basins		**187,760**	**235,990**	**235,890**	**261,490**	**322,090**

Figure ES-11 summarizes projected SSI water usage statewide by subsector, indicating that among SSI needs, the large industry, thermoelectric, and energy development subsectors are projected to use the most water in the future. Future SSI demands are projected to range from 236,000 AFY to 322,000 AFY by 2050, an increase of 48,000 AFY to 134,000 AFY over current (2008) demands.

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 2008 to 2050. Figure ES-12 summarizes statewide M&I and SSI water use projections, including reductions as a result of passive conservation measures, for 2008, 2035, and the low, medium, and high scenario 2050 projections. Total statewide 2035 water demands are projected to be nearly 1.6 million AFY. 2050 water demands are projected to range from approximately 1.75 million AFY to nearly 2.1 million AFY. Figure ES-12 also shows that M&I water demands are estimated to exceed SSI demands for all of the future projections.

Figure ES-13 summarizes statewide existing water use and future water demands. Gross statewide M&I demands including oil shale and other SSI water demands for the low, medium, and high scenario projections are 1.75 million AFY, 1.9 million AFY, and 2.1 million AFY, respectively. These projections include passive conservation savings, but do not include the impacts of active water conservation efforts that are being implemented and planned by many M&I water providers. Current water use is just over 1.1 million AFY.

The following are the major conclusions from Colorado's 2050 M&I water use projections:

- Colorado's population is expected to nearly double to between 8.6 and 10 million people by 2050.
- The Front Range will continue to be the most populous place in Colorado with over 80 percent of the state's population residing in the Arkansas, Metro, and South Platte Basins. The Front Range is expected to grow by approximately 70 percent.
- The West Slope will grow at the fastest rate of any area in Colorado between now and 2050. Population on the West Slope is expected to more than double in the next 40 years with some growth rates as high as 240 percent.
- Statewide M&I water usage rates have decreased by 18 percent. This decrease is due to a combination of drought response, conservation savings, and additional data collection efforts. Additional data collected during this effort has improved the original SWSI water usage information.
- Because population growth is the driving factor in water use across the state, water use is also expected to nearly double by 2050.
- Passive conservation will save approximately 150,000 AFY by 2050 or an 8 percent savings relative to baseline 2050 M&I water demands.
- The basins with the largest SSI water usage in 2050 are projected to be the Yampa-White, Arkansas, Metro, and South Platte Basins.
- Colorado will need approximately 600,000 AFY to 1 million AFY of additional M&I and SSI water by 2050. These estimates incorporate new water demands from population growth, energy, and other SSI needs (including oil shale), and replacement of nontributary groundwater.
- An oil shale industry producing 1,550,000 barrels of oil/day could use between 0 to 120,000 AFY depending upon what technologies and other factors are implemented. Due to ramp up rates, by 2050 projected water use ranges from 0 to 44,000 AFY for an industry providing 550,000 barrels of oil/day.

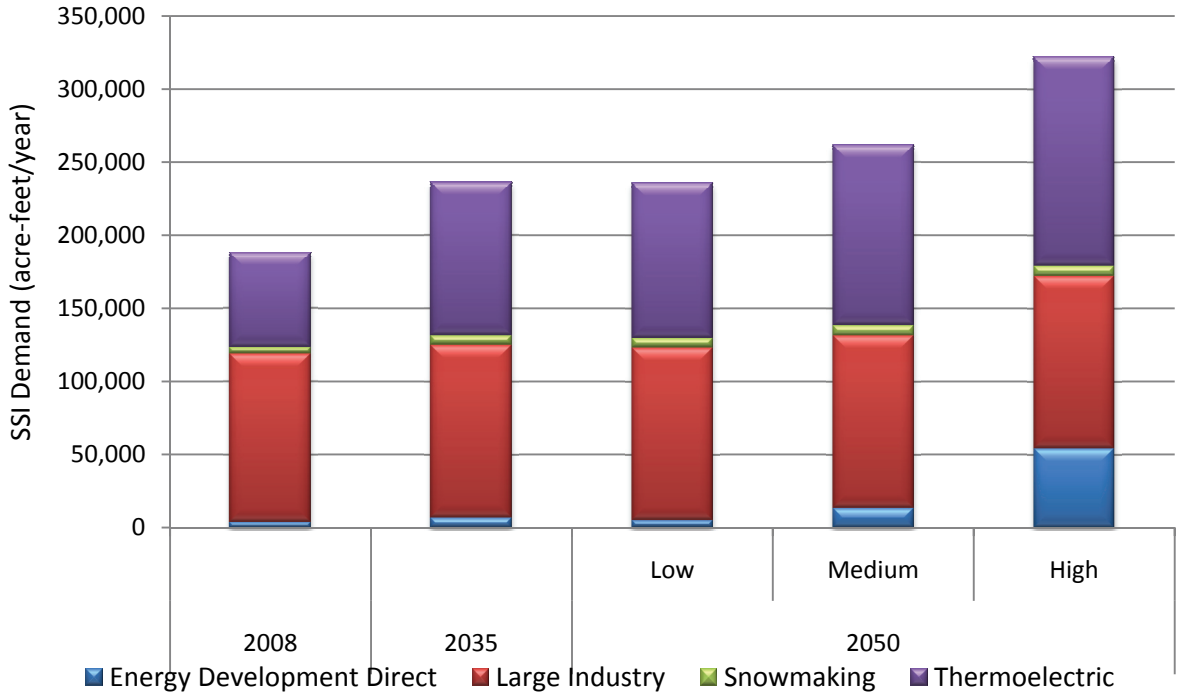


Figure ES-11 Statewide Self-Supplied Industrial Demands by Sector

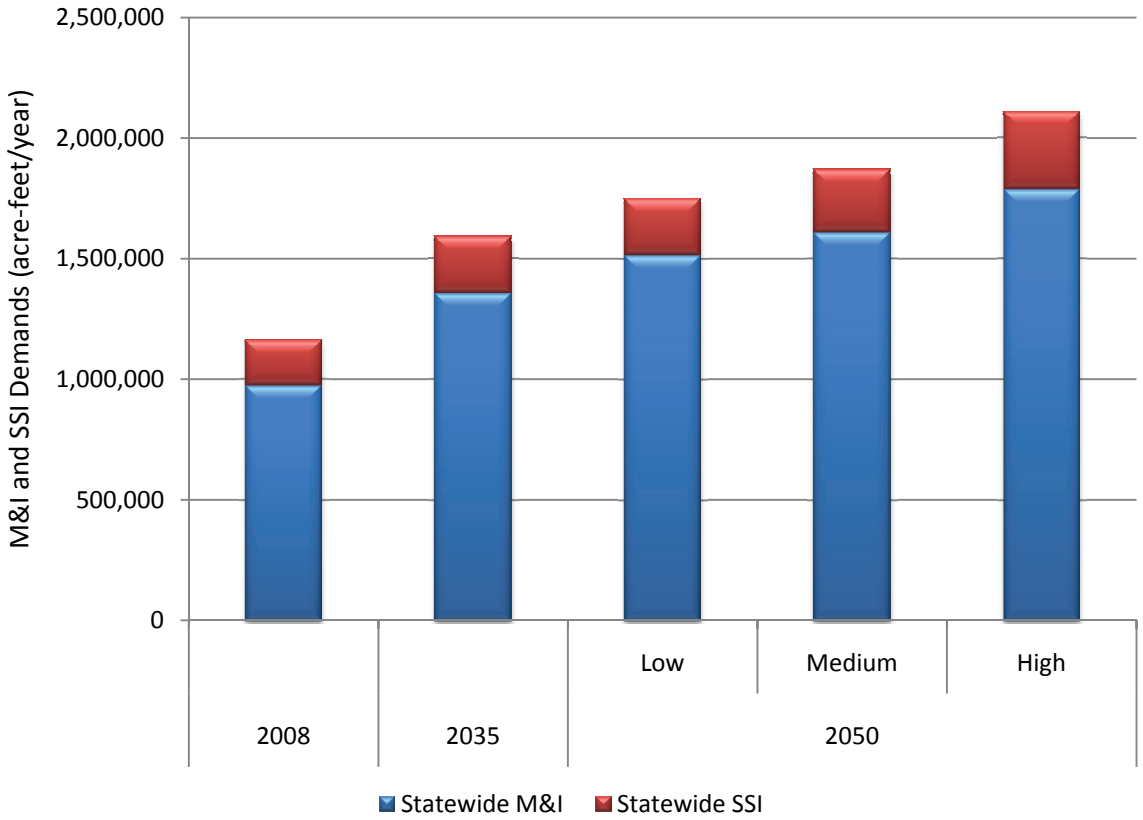


Figure ES-12 Statewide M&I and SSI Demands

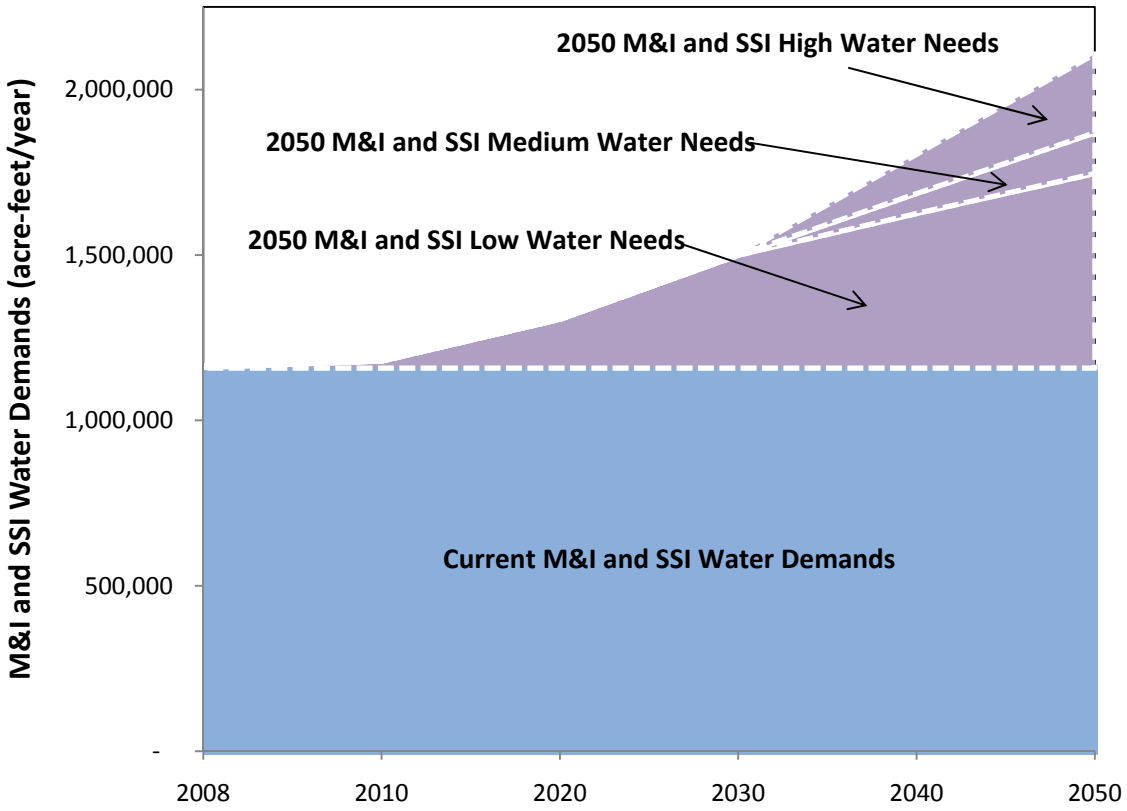


Figure ES-13 Existing and Future M&I and SSI Demands

Agricultural Consumptive Needs

Current Agricultural Demand Results

Each basin in Colorado faces continued water shortages associated with existing agricultural demands. Table ES-3 summarizes results of the average annual current agricultural demands and shortages by basin. It shows irrigated acres, Irrigation Water Requirement (IWR), Water Supply Limited Consumptive Use (WSL CU), and shortage (difference between IWR and WSL CU), and non-irrigation demand.

Figures ES-14 and ES-15 show the current WSL CU and shortage amounts by basin. Basins with the highest current agricultural water demand include the South Platte, Rio Grande, and Republican.

Future Agricultural Demand Results

There are upward economic pressures to keep agriculture viable, and some basins, such as the Yampa, are seeking to expand agriculture. However, the state could also face a significant decline in irrigated acres by 2050 due to urbanization and water transfers. As represented in Figure ES-16, between 500,000 and 700,000 irrigated acres could be dried up by 2050, and large-scale dry-up of irrigated agriculture has adverse economic and environmental impacts.

Table ES-3 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
Metro and South Platte	831,000	1,496,000	1,117,000	379,000	115,000
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
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**

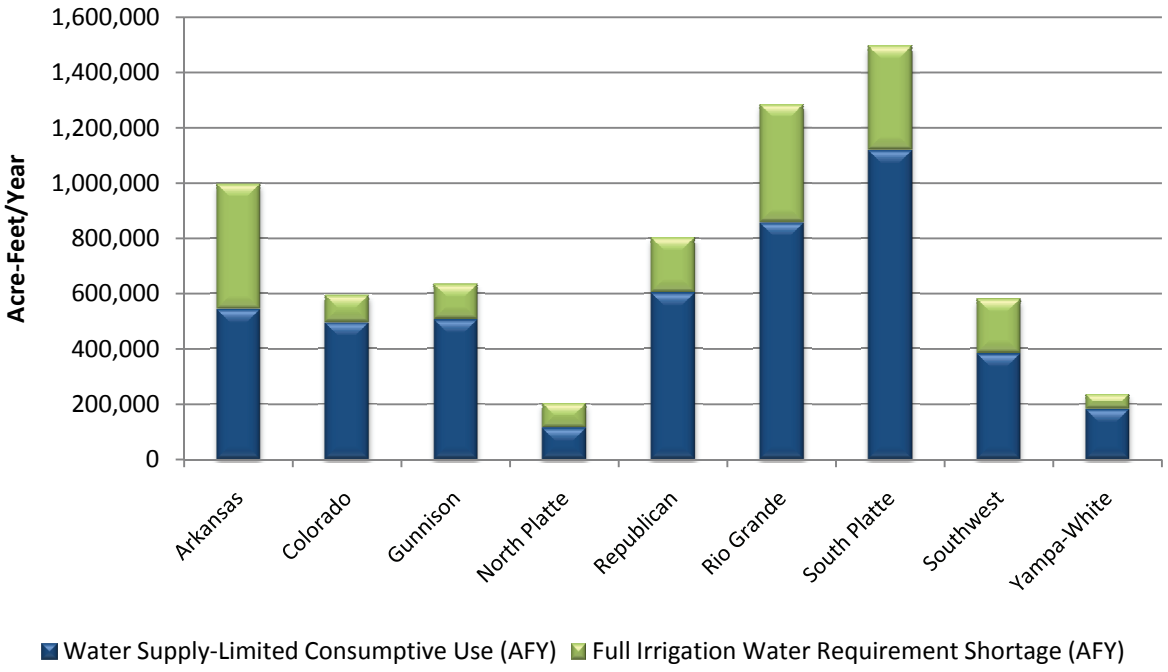


Figure ES-14 Current Agricultural Demands and Shortages

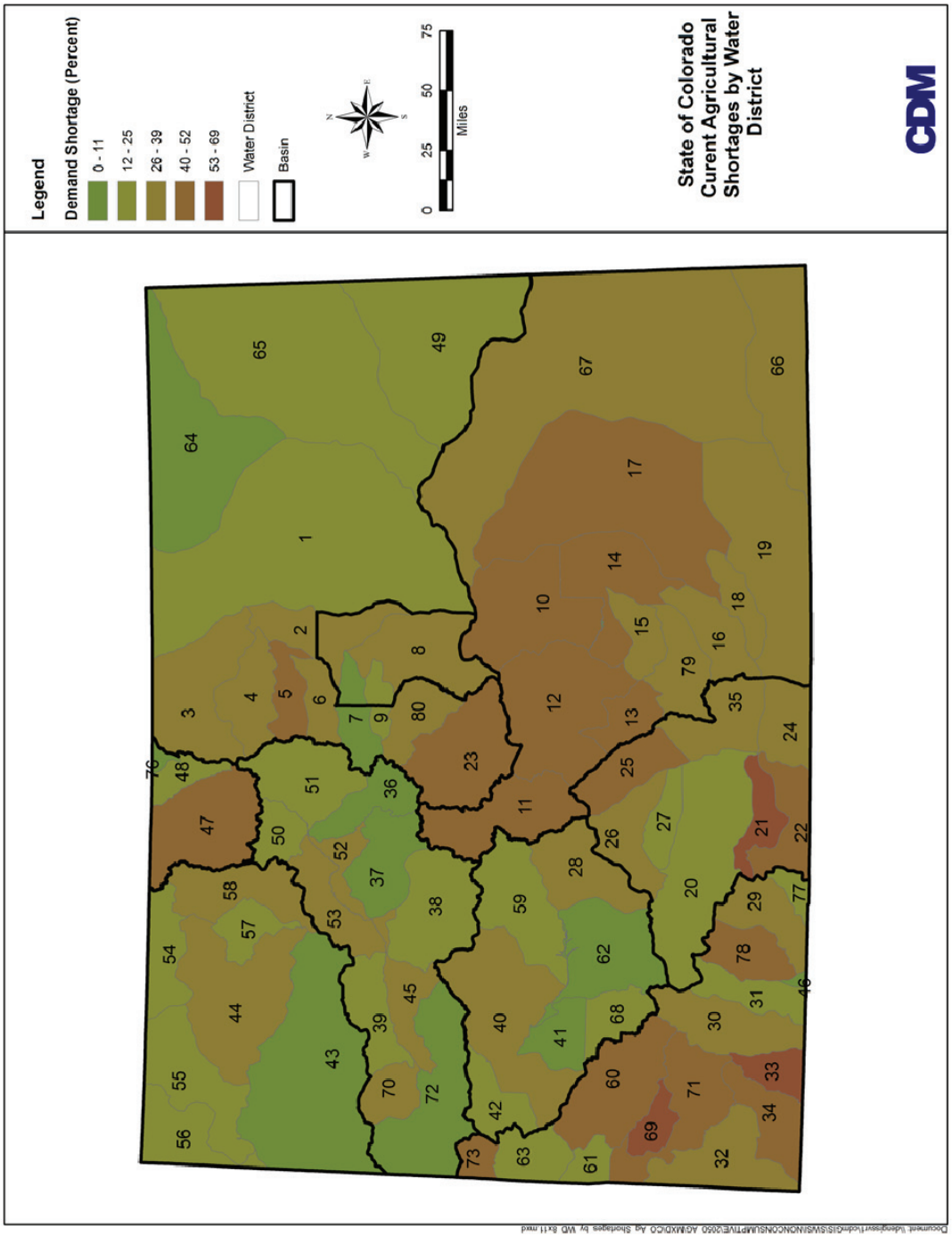


Figure ES-15 State of Colorado Current Agricultural Shortages by Water District

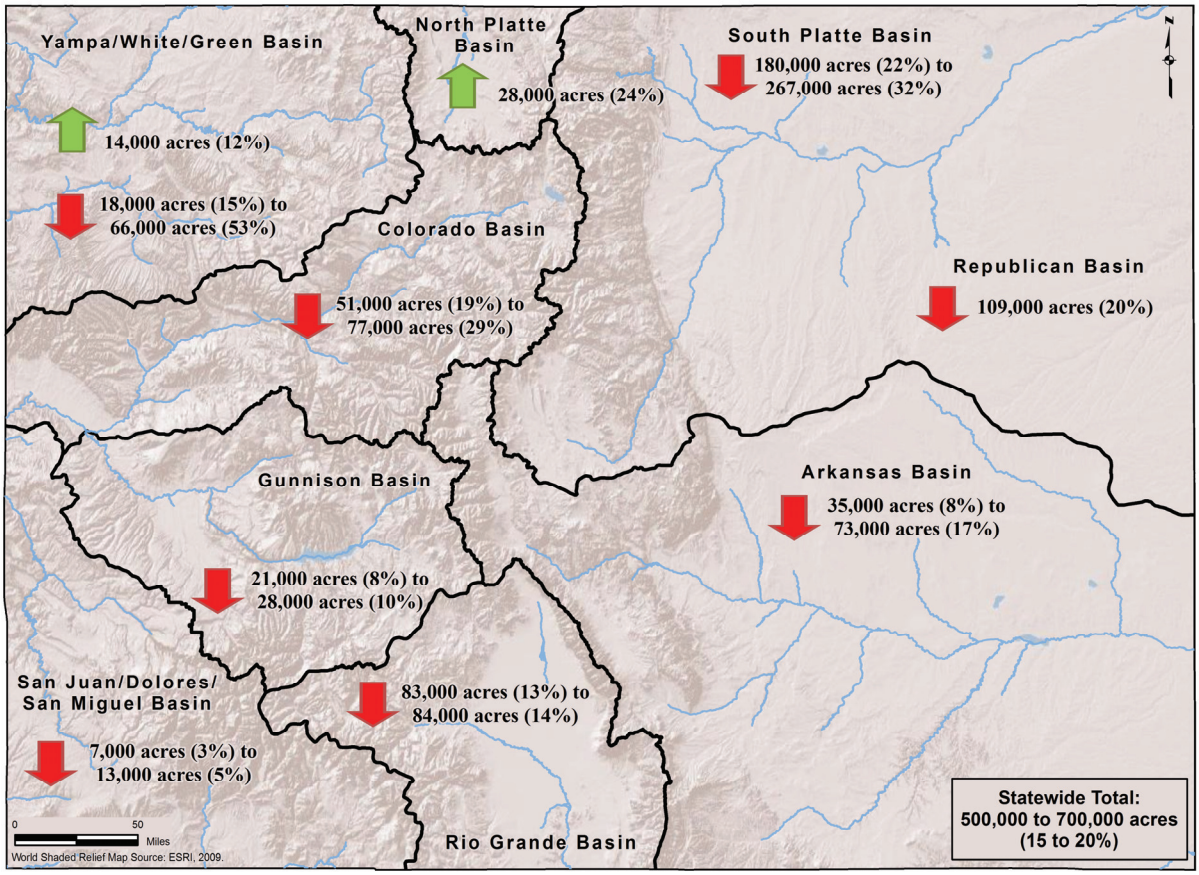


Figure ES-16 Potential Changes in Irrigated Acres by 2050

Table ES-4 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 ES-17 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.

In 2050, Colorado's agricultural demands are projected to be approximately 4 million AFY as represented in Figure ES-17.

Projects and Methods to Meet Basin Needs

Projects and Methods to Meet M&I Consumptive Needs

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 identified projects and processes (IPPs). Statewide, these analyses were performed on a countywide basis and aggregated by basin roundtable area.

Table ES-4 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**

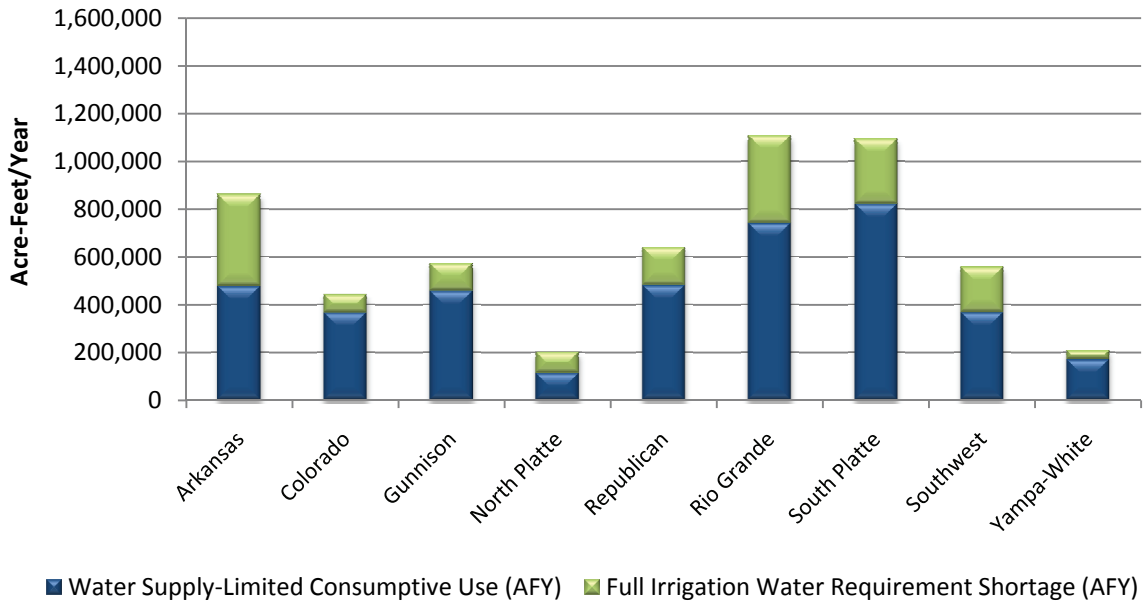


Figure ES-17 2050 Agricultural Demands and Shortages

Water providers throughout Colorado are pursuing water supply projects and 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. IPPs include:

- 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

Table ES-5 identifies the anticipated range of IPP yield from each category for each basin at the 100 percent success rate.

As shown in Table ES-5, if 100 percent of the IPPs are successfully implemented they would provide 430,000 to 580,000 AFY. The largest categories of IPP yields by volume are projected to be regional in-basin projects (150,000 AFY to 170,000 AFY) and growth into existing supplies (100,000 AFY to 160,000 AFY). Figure ES-18 depicts the data graphically.

Implementation of these local projects and processes are critical to meeting Colorado's future water supply needs.

M&I Consumptive Gap Analysis

Colorado faces a significant M&I water supply gap in 2050. The M&I gap varies between 190,000 and 630,000 AFY depending on the success rate of the IPPs. By 2050, Colorado's M&I gap could be between 32 percent and 66 percent of new M&I demands.

Table ES-5 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.

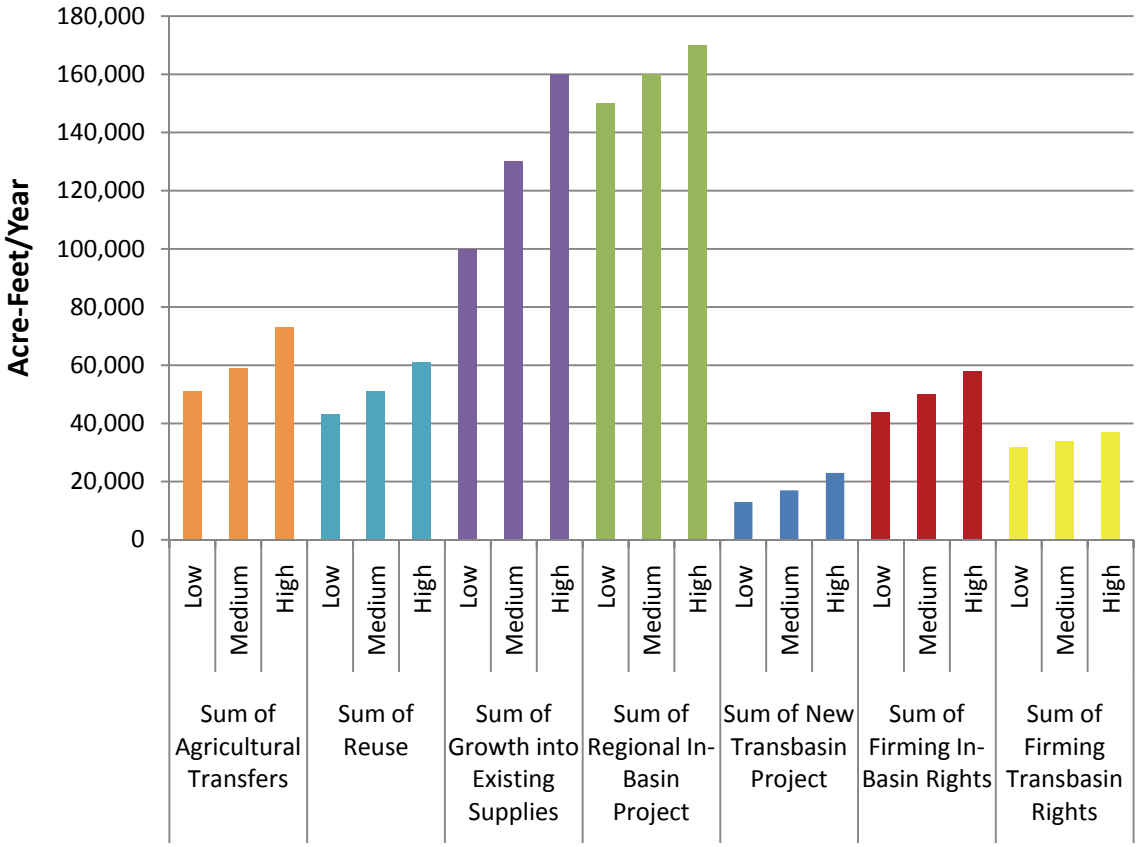


Figure ES-18 Statewide Summary of Yield for IPP Categories at 100 Percent Success Rate

Table ES-6 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 resulting M&I gap. The calculated gap values do not imply a future water supply shortfall; rather, the gap is representative of a future demand for which a project or method has not yet been identified.

SWSI 2010 estimated a low, medium, and high gap scenario. 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 390,000 AFY. Under the high gap scenario (high demands and status quo IPP success rate), the statewide gap is 630,000 AFY.

Figure ES-19 illustrates the timing of the M&I gap under the medium gap scenario. Colorado faces immediate M&I water supply needs. Under the medium gap scenario, these immediate needs are met with the successful implementation of the IPPs. The associated yield of the IPPs increases between 2010 and 2030. Under the medium gap scenario, the IPPs are 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 390,000 AFY.

This figure does not represent a definitive timeline. Instead, it represents the evolving temporal relationship between existing supplies, IPPs, and the gap, the sum of which is equal to total M&I and SSI demands at any point in time.

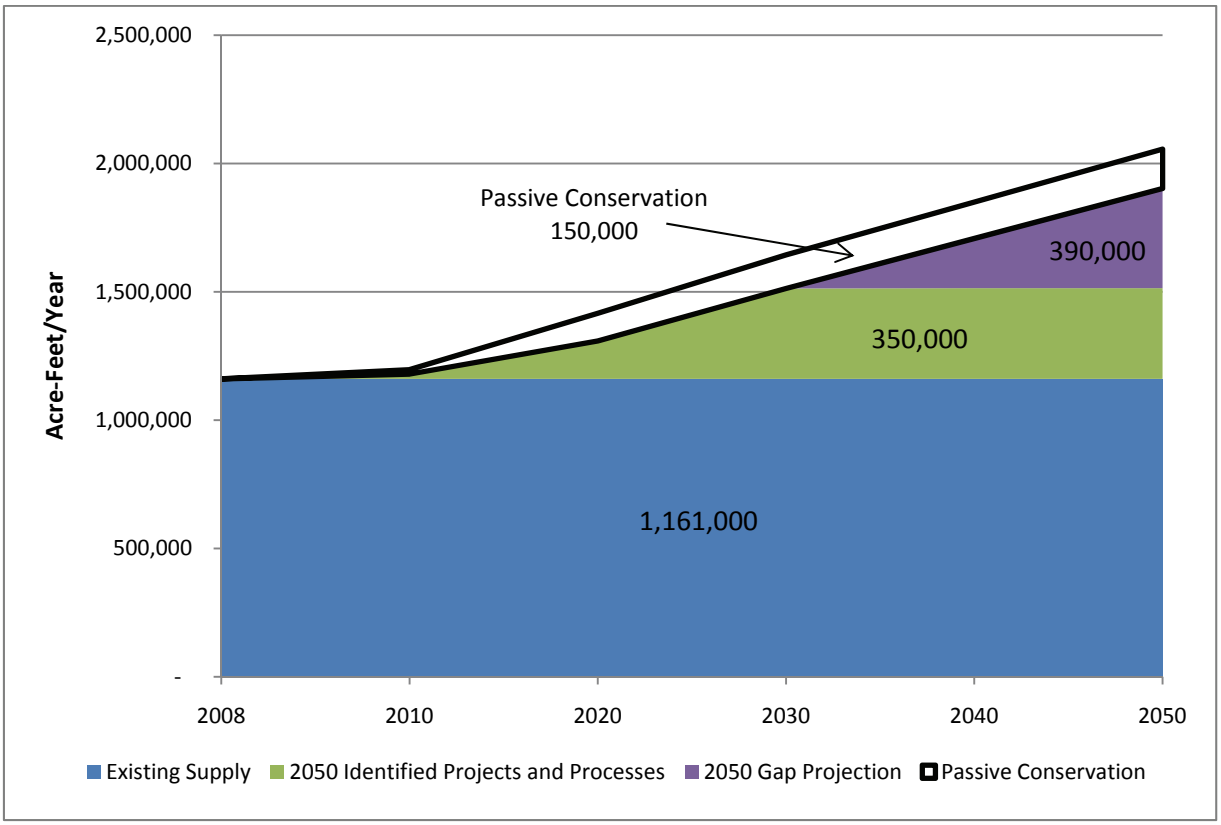
Table ES-6 Statewide M&I and SSI Gaps in 2050[1]

Basin	Increase in M&I and SSI Demand (AFY)			Estimated Yield of Identified Projects and Processes (AFY)			Estimated Remaining M&I/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.



ES-19 Statewide M&I and SSI Gap Summary Medium Scenario (IPPs at 70% Yield)

Figure ES-20 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, the blue represents the yield from the IPPs under the medium IPP success rate for each basin, and red represents the remaining gap.

Projects and Methods to Meet Nonconsumptive Needs

Similar to the M&I IPPs, CWCB conducted an analogous outreach effort with the environmental and recreational community and the basin roundtables to identify nonconsumptive projects and methods. CWCB digitized the project information into a geographic information system and compared this information with the nonconsumptive focus areas summarized previously. With this information, CWCB preliminarily identified nonconsumptive focus areas with and without projects and methods. Note that if a focus area does not have an associated project and method it does not mean that the area is in need of a protective project or method. Conversely, if an area does have one or more projects and methods, it does not mean it is sufficiently protected. The basin roundtables will use this information as they finalize their needs assessments during 2011. This information is 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?

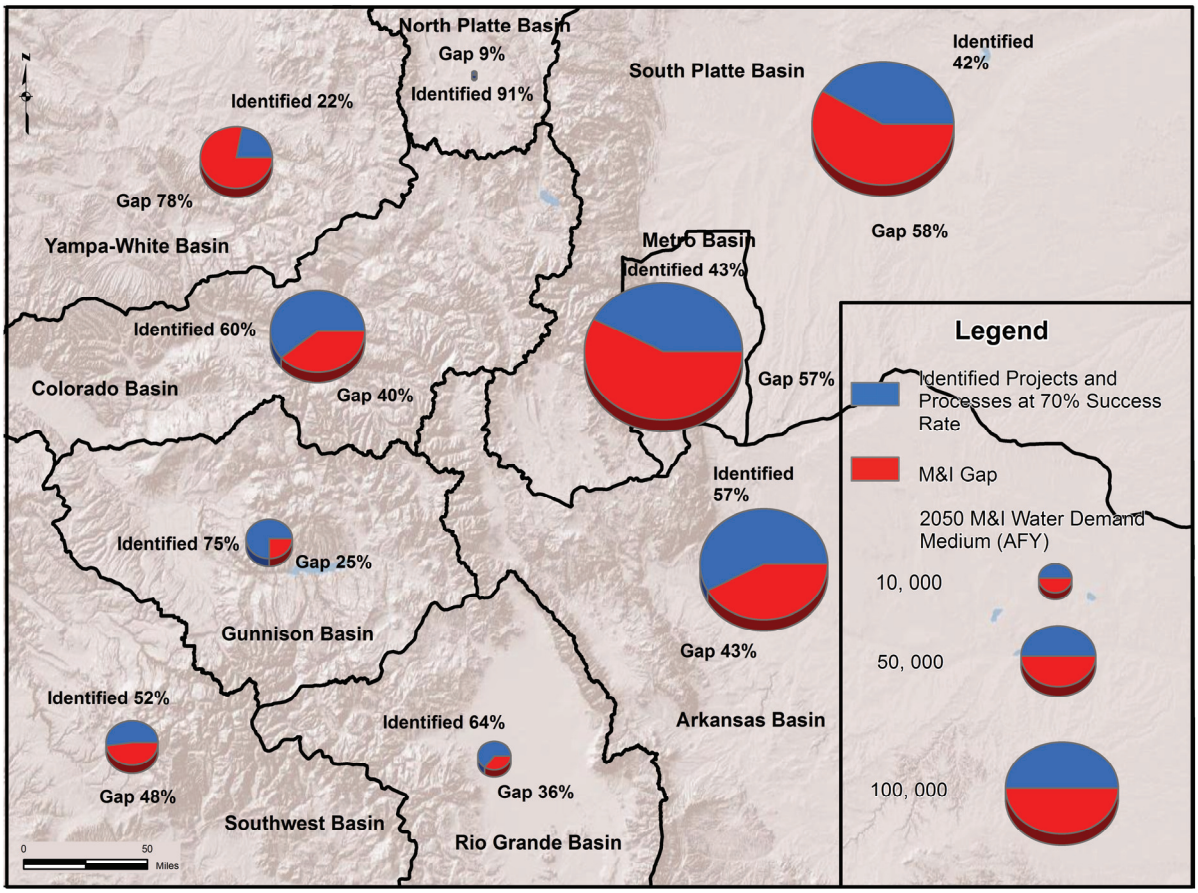


Figure ES-20 2050 M&I and SSI Gap Analysis – Medium Gap Scenario

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?

In summary, environmental and recreational values will continue to be important to the state's economy and quality of life. Although Colorado has many existing projects and methods aimed at meeting these nonconsumptive values, additional projects and methods will be needed to meet Colorado's nonconsumptive water supply needs, especially in warmer waters with endangered, threatened, and imperiled species.

Key findings are:

- Nonconsumptive focus areas were identified on 33,000 miles of streams and lakes in the state with water related environmental and recreational values. Nearly one-third of these focus areas have an identified project or method to support one or more of the nonconsumptive values in the area.
- The focus areas include 12,000 stream miles that have cold water fisheries (e.g., cutthroat trout species and important fishing areas). Of these, nearly 50 percent have an identified project or method to support those values.
- The focus areas include 11,000 stream miles that have warm water fisheries (e.g., Colorado River endangered fish, and species of special concern, such as roundtail chub and Arkansas darter). Of these, approximately 30 percent have an identified project or method to support those values.

Water Availability

Surface Water Supply Availability

Supplies are not necessarily where demands are and localized shortages exist, especially in headwaters areas. Colorado River compact entitlements are not fully utilized. In the South Platte, Arkansas, and Rio Grande Basins, unappropriated water is extremely limited.

The Colorado River Water Availability Study confirmed planning ranges that may be available from the Colorado River system to meet future needs and identified local water availability throughout the Colorado River Basins. Projects and methods to manage risk will be needed in order to develop new water supplies in the Colorado River system.

Groundwater Supply Availability

Between now and 2050, there will need to be a decreased reliance on nonrenewable, nontributary groundwater as a permanent water supply. Without this, there are reliability and sustainability concerns in some areas, particularly along the Front Range.

In addition to meeting future M&I water needs, the South Metro area and northern El Paso County will need to replace nearly 35,000 AFY of nontributary groundwater with a renewable water supply.

Portfolios and Strategies to Address the M&I Gap

CWCB recognizes that Colorado faces significant and immediate water supply challenges and should pursue a mix of solutions to meet the

state's consumptive and nonconsumptive water supply needs.

Because of the growing M&I demands and the need to sustainably meet Colorado's nonconsumptive and agricultural water supply needs, the CWCB, IBCC, and Colorado's water community began a visioning process in 2008. Colorado's water community asked itself, if we let Colorado's water supply continue to develop according to current trends and existing policy, what will our state look like in 50 years? Is this our vision of the future of Colorado and if not, what can and should we do to effect changes? The visioning process included three parts—1) a Vision Statement; 2) Vision Goals; and 3) Water Supply Strategies.

The draft Vision Goals, which constitute Colorado's water management objectives, are as follows:

- Meet M&I demands
- Meet agricultural demands
- Meet Colorado's environment and recreation demands
- Encourage cooperation between water supply planners and land use planners
- Encourage more cooperation among all Colorado water users
- Optimize existing and future water supplies by:
  - Considering conservation as a baseline water supply strategy
  - Minimizing non-beneficial consumptive use (evaporation, nonnative phreatophytes, etc.)
  - Maximizing successive uses of legally reusable water
  - Maximizing use of existing and new in-basin supplies
- Promote cost-effectiveness by:
  - Allocating costs to all beneficiaries fairly
  - Achieving benefits at the lowest cost
  - Providing viable financing mechanisms, including local, state, and federal funding/ financing
  - Mitigating third-party economic impacts
- Minimize the net energy used to supply water, including both the energy used and/or generated with raw water delivery, and the energy used for treatment
- Protect cultural values by:
  - Maintaining and improving the quality of life unique to each basin
  - Maintaining open space
- Provide operational flexibility and coordinated infrastructure
- Promote increased fairness when water is moved between basins by:
  - Benefiting both the area of origin and the area of use
  - Minimizing the adverse economic and environmental impacts of future water projects and water transfers
- Comply with all applicable laws and regulations, meet all applicable compact obligations, and protect water rights including the right of water right owners to market their water, while recognizing some institutional changes may be needed to implement certain strategies
- Educate all Coloradoans on the importance and scarcity of water, and the need to conserve, manage, and plan for needs of this and future generations

The CWCB and IBCC have utilized the visioning process to address Colorado's future M&I Gap. As discussed previously, Colorado will need an additional 190,000 to 630,000 AFY beyond what is currently being planned for by local water providers in order to meet future M&I water demands and replace reliance on nonrenewable groundwater.

The visioning process led to the realization that the current approach for water management—the status quo—will not lead to a desirable future for Colorado. The status quo will likely lead to large transfers of water from agricultural to municipal uses. Maintaining the status quo could result in loss of agricultural lands, harm to ecosystems and

recreation based economies, water-inefficient land use decisions, and continued paralysis on water supply projects. In addition, costs associated with the status quo could cost Colorado's citizens billions of dollars more than a coordinated approach.

With the general agreement that the status quo approach to water management will not lead to a desirable future for Colorado, the IBCC and CWCB began scenario planning. Traditional planning efforts typically examine one predictive future. The scenario planning process is not intended to represent forecasts of the future, but to represent a wide range of potential future conditions that may impact M&I water supply and demand. A summary of the future scenarios is summarized in Figure ES–21.

As described above, the portfolio approach considers different future conditions and combinations of water supply strategies to address each scenario. Each ***scenario*** represents a different, but plausible, representation of circumstances that would result in differing statewide consumptive and nonconsumptive water demand and water supply. As shown in Figure ES-21, seven different future scenarios are being considered. ***Portfolios*** are combinations of strategies that collectively meet statewide water demands. Portfolios can be developed for each future scenario. ***Strategies*** are broad categories of solutions for meeting Colorado's consumptive and nonconsumptive water supply needs and include demand side strategies and supply side strategies. To date, the CWCB and IBCC have considered strategies for conservation, agricultural transfers, and new water supply development. Finally, the CWCB, IBCC, and basin roundtables have identified projects and methods to meet their future consumptive and nonconsumptive needs. ***Projects and methods*** are specific actions that help implement each strategy.

For example, a water project helps implement a new water supply development strategy, a rotational fallowing program helps implement an agricultural transfer strategy, and a block rate pricing program helps implement a conservation strategy.

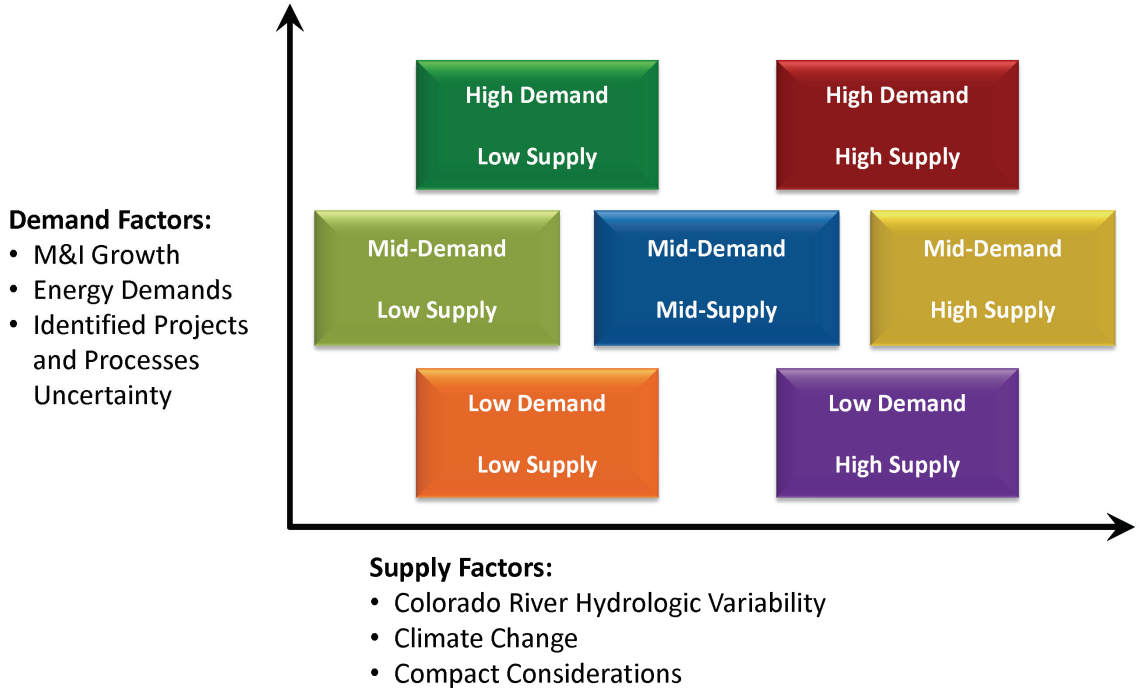
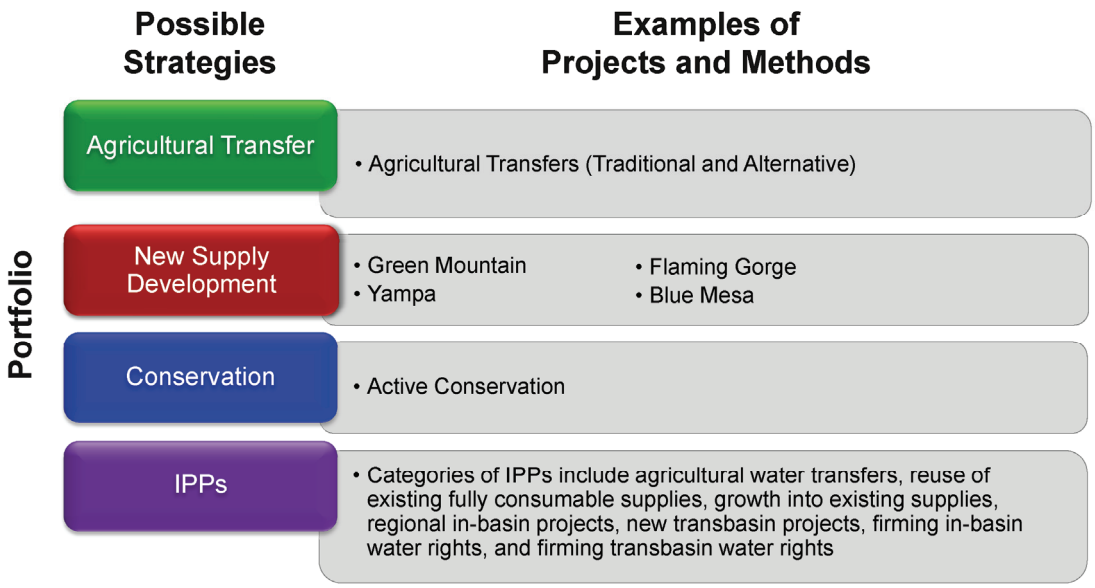


Figure ES-21 Colorado's Water Supply Future Water Demand and Supply Scenario

Figure ES-22 summarizes the portfolio elements that can be used to address future M&I demands. The left side of the figure shows the general category of the portfolio elements—agricultural transfer, new supply development, conservation, and IPPs. These portfolio elements represent strategies to address future M&I demands. The right side of the figure shows example projects and methods that could be used to implement the strategies.

After examining the trade-offs associated with the status quo portfolio, which relies mostly on traditional transfers of agricultural water to municipal uses using the portfolio and trade-off tool, the CWCB and IBCC found that it is clear that no one strategy can meet Colorado's growing water needs without harming values important to all Coloradoans. Therefore, a mix of solutions is needed and this mix of water supply solutions should include all four sources to meet the water supply gap in Colorado—conservation, IPPs, agricultural transfers, and new supply development—while also protecting Colorado's significant water-dependent ecological and recreational resources.

In summary, because the CWCB and IBCC have agreed that if Colorado's water supply continues to develop according to current trends, i.e., the status quo, this will inevitably lead to a large transfer of water out of agriculture resulting in significant loss of agricultural lands and potential harm to the environment. Providing an adequate water supply for Colorado's citizens, agriculture, and the environment will involve implementing a mix of local water projects and processes, conservation, reuse, agricultural transfers, and the development new water supplies, all of which should be pursued concurrently. To help weigh the trade-offs between possible mixes of strategies, the CWCB developed preliminary information for the following strategies— conservation, alternative and traditional agricultural transfers, and new supply development. It should be noted that at this time the CWCB and IBCC have agreed that a mix of strategies and solutions are necessary to meet Colorado's future M&I demands, however agreement has not been reached on what an alternative portfolio should include.



Fiaure ES-22 Portfolio Elements to Address Colorado's Future M&I Demands

Conservation Strategy

Water conservation will be an important tool for meeting future M&I demands, and is one piece of a larger water supply portfolio.

The CWCB defines water conservation as those measures and programs that provide for measurable and verifiable permanent water savings[1]. The purpose of the information provided in the conservation strategy is to update the range of potential future water conservation savings since SWSI 1 and 2, provide water conservation strategies that may contribute toward meeting the projected 2050 M&I water supply gap, and help address Colorado's future M&I water needs.[2]

The potential for future conservation by the year 2050 was estimated for three distinct conservation strategy scenarios titled simply—low, medium, and high. The conservation strategy looked at the potential savings from water conservation measures but did not determine the portion of those savings that could potentially be utilized toward meeting a future water supply gap. Water savings in 2050 were forecast for each river basin in Colorado using a conditional demand forecasting methodology that employed a set of efficiency targets, sectoral demand reductions, and assumed implementation rates. Each strategy includes an overview of the conservation measures and programs that could be implemented to achieve a range of efficiency targets (for indoor use) and estimated sectoral conservation savings that were based upon the best available literature and data on demand management. The conservation savings forecasts are conditional and rely on an assumption of implementation at the described levels in order to achieve the overall estimated savings level. The SWSI levels analysis of statewide passive water conservation potential showed that by 2050 demands will likely be reduced by about 150,000 AFY through the natural replacement of toilets, clothes washers, and other standard domestic fixtures. These passive savings are embedded in all three conservation strategies, but passive and active water savings estimates are presented separately (in Table ES-7) to help ensure double counting of water savings does not occur in the future as these estimates are used.

The conservation savings forecasts presented in the conservation strategy are intended for statewide planning purposes and are not intended to replace water conservation and water resources planning and projections prepared by local entities. There are also other important caveats and assumptions regarding the water conservation strategies that should be understood so that the results are not misinterpreted or misapplied.

Conditional Statewide Strategies to Assess Conservation Potential – These three strategies were used to prepare a conditional demand forecast. The savings estimates presented are expected to be achieved if the programs and measures described are implemented at the specified level across the entire state. The medium and high strategies in particular will require a significant and sustained effort in order to achieve the forecast water savings. The forecasting assumptions do not reflect differences that exist between individual water providers. Each water provider in Colorado is distinct and it is anticipated that over the next 40 years water conservation will be implemented differentially across the state. In order to prepare statewide forecasts of conservation potential it was assumed that the potential to conserve water may exist irrespective of an individual water provider's need or desire to conserve.

[1] Under this definition, water conservation may include measures and programs that are being implemented for political reasons and/or to improve customer satisfaction.

[2] Colorado's 2050 M&I water demands include water demands associated with SSI users – large industrial users that have their own water supplies or lease raw water from others. The potential water conservation savings provided in this SWSI 2010 update include only savings from the M&I demands associated with a typical municipal system. Potential SSI water savings are not estimated.

Table ES-7 Statewide Forecast Water Savings (separating passive and active) Potential from SWSI 1 and SWSI 2010[1]

Project	Level	2030 Forecast Savings[2] (AFY)	2050 Forecast Savings[2] (AFY)
SWSI Phase 1	Level 1 (Passive)	101,900	NA
	Level 2 (active only)	68,633	
	Level 3 (active only)	170,952	
	Level 4 (active only)	341,485	
	Level 5 (active only)	597,283	
SWSI 2010	Passive[3]	131,000	154,000
	Low (active only)	78,000	160,200
	Medium (active only)	133,000	331,200
	High (active only)	197,100	461,300

Notes:

1 Total water savings potential included, which does not decipher the portion of the savings that may be available to meet demands associated with new population versus other planning uses such as drought reserve.

2 Volumes savings estimates are total cumulative and include passive savings (e.g., SWSI 1, Level 3 savings build upon Levels 1 and 2; SWSI 2010, medium savings build upon low savings).

3 From SWSI levels analysis.

In reality, some providers will need little if any conservation savings to meet future demands while others will seek substantial demand reductions.

Permanency of Existing Conservation Efforts – The water savings projections in this report are conditioned on post-drought baseline demands, and assume water conservation savings since the 2002 drought period will be sustained into the future. The permanency of post-drought related reductions in water use is uncertain. Some of this uncertainty may be resolved as additional water utility-level data are obtained and further investigated. Additional and improved data is anticipated through future utility water conservation plans and under data reporting requirements established in Colorado HB 10-1051.

Climate Change Not Considered – The impacts of climate change on water demands were not included in this analysis. Time and budgetary limitation did not allow for this complexity to be included. Climate change is an important factor for consideration in conjunction with future water demands and should be included in subsequent forecasting efforts.

The Future is Uncertain and Water Use May Change – It is impossible to predict all of the technological and cultural changes that could occur over the next 40 years, which might impact water use. The trends over the past 15 years have been towards greater efficiency and lower use and at this moment in time, there is no indication that these trends will not continue. However, it is possible that new uses for water could emerge in the future, which might increase municipal demand (e.g., increased use of evaporative cooling, increased installation rates of swimming pools, spas, and/or multi-headed showering systems). Unanticipated demand increases could counteract some of the savings estimated in this report, even if conservation programs are implemented at the specified levels. Similarly, technology could also serve to reduce future water demands below those estimated here. Updating the baseline condition and demand forecasts regularly is the best way to incorporate unanticipated future changes.

Uses of Conserved Water Are Not Assumed – No assumptions have been made about the portion of the water savings forecast in this report that could potentially be utilized toward water supply, serving new customers, or meeting the M&I gap. Each water provider must decide how best to apply water garnered from demand reductions within their individual water supply portfolio. Utilities will need to make these decisions based on their integrated water resources planning efforts, consideration of their

system's reliability throughout drought periods, impacts of conservation on their return flows and availability of reusable supplies, effectiveness of water rates and impacts to their revenue streams, and other local considerations. Subsequent efforts will be needed to help determine what portion of active conservation savings can be applied to the M&I gap.

Impacts from New Construction – A substantial number of new homes and businesses will be constructed throughout the state between now and 2050. The projections provided for this basin-level planning effort do not distinguish between savings that will be achieved from existing versus new construction. Actual savings may be attributed more to higher efficiency new construction in portions of the state, particularly where more dense development occurs.

Land Use and Water Supply Planning

In 2009, the CWCB and the Western States Water Council conducted a Water and Land Use Planning symposium. This symposium brought together diverse participants from special districts, cities and counties, state and federal agencies, and nongovernmental organizations, including policy and decision-makers, planners, developers, and regulators to look at water and land use patterns, share experiences and concerns, identify problems and potential solutions, discuss obstacles and opportunities, and develop recommendations to better integrate and scale water and land use planning for a sustainable future. The group attending the symposium acknowledged that integrating water and land use planning at different scales is increasingly important as we strive to meet challenges related to growth, change, and sustainability in the arid West.

Overview of New Supply Development and Agricultural Transfer Strategies

In addition to conservation and the implementation of IPPs, the other portfolio elements include the transfer or agricultural water to M&I use and the development of new water supplies from the Colorado River system. The basic attributes of possible projects to implement the agricultural transfer and new supply development strategies are presented in Table ES-8 below and shown in Figure ES-23. Each of these concepts is based on projects that have been discussed in the past but may or may not be implemented.

For the Lower South Platte and Lower Arkansas concepts, the cost of water rights may decrease the further downstream the diversion is from urban areas; however, conveyance and treatment costs will increase accordingly. For the Flaming Gorge and Blue Mesa concepts, water supply would be acquired through the Bureau of Reclamation (BOR) marketable pool for each reservoir. For the other new supply development concepts the water supply would be a new acquisition. For both the Lower South Platte and Lower Arkansas concepts, reverse osmosis (RO) or advanced water treatment would be required due to source water quality. The new supply development concepts would not require advanced water treatment.

Table ES-8 New Supply Development and Agricultural Transfer Concept Attributes

Concept	Water Source/Water Rights	Conveyance and Storage	Water Quality and Treatment Costs
Lower South Platte	• South Platte agricultural rights	• 36 to 84 mile pipeline with static pumping requirement of 700 to 1,300 feet • Firming storage required	• RO or advanced water treatment will be required
Lower Arkansas	• Arkansas agricultural rights	• 96 to 133 mile pipeline with static pumping requirement of 3,100 to 3,600 feet • Firming storage required	• RO or advanced water treatment will be required
Green Mountain	• Blue River water in the Colorado River basin as well as new South Platte water rights	• 22 mile pipeline with static pumping requirement of 1,100 feet • Firming storage required	• Conventional treatment technology
Yampa	• New water rights appropriation	• 250 mile pipeline with static pumping requirement of 5,000 feet • Firming storage required	• Conventional treatment technology
Flaming Gorge	• Contract with BOR for water from the Flaming Gorge marketable pool	• 357 to 442 mile pipeline with static pumping requirements of 1,400 to 3,100 feet • Firming storage required	• Conventional treatment technology
Blue Mesa Reservoir	• Contract with BOR for water from the Aspinall marketable pool	• 81 mile pipeline with static pumping requirement of 3,400 feet • Firming storage required	• Conventional treatment technology

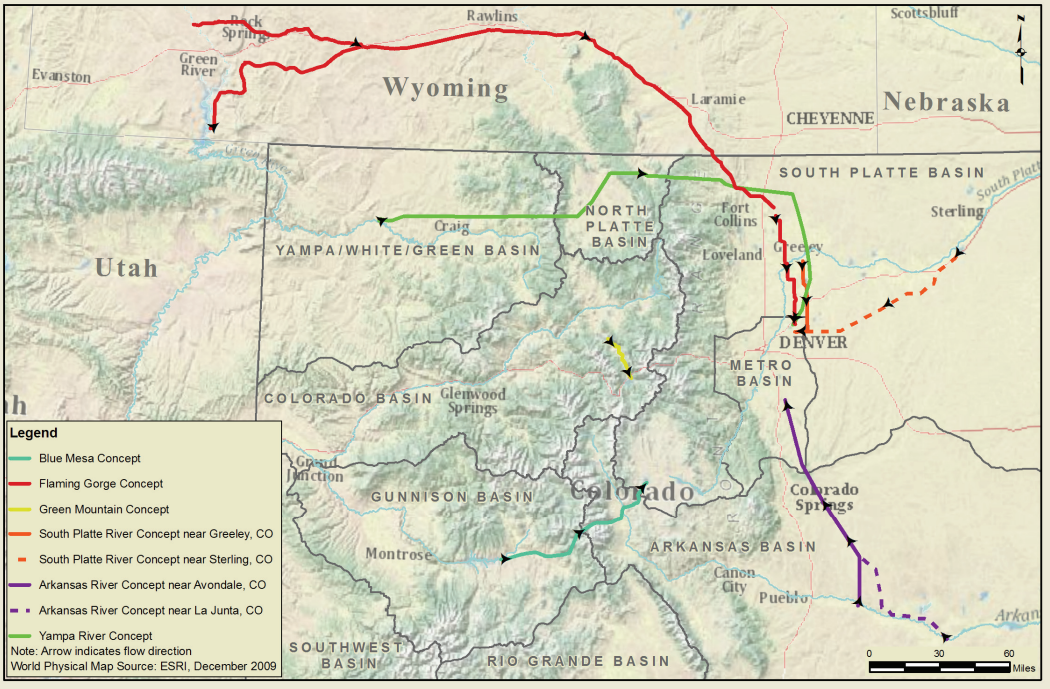


Figure ES-23 Overview of New Supply Development and Agricultural Transfer Concepts

Reconnaissance Level Capital and Operation and Maintenance Costs

With exception of the Green Mountain concept, which was assumed to deliver 68,000 AFY in a single phase, reconnaissance level cost estimates were developed for each of the concepts described above based on three options:

- Option 1: delivery of 100,000 AFY constructed in a single phase
- Option 2: delivery of 250,000 AFY constructed in a single phase
- Option 3: delivery of 250,000 AFY constructed with the first phase delivering 100,000 AFY and the second phase delivering the remaining 150,000 AFY

Key elements for each water supply concept were identified and evaluated using uniform assumptions to determine infrastructure requirements and sizing for the reconnaissance cost estimates. The following key elements were considered for each option—water rights, firming storage, transmission facilities (including pipelines, pump stations, and tunnels), diversion structures, water treatment, reuse, and engineering, legal and administrative costs including permitting.

Figure ES-24 shows the summary of the reconnaissance level capital costs for each of the concepts. The range of capital costs for all of the concepts is $840 million (Green Mountain) to $9.8 billion (Flaming Gorge Option 3). Although the new supply development concepts and agricultural transfer concepts are similar in total capital costs for each of the options, the relative percentages of subcomponent capital costs vary. For the agricultural transfer concepts, the majority of the capital cost is comprised of water rights acquisitions. For the new supply development concepts, the majority of the capital costs are associated with pipeline and pump stations.

Operation and maintenance costs for each concept are summarized in Figure ES-25.

Reconnaissance level annual operation maintenance range from $29 million per year (Green Mountain) to $273 million per year (Arkansas Option 3). The variability between concepts is due primarily to conveyance costs but differences between conventional treatment (Yampa, Blue Mesa, Green Mountain, and Flaming Gorge) and RO with zero liquid discharge (South Platte and Arkansas) also contribute to the variation.

Reconnaissance Life Cycle Costs

CWCB also developed reconnaissance level life cycle costs for all concepts. Life cycle costs allow comparison of not only the capital costs, but also the operational costs associated with the concepts, all brought back to present value in order to evaluate the long range economic feasibility of each concept. CWCB utilized the following key assumptions for the life cycle cost analysis:

- Planning period – 50 years after completion of construction
- Present worth – capital and operating costs brought based to 2009
- Capital costs expended in 2020, with operation and maintenance starting in 2021 for options 1 and 2
- Capital costs expended in 2020, with operation and maintenance starting in 2021 for Phase 1 of Option 3 and 2040, with operation and maintenance starting in 2041 for Phase 2 of Option 3
- Discount rate, or cost of money – 6 percent
- Escalation – Capital items (3 percent), annual operation and maintenance (3 percent), and energy (5 percent)
- 2009 energy costs ($/kilowatt hour) - $0.08

In addition to initial capital costs, CWCB considered replacement costs for the constructed facilities if the replacement was required during the 50-year planning period.

Figures ES-26 and ES-27 provide a summary of the total life cycle costs and the total life cycle costs per acre-foot of water developed by each concept.

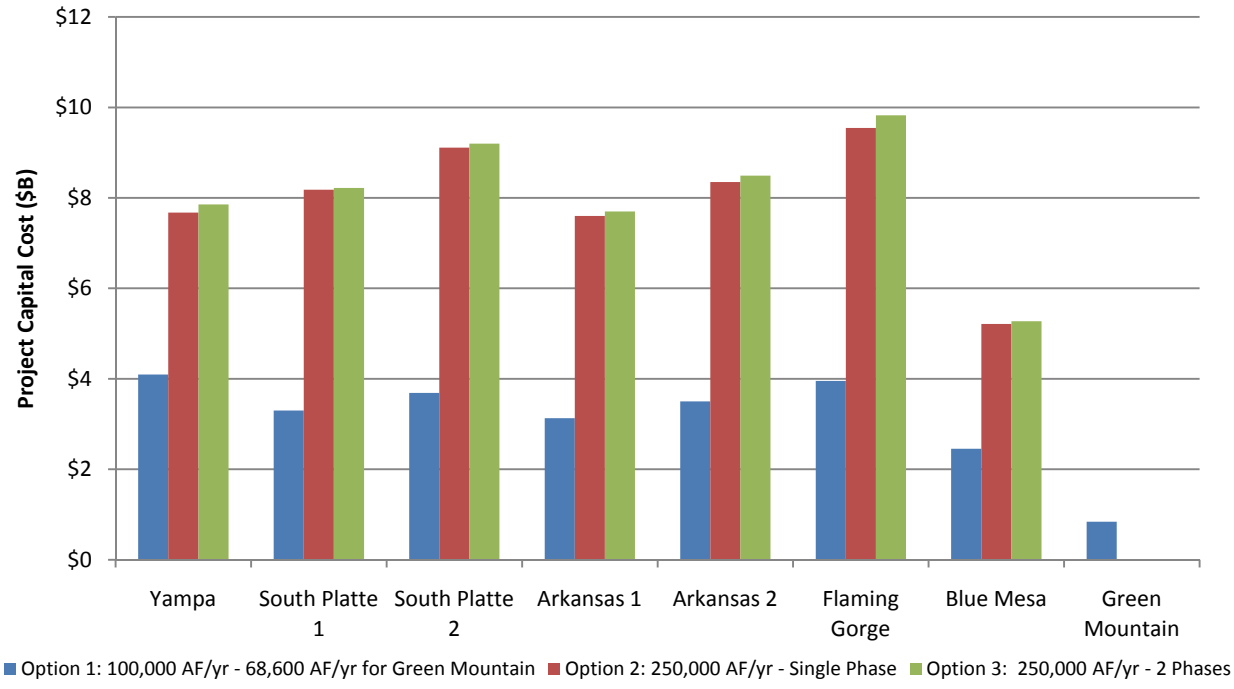


Figure ES-24 Summary of Reconnaissance Capital Costs

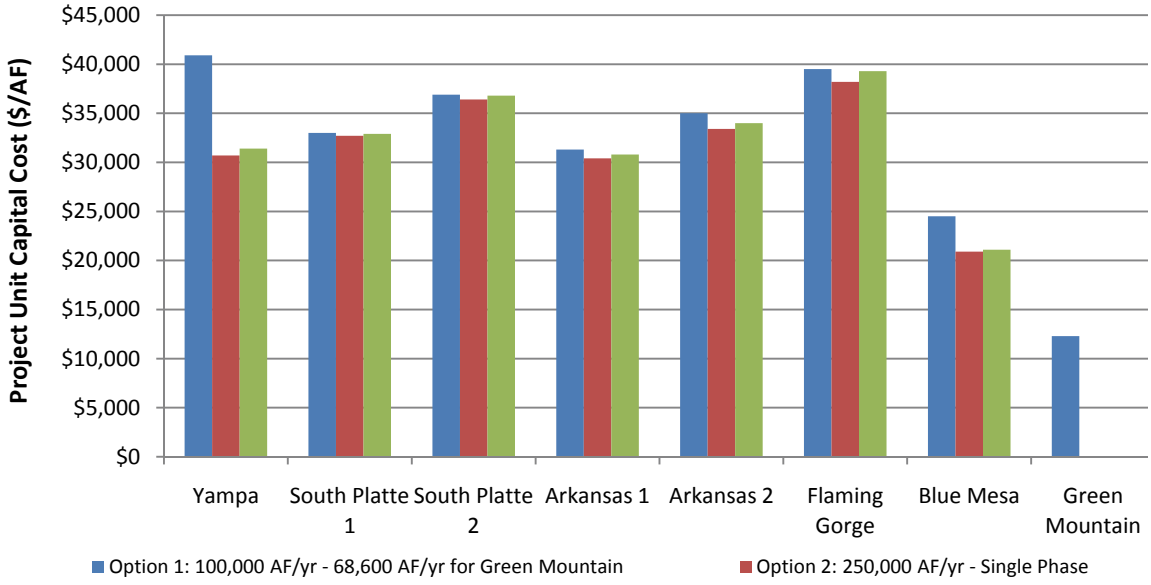


Figure ES-25 Summary of Reconnaissance O&M Costs

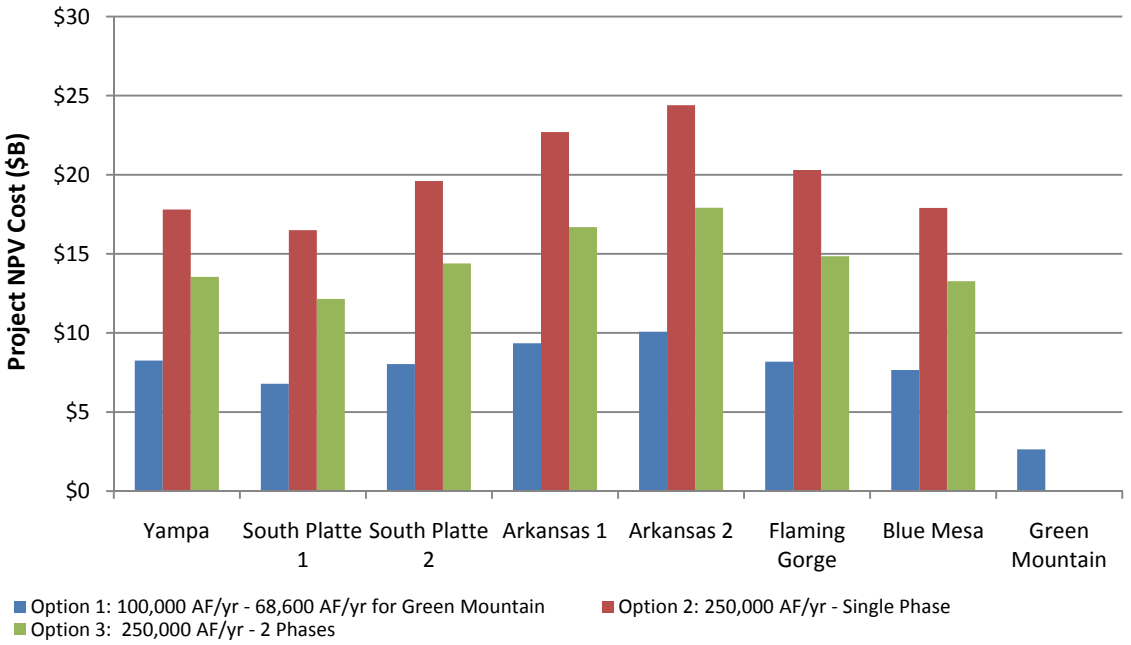


Figure ES-26 Summary of Reconnaissance Life Cycle Costs

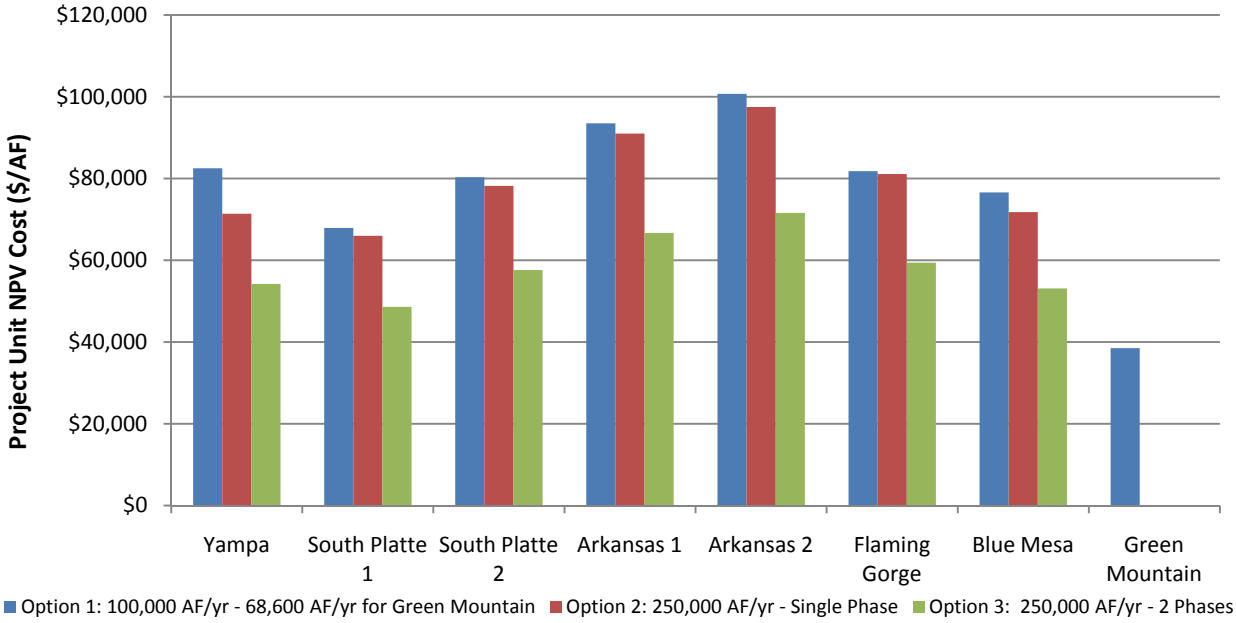


Figure ES-27 Summary of Reconnaissance Life Cycle Unit Costs

These figures show that the least expensive concept is Green Mountain and most expensive is either Arkansas concept. The Arkansas concepts are most expensive due to the annual treatment costs that would be associated with them. The remaining concepts generally have similar life cycle costs.

Status Quo Portfolio

If Colorado's water supply continues to develop according to current trends, i.e., the status quo, this will inevitably lead to a transfer of water out of agricultural lands and potentially harm the environment. The status quo is the default position—the results that will likely occur if current trends continue unchanged. Inaction is a decision itself, a decision with significant consequences. The general consensus is that the status quo scenario is not a desirable future for Colorado.

The summary below is an illustration of the status quo using the portfolio and trade-off tool. This tool was developed to evaluate water supply portfolios. The status quo scenario presented is based on the following assumptions:

- 2050 mid-demand scenario.
- The status quo IPP success by basin is defined in Figure ES-26. Applying these basin level success rates results in the implementation of about 60 percent of the IPP yield statewide by 2050.
- Passive conservation savings will be realized by 2050 and those savings will be used to meet new demands. Active conservation will not be utilized toward water supply, serving new customers, or meeting the M&I gap.
- New supply development from the Colorado River system will be available for West Slope uses only. No additional transbasin diversions beyond the IPPs are assumed in the status quo portfolio.
- The remaining M&I demands are met with agricultural transfers.

trade-off tool v11 STATUS QUO.xlsx - Microsoft Excel

Colorado's Water Supply Future Portfolio & Trade-Off Tool IPPs

IPP Success Rate	(% Yield)	(Yield AFY | Total IPP Yield AFY)
Arkansas	75%	71,000 | 95,000
Colorado	90%	49,000 | 54,000
Gunnison	90%	14,000 | 16,000
Metro	50%	82,000 | 163,000
North Platte	90%	200 | 200
Rio Grande	90%	6,000 | 7,000
South Platte	40%	52,000 | 129,000
Southwest	75%	13,000 | 17,000
Yampa/White	90%	11,000 | 12,000

S P C A A R T S R

Figure ES-26 IPP Success Rate Data Entry Screen from Portfolio and Trade-Off Tool

Water from over 500,000 irrigated acres statewide could be transferred to M&I use statewide with the status quo portfolio.

Figure ES-27 shows the resulting loss of irrigated acres that may potentially occur as a result of the status quo portfolio. The yellow bars in the figure relate to the left axis and show the percentage of irrigated acres that may be lost in the future if the status quo is maintained. The red squares relate to the right axis and specify the number of acres that may be lost. Based on the status quo scenario, the South Platte Basin could lose 35 percent of current irrigated agriculture or nearly 300,000 acres. The Arkansas, West Slope, and North Platte/Rio Grande Basins could lose over 10 percent of their irrigated agriculture under the status quo portfolio. Water from over 500,000 irrigated acres statewide could be transferred to M&I use statewide with the status quo portfolio. Other trade-offs associated with the status quo portfolio are described in Section 7 of this report.

Cost of Meeting Future Water Needs

Meeting Colorado's M&I water supply needs will require significant investment. The costs for the status quo portfolio are presented in Table ES-9. Implementing a mix of solutions to address Colorado's 2050 medium M&I water supply needs will cost around $15 billion under status quo assumptions. These costs will increase if Colorado experiences high M&I demands and will decrease if Colorado experiences low M&I demands or implements an alternative mix of solutions to the status quo. The costs associated with meeting Colorado's future M&I needs could be reduced if an alternative approach, incorporating fewer but larger projects and increased levels of conservation, were used. However, while an alternative approach could save the citizens of Colorado billions of dollars, it would require a higher level of state involvement including significant state funding.

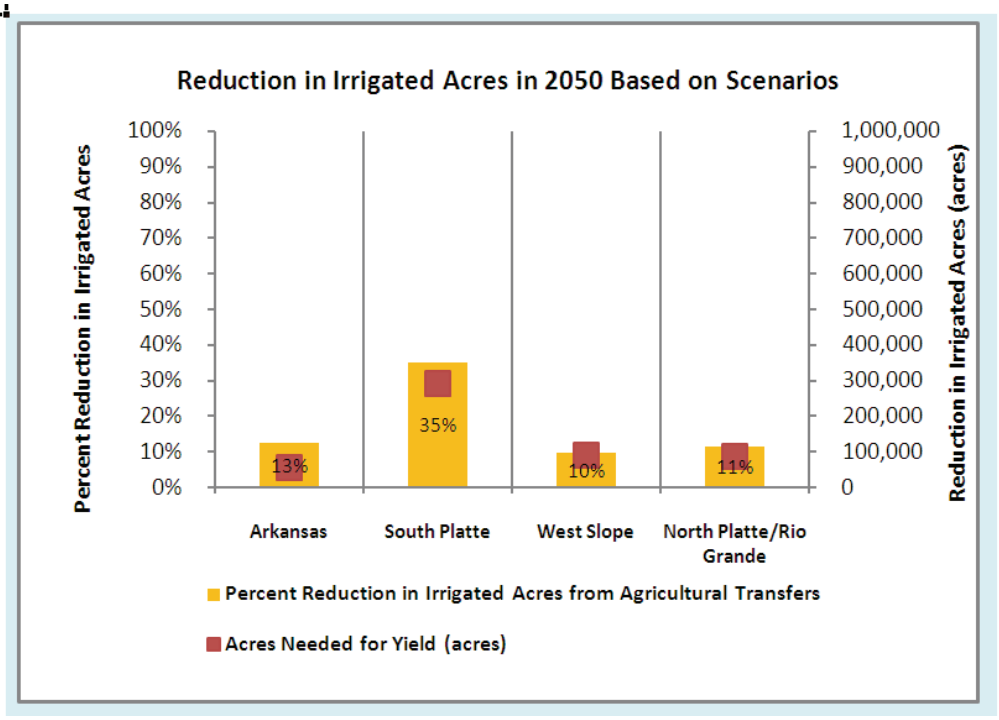


Figure ES-27 Reduction in Irrigated Acres in 2050 Based on Status Quo Scenario

Table ES-9 Status Quo Medium M&I Demand Portfolio (800,000 AFY of new water needed)

Strategy	West Slope[1] Unit Cost	West Slope[1] New Water Needed (AFY)	West Slope[1] Costs	East Slope Unit Cost	East Slope New Water Needed (AFY)	East Slope Costs	Total New Water Needed (AFY)	Total Costs
New Supply	$5,900	150,000	$860,000,000	$0	—	$0	150,000	$860,000,000
Ag Transfers	$40,000	3,500	$140,000,000	$40,000	270,000	$11,000,000,000	270,000	$11,000,000,000
IPPs	$5,900	93,000	$550,000,000	$14,000	200,000	$2,900,000,000	290,000	$3,400,000,000
Active Conservation	$7,200	—	$0	$7,200	—	$0	—	$0
Reuse[2]			$0		90,000	$0	90,000	
Total		**240,000**	**$1,600,000,000**		**560,000**	**$14,000,000,000**	**800,000**	**$15,000,000,000**

[1] Costs for the Rio Grande and North Platte Basins are the same as the West Slope and are integrated with the West Slope for the purpose of this cost analysis.

[2] The costs of reuse are incorporated into the costs associated with agricultural transfers or new supply development.

While there is general agreement that the status quo is not desirable and that a mix of solutions will be needed, there is not agreement on the specific quantities of water that will be needed for each strategy. However, there is agreement that in order to balance meeting municipal, agricultural, and nonconsumptive needs, Colorado will need a mix of new water supply development for West Slope and East Slope uses, conservation, completion of IPPs, and agricultural transfers. The CWCB and IBCC have agreed that all parts of this four-pronged framework are equally important and should be pursued concurrently.

In addition to meeting M&I needs, state funding will continue to be needed to meet agricultural and environmental water supply needs. Without a mechanism to fund environmental and recreational enhancement beyond the project mitigation measures required by law, conflicts among M&I, agricultural, recreational, and environmental users could intensify.

The ability of smaller, rural water providers and agricultural water users to adequately address their existing and future water needs is also significantly affected by their financial capabilities, and many of them rely on state funding to help meet their water supply needs.

Recommendations

With the completion of 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. Section 8 or this report provides additional detail on each recommendation.

1. Actively encourage projects to address multiple purposes, including municipal, industrial, environmental, recreational, agricultural, risk management, and compact compliance needs.
2. Identify and utilize existing and new funding opportunities to assist in implementing projects and methods to meet Colorado's consumptive and nonconsumptive water supply needs.
3. Continue to lead the dialogue and foster cooperation among water interests in every basin and between basins for the purpose of

implementing solutions to Colorado's water supply challenges.

4. Support water project proponents and opponents in resolving conflict and addressing concerns associated with implementing IPPs that will reduce the M&I water supply gap. Identify IPPs that could be implemented by 2020.
5. Support meeting Colorado's nonconsumptive water needs by working with Colorado's water stakeholders to help:
   - Promote recovery and sustainability of endangered, threatened, and imperiled species in a manner that allows the state to fully use its compact and decreed entitlements.
   - Protect or enhance environmental and recreational values that benefit local and statewide economies.
   - Encourage multi-purpose projects that benefit both water users and native species.
   - Pursue projects and other strategies, including CWCB's Instream Flow Program, that benefit consumptive water users, the riparian and aquatic environments, and stream recreation.
   - Recognize the importance of environmental and recreational benefits derived from agricultural water use, storage reservoirs, and other consumptive water uses and water management.
6. Help meet Colorado's agricultural water supply needs by incorporating agricultural water needs into the development of water supply portfolios and supporting the implementation of multi-purpose agricultural water supply projects.
7. In order to determine the appropriate combination of strategies (IPPs, conservation, reuse, agricultural transfers, and the development of new water supplies) and portfolios to meet the water supply needs, CWCB will identify what it considers is achievable for each portfolio element and how those portfolio elements could be implemented.
8. Evaluate multi-purpose projects or packages of projects to develop new water supplies for use on the West Slope and the Front Range.
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.

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