6.2 MEETING COLORADO'S WATER GAPS

GOAL

Colorado's Water Plan uses a grassroots approach to formulate projects and methods that avoid some of the undesirable outcomes of the supply-demand gaps. The plan addresses the gaps from multiple perspectives—such as water storage, reuse, recycling, integrated water management, restoration, and conservation.

Overview

This section describes how the basin roundtables' BIPs meet Colorado's growing municipal, industrial, agricultural, environmental, and recreational water needs. It also describes the BIP goals and measurable outcomes, and identifies by basin the remaining needs Colorado must meet to accomplish those objectives. These remaining needs are referred to as "gaps." This section relies on previous technical work the SWSI 2010 conducted, the basin needs assessments, and the No-and-Low-Regrets work Section 6.1 describes.

In addition, this section assesses the projects and methods identified in the BIPs to determine whether they address the gaps. Finally, the section ends with a list of actions to support closing Colorado's water gaps. Sections 6.3 through 6.6 indicate the types of projects and methods the BIPs are considering, and actions to support them.

Colorado's Water Plan does not prescribe or endorse specific projects. However, the implementation of a combination of projects and methods, as the BIPs outline, will be necessary to meet Colorado's current and future municipal, industrial, agricultural, environmental, and recreational water needs. Failure to implement those projects and methods will result in an even greater water gap in Colorado's future.

In compiling its BIP, each basin roundtable developed goals and measurable outcomes that add up to each basin's vision for plans to support each major sector. While it is relatively easy to quantify a water supply gap for M&I needs, the future needs of agriculture, the environment, recreation, and other uses the BIPs identified are based on each basin roundtable's vision.

Goals and Measurable Outcomes by Basin

The degree to which the BIP goals and measurable outcomes demonstrate concurrence across Colorado is remarkable. The CWCB developed several long-term themes to meet the objectives the Governor's Executive Order outlined.[15] These include:

1. Meet Colorado's municipal water needs.
2. Meet Colorado's agricultural water needs.
3. Meet Colorado's environmental and recreational water needs.

In addition, Colorado has a long-term goal related to water quality, which Section 7.3 discusses:

4. Meet Colorado's water quality management needs.

The BIP goals and measurable outcomes reflect each of these major themes. Additionally, the basin roundtables identified several major themes that reach across all BIPs. These include:

- Protect and restore watershed health.
- Develop multipurpose storage/balance all needs and reduce conflict.

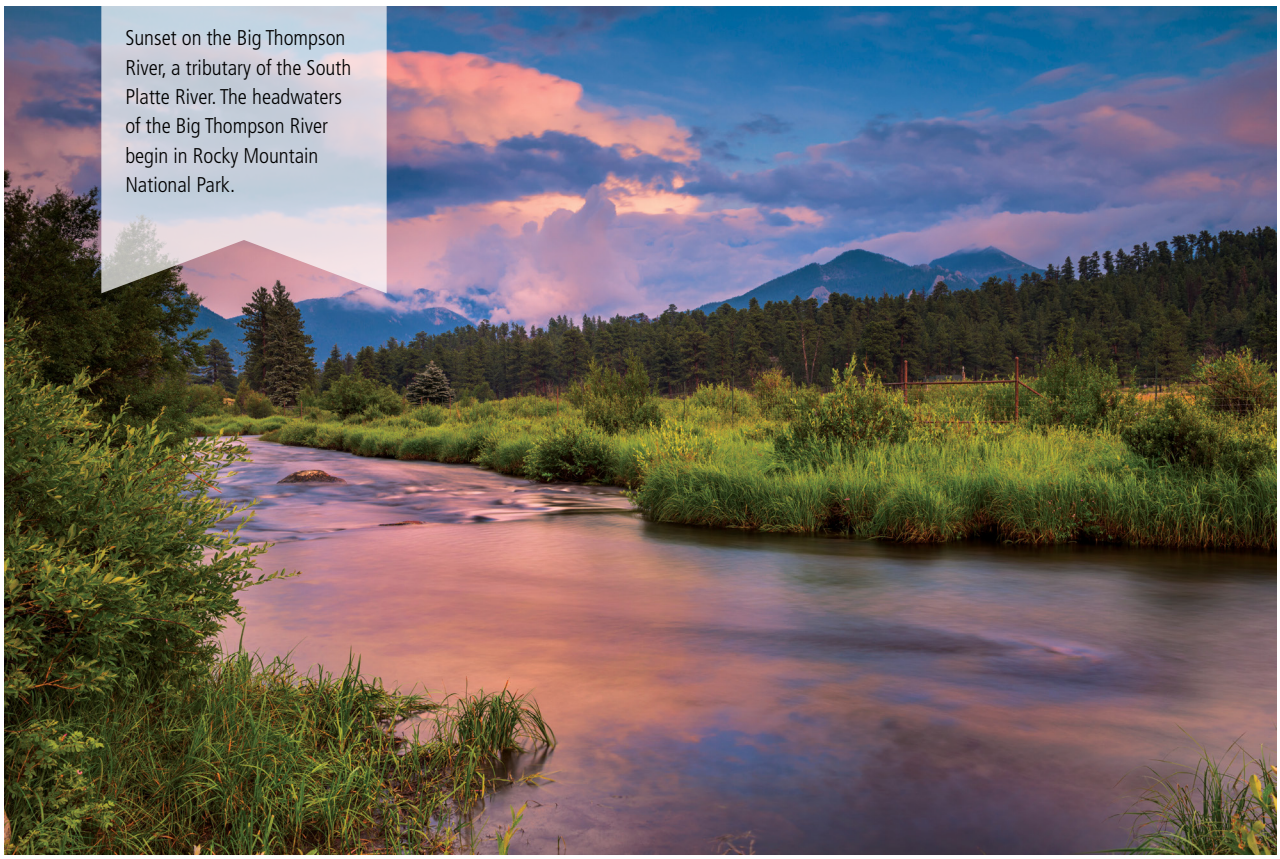
- Comply with and manage the risk associated with interstate compacts and agreements.
- Continue participation, education, outreach, and communication.

Table 6.2-1, on page 6-17, demonstrates the common themes across the eight BIPs, and outlines the steps by which the BIPs propose to specifically address these themes.

Below is a brief summary of how the basins addressed these themes through their BIPs.

Meet Colorado's Municipal Water Needs through Conservation and Identified Projects and Methods: Every basin roundtable discusses the importance of conservation. This is especially a focus for the Arkansas, Colorado, Metro, South Platte, and Southwest Basin Roundtables. In the Southwest and South Platte BIPs, the roundtables focus on implementing already-specified IPPs from SWSI 2010. The Southwest and the Colorado Roundtables also identify additional projects and methods. The Colorado, South Platte, Metro, and Arkansas Roundtables also feature reuse in their BIPs.

Meet Colorado's Agricultural Needs: In general, the Arkansas, Colorado, Rio Grande, and Southwest Basin Roundtables are approaching agricultural needs from an economic and productivity standpoint. The North Platte and Yampa/White Basin Roundtables seek to increase their irrigated acres, while several basins, such as the Gunnison and Colorado, seek to reduce agricultural shortages. Nearly every basin also focuses on improving agricultural efficiencies and modernizing water infrastructure. The South Platte and Metro Basin Roundtables are concerned about maintaining the viability of agriculture in the South Platte against the pressure of agricultural transfers and urbanization. They are therefore exploring alternative options, including the successful implementation of conservation, reuse, IPPs, alternative agricultural transfers, and the development of new supplies from the Colorado River system. Some western slope roundtables, such as the Southwest Roundtable, indicate that agriculture across the state is important, and have expressed support for strategies such as high-conservation to minimize the potential loss of irrigated acres. In the South Platte BIP, the South



Sunset on the Big Thompson River, a tributary of the South Platte River. The headwaters of the Big Thompson River begin in Rocky Mountain National Park.

TABLE 6.2-1 COMMON THEMES ACROSS BASIN IMPLEMENTATION PLANS

✓ = BIP goal or measurable outcome; ✓ = BIP activity	Ark	Co	Gu	NP	RG	SP/Mt	SW	Y/W/G
A. Meet Municipal Water Needs thoughout Colorado								
• *Focus on M&I gaps*	✓	✓	✓	✓	✓	✓	✓	✓
• *Focus on conservation / demand management*	✓	✓	✓	✓	✓	✓	✓	✓
B. Meet Colorado's Agriculture Needs								
• *Focus on agricultural economy*	✓	✓	✓		✓	✓		
• *Focus on reducing shortages*		✓	✓			✓	✓	✓
• *Improve agricultural efficiencies*	✓	✓	✓		✓		✓	✓
• *Increase irrigated acres*				✓				✓
• *Conduct the goals while protecting private property rights*	✓	✓	✓	✓	✓	✓	✓	✓
C. Meet Colorado's Environmental and Recreational Water Needs								
• *Focus on recovering imperiled and/or endangered species*	✓	✓	✓	✓	✓	✓	✓	✓
• *Protect wetlands and riparian areas*	✓	✓	✓	✓	✓	✓	✓	✓
• *Protect recreation*	✓	✓	✓	✓	✓	✓	✓	✓
• *Quantify nonconsumptive needs*	✓	✓	✓			✓	✓	✓
D. Protect and Restore Watershed Health								
• Include one or more goals / activities associated with watershed health	✓	✓	✓	✓	✓	✓	✓	✓
E. Balance All Needs and Reduce Conflict / Multi Purpose Storage								
• *Protect private property rights / water rights*	✓	✓	✓	✓	✓	✓	✓	✓
• *Multi-purpose focus*	✓	✓	✓	✓	✓	✓	✓	✓
• *Modernize water infrastructure*	✓		✓	✓	✓	✓	✓	✓
• *Determine how agriculture supports nonconsumptive needs*	✓	✓	✓	✓	✓	✓		✓
• *Increase storage*	✓	✓	✓	✓	✓	✓	✓	✓
F. Comply with Interstate Compacts, Agreements, and Manage the Risk Associated with These								
• Include one or more goals /activities associated with this	✓	✓	✓	✓	✓	✓	✓	✓
G. Continue Participation, Education, Outreach, and Communications								
• Include one or more goals / activities associated with this	✓	✓	✓	✓	✓	✓	✓	✓
H. Meet Colorado's Water Quality Management Needs								
• Include one or more goals / activities on water quality	✓	✓	✓	✓	✓	✓	✓	✓

Platte and Metro Roundtables indicate that they will need to consider all of these strategies to reduce the pressure on agricultural transfers. The Rio Grande Roundtable expresses concern about maintaining the viability of agriculture in light of current unsustainable groundwater depletions.

Meet Colorado's Environmental and Recreational Needs: Each of the state's basins has environmental water quality and water quantity needs and objectives it must meet. Every roundtable discusses the need to recover imperiled and/or threatened and endangered species, and to protect recreational opportunities, wetlands, and riparian areas. In addition, several roundtables state the need to further quantify environmental and recreational needs, and the Gunnison, South Platte, Metro, and Yampa/White/Green Roundtables discuss the need to better determine how agriculture supports environmental and recreational values.

Meet Colorado's Water Quality Management Needs: Although water quality is not an issue the basin roundtables traditionally study, every roundtable addresses water quality in its BIP. Section 7.3 summarizes this.

Protect and Restore Watershed Health: While the Arkansas, North Platte, Rio Grande, and Southwest Basin Roundtables are the most focused on watershed health, every roundtable recognizes the importance of watershed health in its BIP. Many roundtables link watershed health to environmental needs or the protection of important infrastructure for municipal and agricultural needs. Section 7.1 summarizes the watershed health efforts.

Continue Participation, Education, Outreach, and Communication: Every basin roundtable has active education and outreach activities, as Section 9.5 describes.

While each of the above topics demonstrates a gap associated with the goals and measurable outcomes, several other important themes do not directly address the gaps. Some of these include:

- **Protect private property and water rights:** Every roundtable makes it clear in its BIP that basins must pursue solutions to protect agriculture and the environment in the context of protecting private property and water rights. This general theme is consistent with Colorado's Water Plan.
- **Comply with and manage the risk associated with interstate compacts and agreements:** Every basin in Colorado must grapple with interstate compacts or agreements, and each basin has addressed this topic explicitly in its BIP. Chapter 8 discusses how the basins address the issue of TMDs.
- **Develop multipurpose storage and projects/ Balance all needs and reduce conflict:** In their BIPs, all roundtables stress an interest in multipurpose projects and approaches. Some, like the Arkansas, Colorado, Gunnison, North Platte, Rio Grande, and South Platte/Metro Basin Roundtables, are interested in ways in which agriculture supports nonconsumptive needs.

Meeting M&I Water Needs Throughout Colorado

In the BIP process, the CWCB identified three statewide long-term goals to meet community water needs throughout Colorado:[16]

- Use water efficiently to reduce overall future water needs.
- Identify additional projects and processes to meet the water supply gap for municipalities while balancing the needs of agriculture, the environment, and recreation across the state.
- Meet community water needs during periods of drought.

The SWSI 2010 indicated that under current conditions, the M&I gap could total between 310,000 and 560,000 acre-feet, depending on the rate of population growth in Colorado. As Section 6.1 discusses, this assumes that planned projects, or IPPs, are ultimately implemented at fairly high rates.[17]

As described in the updated SWSI glossary,[18] IPPs meet the following criteria and are listed in SWSI 2010:[19]

- The project or method has a project or method proponent.
- When the proponent is a retail water provider, the project or method is being used to meet the water supply needs of its customers by 2050.

- When the project proponent is a wholesale water provider, at least one retail water provider must express interest in writing and plan on using the project or method to meet the water supply needs of its customers by 2050.
- The project or method must have at least preliminary planning, design, conditional or absolute water rights, rights of way, and/or written negotiations with local governments the water project could affect.
- The water supply needs must be identified and included in the BIPs and/or SWSI documents.

The majority of Colorado's water providers responsibly plan to address their water needs according to their timelines and objectives. However, there is still a water supply gap. To address the minimum water gap, the basin roundtables and the IBCC developed several No-and-Low-Regrets goals and measurable outcomes, as Section 6.1 describes. In offering guidance to the basin roundtables, CWCB demonstrated how these measurable outcomes could inform the BIPs at a basin specific level. Table 6.2-2 compares BIP actions to these measurable outcomes, which include measures for conservation, IPPs, reuse, agricultural transfers, and Colorado River supplies:[20]

- *Establish low-to-medium conservation strategies*
  - Implement strategies at the basin-level to meet medium levels of conservation, and apply half of that to meet the M&I gap, equivalent to 67,000 acre-feet per year by 2030 and 167,000 acre-feet by 2050 statewide.
  - 2050 conservation savings by basin:
    - Arkansas: 36,000 acre-feet
    - Colorado: 15,000 acre-feet
    - Gunnison: 4,300 acre-feet
    - North Platte: 85 acre-feet
    - Rio Grande: 3,200 acre-feet
    - South Platte (including Metro Area): 97,000 acre-feet
    - Southwest: 7,500 acre-feet
    - Yampa/White/Green: 3,700 acre-feet
- *Have a high success rate for IPPs*
  - Implement IPPs to yield 80 percent of the statewide planned water deliveries, equivalent to 70,000 acre-feet per year for the western slope and 280,000 acre-feet per year for the eastern slope
  - 2050 No-and-Low-Regret IPP success by basin:
    - Arkansas: 76,000 acre-feet
    - Colorado: 45,000 acre-feet
    - Gunnison: 12,000 acre-feet
    - North Platte: 100 acre-feet
    - Rio Grande: 6,000 acre-feet
    - South Platte (including Metro Area): 200,000 acre-feet
    - Southwest: 13,000 acre-feet
    - Yampa/White/Green: 7,000 acre-feet
- *Implement reuse strategies*
  - Produce 25,000 acre-feet per year of yield resulting from new agricultural-transfer and TMD projects above and beyond the IPPs in the South Platte and Arkansas Basins.
- *Plan and preserve options for existing and new supply*
  - Develop 35,000 acre-feet per year of new supplies in the Colorado River system for the western slope.
  - Develop a conceptual framework among basin roundtables regarding ways to preserve the option for a potential future TMD from the western slope to the eastern slope. (Chapter 8 discusses the conceptual framework the IBCC developed.)

Many of the basins seek to meet these short- and long-term M&I goals in their BIPs; this subsection reviews BIPs by basin. Table 6.2-2 summarizes the success of each basin in meeting the overall water supply gap for municipalities and industry.

The current No-and-Low-Regrets actions and SWSI 2010 gap calculations do not take into account the potential effects of climate change. As this plan discusses, warming temperatures can affect water supply, water availability, and water demands. Should average annual temperature continue to increase at projected levels (2.5 to 5° F) by mid-century, it is reasonable to expect that the existing gap will increase.

TABLE 6.2-2 SUMMARY OF BASIN IMPLEMENTATION PLANS ADDRESSING THE MUNICIPAL AND INDUSTRIAL NO-AND-LOW-REGRETS AND GAPS

Basin	2050 New Needs (acre-feet)[21]	2050 Gap (acre-feet)[22]	BIP-Identified Potential New Projects and Methods (acre-feet)[a]	# of New Projects w/ acre-foot info	Are No/Low Regrets Likely Met?	Notes
Arkansas	110,000 - 170,000	59,500[23] (M&I Shortage) 45,000 - 94,000 (SWSI 2010)	125,000	10	Yes: IPP success, identify additional projects to meet the gap.	A database categorized which projects listed in the BIP count as IPPs
Colorado	65,000 - 110,000	26,000 - 48,000	40,000 (20,000 in projects and 20,000 from high active conservation)	3	Yes: High conservation; some IPP success; identify additional Colorado River Basin supply projects	The BIP identified priority projects by region, and the largest project has a large agricultural component, so it is unclear if the gaps will be fully met with only the priority projects[24]
Gunnison	16,000 - 23,000	3,700 - 6,100	17,500 (12,000 in projects and 5,500 from high active conservation)	5	Yes: High conservation; success of IPPs; identify additional Colorado River Basin supply projects	BIP indicates M&I needs "are generally expected to be managed with sufficient existing supplies and/or through planned projects"[25]
North Platte	100-300	10 - 30	N/A	Completed Project	Yes: Accept conservation standards; IPP success.	The North Platte has met its municipal gap[26]
Rio Grande	7,700 - 13,000	2,300 - 5,100	800	1	Partially: Little conservation discussion; some IPP success	Because the basin is focused on groundwater sustainability, the BIP did not identify additional acre-feet for municipal projects.[27]
South Platte (including Metro)	340,000 - 505,000	204,000 - 310,000	98,000 (45,000 in projects and 53,000 from active conservation)	8	Partially: Some conservation, IPP success, reuse success, some agricultural transfers.	The BIP developed portfolios, which conceptually fill the gap with additional agricultural transfers, ATMs, multipurpose projects, and potentially a new TMD[28]
Southwest	20,000 - 31,000	8,800 - 16,000	49,000 (40,000 in projects and 9,000 from high active conservation)	7	Yes: High conservation; high IPP success; develop additional Colorado River Basin supplies.	Projects and methods identified will meet M&I gap as well as the infrastructure needs of the basin[29]
Yampa / White / Green	34,000 - 95,000	24,000 - 83,000	203,000 (198,000 in projects and 5,000 from high active conservation)	8	Yes: Some conservation; high IPP success; develop additional Colorado River Basin supplies.	85 percent of the yield for M&I projects stems from one large project.[30]
TOTALS	590,000 - 950,000	310,000 - 560,000	530,000	**42**		

a. This column represents the total number of acre-feet gathered from the projects and methods (P&M) the roundtables identified in the BIPs, which could serve municipal or industrial uses. Conservation is included as a method. The values do not consider hydrological limitations. These values do not include the IPPs previously identified in SWSI 2010.

Arkansas

The Arkansas Basin faces an immediate municipal gap in some areas, especially if one takes into account the need to replace nontributary groundwater in El Paso and Elbert Counties.[31] Future needs in the Arkansas Basin are likely to increase by 110,000 to 170,000 acre-feet, and currently planned projects leave a municipal water supply gap of between 45,000 and 94,000 acre-feet within the basin. This assumes that the basin implements identified projects and processes at a relatively high success rate.[32]

Arkansas Goals and Measurable Outcomes

To address this municipal gap, the Arkansas Roundtable identifies four goals related to meeting M&I needs.[33] These goals and their associated measurable outcomes, as stated in the BIP, are:

- *Meet the municipal supply gap in each county within the basin.*
  - *Generate a study by December 2015 determining surpluses and deficits within sub-regions/counties.*
  - *Funds provided in support of collaborative efforts reported annually.*
- *Support regional infrastructure development for cost-effective solutions to local water supply gaps.*
  - *Agreements to regional use of identified IPPs such as Southern Delivery System.*
  - *New Water Supply Reserve Grant (WSRA) grant request for regional infrastructure studies.*
  - *Agreements for off take of conduit water; funding of conduit processes and construction.*
- *Reduce or eliminate Denver Basin groundwater dependence for municipal users.*
  - *Presentations by groundwater dependent entities on solutions that have been implemented.*
  - *Presentations on interim solutions and funding requests to support those solutions and funding requests to support those solutions.*
  - *Funds provided in support of collaborative efforts reported annually.*
- *Develop collaborative solutions between municipal and agricultural users of water, particularly in drought conditions.*
  - *Pilot project implemented as reported annually.*
  - *Engineering template implemented by the DWR to expedite temporary transfers at reduced cost.*
- *Increase surface storage available within the basin by 70,000 acre-feet by the year 2020.*
  - *Storage capacity and percentage of stored water annually from 2015 to 2020.*
- *Annual reporting of projects that have been permitted and/or constructed.*

Meeting the Arkansas' M&I Gaps

The BIP supports the three primary recommendations to address the Arkansas Basin's M&I supply gap:[34]

- *The Arkansas Basin Roundtable acknowledges that a limited number of IPPs may be able to meet most of the gap.*
- *Storage is essential to meeting all of the basin's consumptive, environmental, and recreational needs. In addition to traditional storage, aquifer storage and recovery must be considered and investigated as a future storage option.*
- *The roundtable identified a critical gap as the need to replace nonrenewable groundwater and augment the sustainability of designated basins.*

Within its 2015 IPPs list, the basin has identified six projects that address M&I needs, four projects that address both M&I and agricultural needs, and one conservation project for a total of 125,000 acre-feet. The M&I projects identify 77,000 new acre-feet; the combined M&I and agriculture projects identify 48,000 new acre-feet; and the conservation project may reduce 500 acre-feet by 2030. These projects meet basin M&I gaps. Additionally, the basin identified examples of rehabilitation of nonfederal Arkansas Basin reservoirs to modern standards. If all potential rehabilitations were implemented, they would affect 220,775 acre-feet, and the estimated costs of the repairs would total $37,500,000.[35]

Actions required in order to meet the basin goal of increasing surface storage available within the basin by 70,000 acre-feet by 2020 include:

- *Implement a critical IPP.*
- *Work with the Office of Dam Safety to identify storage projects for restoration, rehabilitation, and increased capacity.*
- *Support funding, including grant contributions where appropriate, for storage restoration and expansion projects.*

These actions will work to meet both M&I and agricultural gaps.

Colorado

The Colorado Basin faces a gap in Mesa County that could begin as early as 2030.[36] Future needs in the basin are likely to increase by 65,000 to 110,000 acre-feet, and currently planned projects leave a municipal water supply gap within the Colorado Basin of 26,000 to 48,000 acre-feet. This assumes that the basin implements identified projects and processes at a relatively high success rate.[37]

Colorado Goals and Measurable Outcomes

To address this municipal gap, the Colorado Basin Roundtable identifies seven goals in their BIP related to meeting M&I needs.[38] These goals and their associated measurable outcomes are:

- *Develop land use policies requiring and promoting conservation.*
  - *Develop recommendations for city, county, and state governing bodies promoting water awareness and efficiency in land use policy.*
  - *Develop educational materials or opportunities for municipal and county elected officials and planning officials on water supply issues and conservation options.*
  - *Preserve agriculture and reduce the transfer of agriculture water to municipal use.*
- *Raise awareness of current obstacles and efforts facing water providers.*
  - *Publish a summary of state and basin water providers' true cost of water by analyzing operation and maintenance costs including sustainable infrastructure replacement programs.*
  - *Development of national, state or local funding assistance programs to replace aging infrastructure.*
  - *All basin water providers have sustainable infrastructure replacement funding programs.*
- *Protect drinking water supplies from natural impacts such as extended droughts, forest fires, and climate change, among others.*
  - *Every basin water provider has a reliable redundant water supply to meet 2050 demands.*
  - *Colorado Basin Roundtable or the CWCB to establish a biannual basin conference on natural disaster planning for water providers and government officials.*
- *Improve water court process*
  - *Recommendations to improve the objector process.*
  - *Recommendations to limit vulnerability of water rights when changing existing water rights in water court.*
  - *Improvements to Colorado water law to encourage agricultural water efficiency practices without harming water right value.*
- *Secure growing water demand by developing in-basin supplies and expanding raw water storage supply.*
  - *All basin water providers to meet current supply needs with redundancy, drought plans, and viable project options to meet future water needs.*

- *Reduce average permitting time for a reservoir project to less than 10 years.*
- *Establish regional water provider and ditch company cooperatives focused on improving regional relationships, water supply redundancy and flexibility, water quality, coordinated efforts for multi-beneficial projects, and addressing environmental and recreational needs.*
- *Reduce demands by establishing water conservation goals and strategies.*

- *Improve Colorado Water Law to encourage efficiency, conservation, and reuse.*
  - *Revised Colorado water law through legislation to allow more flexibility among water providers and the agricultural community to promote stream health through conservation, bypass flows, and flexibility in diversion location.*
  - *Reduce time of average Division 5 water court process by adding staff including judges, referees, and supporting staff.*
- *Pursue continued M&I conservation.*
  - *Achieve and sustain a high level of conservation by all basin water providers and industrial users.*

Meeting the Colorado's M&I Gaps

The Colorado Basin Roundtable underwent a prioritization process to identify and include high-ranking projects in its BIP. From its initial list of high-priority projects, it quantified 20,272 acre-feet of additional supplies beyond the IPPs to meet both M&I and agricultural gaps. In addition, the roundtable plans to implement high conservation. Half of total savings, which is equivalent to 20,000 acre-feet, could be used to address new demands. Together, at just over 40,000 acre-feet, the Colorado mainstem could have sufficient water to meet the 26,000 acre-feet needed under the No-and-Low-Regrets scenario, but not enough for the high potential M&I gap of 48,000 acre-feet the SWSI 2010 identified.[39]

In addition, the basin roundtable developed an extensive list of potential M&I projects by interviewing more than 60 water providers throughout the basin.[40]

If all of the projects and methods identified were implemented, as a whole the Colorado Basin's M&I gap would be more than met. The BIP identified 54 potential M&I projects that quantified the acre-feet, which added up to nearly 510,000 to 540,000 acre-feet—far exceeding the amount needed under the high potential M&I gap.[41] However, given that many have not identified a project proponent, uncertainty exists about whether communities can count on many of these water projects becoming a reality.

In summary, even the high potential M&I gap could be fully met if the Colorado River Basin implements high conservation, the high-priority projects identified, and a small portion of the projects from the full list of potential projects. However, uncertainty about the viability of many of the projects, and about specific commitments from water providers, makes reliance on these projects and commitment to high conservation levels uncertain.

Gunnison

The Gunnison Basin faces a gap that could begin as early as 2035 in Delta County.[42] Future needs in the basin are likely to increase from 16,000 to 23,000 acre-feet, and currently planned projects leave a municipal water supply gap of 3,700 to 6,100 acre-feet within the Gunnison Basin. This assumes that the basin implements identified projects and processes at a relatively high success rate.[43] In addition, the Gunnison BIP states that demands in Ouray County may be higher than the SWSI 2010 indicated.[44]

Gunnison Goals and Measurable Outcomes

To address this municipal gap, in its BIP the Gunnison Basin Roundtable identifies one goal related to meeting M&I needs.[45] That goal and its associated measurable outcomes are:

- *Identify and address M&I water shortages.*
  - *Reliably meet 100 percent of essential municipal water provider system demands in the basin through the year 2050 and beyond.*
  - *Continue the current baseline of effective water conservation programs by covered entities in the basin, with the goal being high levels of conservation savings as defined in SWSI 2010.*

In addition, the Gunnison BIP outlines the following statewide principles related to municipal conservation, including implementation steps:[46]

- *Water conservation, demand management, and land use planning that incorporates water supply factors should be equitably employed statewide.*
  - *Work with other basin roundtables to support conservation, demand management, and the incorporation of water supply factors into land use planning and development.*
  - *Promote programs that encourage drought tolerant vegetation and discourage lawn irrigation.*

Meeting the Gunnison's M&I Gaps

The Gunnison Basin Roundtable identified two water conservation activities and five tier-1 projects that would help meet future M&I needs and that were not previously identified in the SWSI 2010. "Tier 1" signifies that implementation is likely feasible by 2025, and that the project does an excellent job of meeting basin goals. If the basin implements the five projects, they will provide nearly 12,000 acre-feet.[a] This volume fully meets the gap the SWSI 2010 identified. The Gunnison BIP states that, "M&I needs … are generally expected to be managed with sufficient existing supplies and/or through planned projects."[b] Given this analysis, the Gunnison Basin meets its M&I gap.

In addition to these projects, the Gunnison Basin Roundtable also advocates for high-conservation standards, as the SWSI 2010 identified. The implementation of these standards and active conservation would likely result in water savings of another 5,500 acre-feet, which the basin could apply to meet future demands.

North Platte

The North Platte Basin no longer has an M&I supply gap. As stated in the North Platte BIP, "The North Platte Basin has only one municipal water provider, the Town of Walden, serving a population of about 600. Limitations to the town's water supply were identified in the original SWSI report, and subsequently addressed through a CWCB funded study and multi-alternative project, eliminating the only municipal water supply gap in the basin."[47]

North Platte Goals and Measurable Outcomes

Nonetheless, the basin indicated support for municipal conservation, which could help meet any additional needs. As expressed in the BIP, this goal and its associated measurable outcome are:

- *Support the equitable statewide application of municipal water conservation.*
  - *Comply with future statewide municipal-conservation strategies and any related legislation by 2020, or as appropriate.*

Meeting the North Platte's M&I Gaps

The North Platte has met its future M&I needs.

Rio Grande

The Rio Grande Basin has a relatively small, though important, M&I gap. According to the CWCB's analyses, this gap could begin as early as 2025 in Costilla County.[48] The studies indicate that future needs in the Rio Grande are likely to increase by 7700 to 13,000 acre-feet, and currently planned projects leave a municipal water supply gap of between 2300 to 5100 acre-feet within the Rio Grande Basin.[49] This assumes that the basin implements the identified projects and processes at a relatively high success rate.[50] The Rio Grande Basin would like to better determine the amount, timing, and location of the gap once the Rio Grande Decision Support System groundwater model is ready. The basin expects that most water providers will have a gap and will need to join a groundwater management subdistrict or develop an independent augmentation plan.

Rio Grande Goals and Measurable Outcomes

To address this municipal gap, in its BIP the Rio Grande Basin Roundtable identifies three primary goals for meeting M&I needs. These goals and their associated measurable outcomes are:[51]

- *Operate, maintain, rehabilitate, and create necessary infrastructure to meet the basin's long-term water needs, including storage.*
  - *A database of existing water infrastructure including documentation of infrastructure condition and mapping of all storage reservoirs and major ditch diversions is created.*

[a] Wilson Water Group, Gunnison Basin Implementation Plan.
[b] Wilson Water Group, Gunnison Basin Implementation Plan.

- *Reservoirs operate at full design capacity without restrictions.*
- *Diversion structures and conveyance systems function optimally.*
- *Municipal potable water supplies are adequate to meet needs.*
- *Water supplies and wastewater treatment systems are fully functional and meet all necessary standards.*

- *Support the development of projects and methods that have multiple benefits for agricultural, M&I, and environmental and recreational water needs.*
  - *Opportunities for multiple use benefits have been explored and implemented where possible.*
  - *Multiple-purpose projects will have preference in the funding process.*
- *Meet new demands for water, to the extent practicable, without impacting existing water rights and compact obligations.*
  - *Reduce per capita per day water use to a reasonable level.*
  - *Inventory existing and expected future M&I and environmental and recreational water needs.*
  - *Add hydropower electrical generating capacity where possible.*
  - *Develop an M&I plan that addresses water needs, availability, and a strategy for meeting the needs for M&I while sustaining agricultural water use and minimizing effects on other uses.*

Meeting the Rio Grande's M&I Gaps

The Rio Grande Basin Roundtable identified very few municipal projects beyond the identified projects and processes in SWSI 2010, and only one of these projects provides additional acre-feet to meet growing municipal needs. In its BIP, it acknowledges this by stating:

- *While M&I and Self-Supplied Industrial (SSI) water use will remain a small percentage of overall basin water use, it is important to provide additional resources to M&I water providers to assist them in meeting future needs by identifying and assisting in the development of:*
  - *Measures to manage water demands and return flows and develop methods to receive augmentation credits for wastewater discharges and lawn irrigation return flows.*
  - *Water rights, storage and augmentation supplies, either directly or through the groundwater management subdistricts.*
  - *Finalization of the Rio Grande Decision Support System groundwater model so that M&I pumping depletions can be determined in amount, timing, and location.*[52]

The Rio Grande has not yet quantified its future M&I gap. Once the basin determines well-pumping depletions by amount, timing, and location, the M&I providers will either join a subdistrict or develop an independent augmentation plan.

South Platte (including the Metro Area and Republican Basin)

The Metro, South Platte, and Republican Basins face a municipal gap that could begin as early as 2020 in the Lower South Platte. When taking into account the need to replace nontributary groundwater, that gap already exists in the South Metro Area Basin.[53] The potential gap in the Lower South Platte is relatively small compared to that of the urbanized Front Range, which holds the largest gap in Colorado. Future needs in the basin as a whole are likely to increase by 340,000 to 505,000 acre-feet. However, water needs for hydraulic fracturing must be added to the water supply gap. With existing data, currently planned projects leave a municipal water supply gap within Colorado's northeast region of 204,000 to 310,000 acre-feet. This assumes that the basin implements identified projects and processes at a relatively high success rate.[54]

South Platte Goals and Measurable Outcomes

To address this M&I gap, the South Platte BIP developed a long-term goal:[55]

Meet community water needs throughout Colorado by: 1) Using water efficiently with high levels of participation in conservation programs; 2) Developing additional water throughout the state through balanced, multi-purpose projects and methods; and 3) Assuring strong drought protection programs through broad development of protection plans and dedicated reserves potentially including storage, interruptible service agreements (ISAs), water banks, water use restrictions and nontributary groundwater, among others.

In the short term, the South Platte developed four goals and associated measurable outcomes to meet the large M&I water supply gap in the South Platte Basin:[56]

- *Continue the South Platte River Basin's leadership in wise water use.*
  - *Further quantify the successes of programs implemented in the past several years throughout the South Platte River Basin and establish a general baseline against which the success of future programs will be assessed.*
  - *Distribute and encourage adoption of "best management practices" as "guidelines" (not standards) for M&I water suppliers to consider in their "provider-controlled" programs recognizing the substantial differences in climates, cultures, and economic conditions throughout the South Platte River Basin.*
  - *Enhance current levels of municipal water reuse and consider studies to quantify the effects of: 1) additional municipal water conservation on water available for reuse; 2) additional municipal water reuse in elation to water available for exchanges; 3) reuse and successive uses of water downstream including effects on agricultural water shortages.*
  - *Ensure conservation, reuse, and drought management plans take into consideration environmental and recreational focus areas and attributes.*
- *Bring a high percentage of entries in the updated IPP list online as a key strategy consistent with the "no/low regrets" scenario planning approach.*
  - *Maximize implementation of the updated IPP list.*
  - *Encourage multi-purpose projects that also provide environmental and recreational considerations. Foster opportunities to improve environment and recreation conditions of affected watersheds in association with IPPs.*
- *To the extent possible, develop multi-purpose storage, conveyance, system interconnections, and other infrastructure projects to take advantage of limited remaining South Platte supplies and enhance water use efficiencies and supply reliability.*

Baseball fields dot the landscape near the Denver Technological Center (DTC). The DTC is home to several major businesses and corporations.

- *Explore opportunities to maximize yield from additional South Platte Basin strategic and multi-purpose storage and other infrastructure including collaborative interconnections between water supply systems and above ground and groundwater (e.g. Aquifer storage and recharge (ASR) and alluvial recharge) storage.*
- *Encourage multi-purpose projects that provide environmental and recreational considerations.*
- *Take into consideration environmental and recreational attributes when considering Storage and Other Infrastructure projects and methods.*

- *Maintain, enhance and proactively manage water quality for all use classifications.*
  - *Maintain or improve the delivery of safe water supplies throughout the basin.*
  - *Monitor, protect and improve watershed water quality and identify and document progress and improvements.*
  - *Improve areas where water quality may be limiting the suitability of focus areas identified by BRTs through environmental and recreational mapping efforts.*
- *Develop agreements governing additional trans basin water imports that: 1) are in accordance with the South Platte Basin's overarching theme that economic, environmental and recreational benefits should equitably accrue to both the western slope and the eastern slope; 2) include project(s) or project elements that provide multiple types of uses; 3) supported with state investment; and 4) provide enough certainty in conditions to substantially lessen current trends of traditional buy-and-dry transfers from agricultural uses to M&I uses.*
  - *Through the IBCC, negotiate a conceptual agreement with the western slope basin roundtables on investigating, preserving, and developing potential options so that future multi-purpose projects benefiting both slopes can be addressed on a timely basis.*
  - *Encourage multi-purpose projects that provide environmental and recreational considerations.*

Meeting the South Platte's M&I Gaps

The South Platte BIP includes a list of potential M&I projects, a conservation strategy, and some initial portfolios to accomplish its goals and meet the identified M&I gaps.[57] It used similar categories to the No-and-Low-Regrets work Section 6.1 describes. A comparison is provided below:

- The BIP partially meets the No-and-Low-Regrets goals associated with conservation. The Metro and South Platte Basins estimate they will further reduce M&I demand to 129 gallons per day per capita (GPCD) and 146 GPCD, respectively. The BIP applies 50 percent of active conservation savings, plus all passive savings, to meet future needs in their portfolio work. Approximately 53,000 acre-feet of active conservation savings apply to future needs. The basins would need to apply a substantially higher percentage of active conservation in order to fully meet the No-and-Low-Regrets goal of applying 97,000 acre-feet to meet new demands.
- The BIP meets the No-and-Low-Regrets goal of 199,000 acre-foot yield from the IPPs. The total yield from the IPPs the basin describes in its BIP exceeds the No-and-Low-Regrets goals, yielding about 225,000 acre-feet. This is partly attributed to the fact that the BIP identifies 16 new projects (seven for reuse, four for agricultural transfers, and five for basin projects) that were not previously in the SWSI 2010.
- The No-and-Low-Regrets actions indicate that basins would need to generate 22,000 acre-feet of reuse water from new agricultural diversions and any new TMD projects. The BIP proposes 45,010 new acre-feet of water from reuse. Although the South Platte BIP discusses reuse, the BIP's portfolio work did not calculate reuse from these new projects.
- The No-and-Low-Regrets actions indicate that the basin needs a minimum of 44,000 acre-feet of additional agricultural transfers, and that these transfers should ideally be alternative agricultural transfers. The BIP identifies 4560 acre-feet of alternative transfer methods (ATMs). It also indicates that, by applying conservation to meet new demands, portfolios B and C would need between 25,000 and 90,000 acre-feet of

additional agricultural dry-up. Therefore, the BIP likely meets this No-and-Low-Regrets goal. Portfolios B and C identified about 30,000 acre-feet of alternative transfer-method water. The BIP also includes recommendations to streamline transaction costs for ATMs.

Southwest

The Southwest Basin faces a gap that could begin as early as 2015 in Montrose County.[58] Future needs in the Southwest Region are likely to increase by 20,000 to 31,000 acre-feet, and currently planned projects leave a municipal water supply gap within the Southwest region of 8,800 to 16,000 acre-feet. This assumes that the basin implements identified projects and processes at a relatively high success rate.[59]

Southwest Goals and Measurable Outcomes

To address this municipal gap, in its BIP the Southwest Basin Roundtable identified four goals related to meeting M&I needs. These goals and their associated measurable outcomes are below:[60]

- *Pursue a high success rate for identified specific and unique projects and processes to meet the municipal gap and to address all water needs and values.*
  - *Complete 40 IPPs aimed at meeting municipal water needs.*
- *Provide safe drinking water to Southwest Colorado's citizens and visitors.*
  - *Consistently meet 100 percent of residential, commercial, and industrial water system demands identified in SWSI 2010 in each sub-basin, while also encouraging education and conservation to reduce demand.*
  - *Implement at least one IPP that protects or enhances the ability of public water supply systems to access and deliver safe drinking water that meets all health-based standards.*
- *Promote wise and efficient water use through implementation of municipal conservation strategies to reduce overall future water needs.*
  - *Change the ratio of in-house to outside treated water use for municipal and domestic water systems (referred to as water providers herein) from the current ratio of 50 percent in-house use and 50 percent outside use, to 60 percent in-house use and 40 percent outside use (60/40 ratio) for Southwest Colorado and the entire defined as requiring a water court change case state by 2030.*
  - *Implement three informational events about water reuse efforts, tools, and strategies.*
  - *The water providers in the state that are using dry up of agricultural land[c] and/or pursuing a new TMD[d] shall have a higher standard of conservation. The goal for these water providers is a 70/30 ratio by 2030. This is a prerequisite for the roundtable to consider support of a new TMD.*
- *Support and implement water reuse strategies.*

Meeting the Southwest's M&I Gaps

The Southwest BIP includes a list of potential M&I projects compiled from interviews with providers in each sub-basin.[61] The roundtable identified seven new projects to include components that would meet future municipal supply needs, and several others that would address other infrastructure needs within the basin. Among these seven projects, a total of nearly 40,000 acre-feet was identified. However, it is not clear whether each geographic region in the basin will be able to meet its future needs if it implements the listed projects.[62]

The Southwest Basin Roundtable acknowledged that while it did not quantify every identified project in its BIP, the projects and methods would fully meet their M&I water supply gap as well as the basin's infrastructure needs.

[c] Defined as requiring a water court change case.
[d] As defined by the IBCC to be a new western slope to eastern slope diversion project.

Yampa/White/Green

The Yampa/White/Green Basin faces a gap that could begin as early as 2015 in Rio Blanco and Moffat Counties.[63] According to SWSI 2010, future needs in this northwest Colorado region are likely to increase by 34,000 to 95,000 acre-feet. However, these needs will likely be revised downward, since all indications show that oil shale will not become commercially viable by 2050.[64] Energy development from hydrologic fracturing is a new need that basins should also take into account when calculating the M&I water supply gap. With existing data, currently planned projects leave a municipal water supply gap of 24,000 to 83,000 acre-feet within Colorado's northwest region. This assumes that the basin implements identified projects and processes at a relatively high success rate.[65]

Yampa/White/Green Goals and Measurable Outcomes

To address this M&I gap, the Yampa/White/Green BIP identified four goals related to meeting M&I needs. These goals and their relevant measurable outcomes and processes are below:[66]

- *Protect and encourage agricultural uses of water in the Yampa/White/Green Basin within the context of private property rights.*
  - *Process*
    - *Identify agricultural water shortages and evaluate potential cooperative and/or incentive programs to reduce agricultural water shortages.*
    - *Identify projects that propose to use at-risk water rights, alternative transfer methods, water banking, and efficiency improvements that protect and encourage continued agricultural water use.*
    - *Encourage and support M&I projects that have components that preserve agricultural water uses.*
  - *Outcomes*
    - *Preserve the current baseline of about 119,000 irrigated acres and expand by 12 percent by 2030.*
    - *Encourage land use policies and community goals that enhance agriculture and agricultural water rights.*
- *Identify and address M&I water shortages.*
  - *Processes*
    - *Identify specific locations in the Yampa/White/Green Basin where M&I shortages may exist in drought scenarios and quantify shortages in time, frequency, and duration.*
    - *Identify effects throughout the Yampa/White/Green Basin in the context of water shortages (drought and climate change), wildfire and compact shortage on M&I demands.*
    - *Identify projects and processes that can be used to meet M&I needs.*
    - *Encourage collaborative multi-purpose storage projects.*
    - *Support efforts of water providers to secure redundant supplies in the face of potential watershed effects from wildfire.*
    - *Encourage municipal entities to meet some future municipal water needs through water conserv*ation and efficiency
  - *Outcomes*
    - *Reliably meet 100 percent of M&I demands in the basin through the year 2050 and beyond through the following processes:*
- *Maintain and consider the existing natural range of water quality that is necessary for current and anticipated water uses.*
  - *Processes*
    - *Encourage and support water quality protection and monitoring programs in the sub-basins of the Yampa/White/Green Basin through watershed groups, municipalities, land management agencies and other efforts.*
  - *Outcomes*
    - *Consider and maintain the existing water quality necessary for current and future water uses when reviewing IPPs.*
    - *Support the implementation of water-quality monitoring programs to create quality-controlled baseline data for all sub-basins of the Yampa/White/Green Basin.*

Meeting the Yampa/White/Green's M&I Gaps

The Yampa/White/Green Basin Roundtable conducted the most thorough analysis of how well the implementation of future projects and methods would meet M&I needs. In addition, the roundtable assessed these needs under a hot-and-dry future. Below is an excerpt from the BIP describing potential future shortages:

> *Municipal Shortages:*
>
> *M&I demands are small compared to agricultural demands in the Yampa/White/Green Basin. Under Baseline Conditions, no shortages exist to M&I demand nodes because of generally adequate water supply and augmentation from reservoirs.*
>
> *While M&I shortages exist under the high demand, low water supply scenarios of the Dry Future IPP Scenario and the Dry Future Scenario, the shortages remain below 10 percent. Under both scenarios, District 43 existing M&I in Rio Blanco County (Rangely Water, Meeker Demand) and District 58 existing M&I in Routt County (the City of Steamboat Springs) begin to exhibit shortages, whereas Moffat County municipal nodes do not show M&I shortages under either scenario. If IPPs are developed that include M&I use, shortages would likely decrease in locations with supply augmentation.*
>
> *Industrial Shortages:*
>
> *Under Baseline Conditions, no shortages exist for SSI, which consist of thermoelectric power generation needs. Slight shortages exist for the Hayden Station and units 1 and 2 of Craig Station under the Dry Future IPP Scenario and the Dry Future Scenario. These scenarios meet thermoelectric demands with redundant water supplies from Steamboat Lake for Hayden Station and Elkhead and Stagecoach Reservoirs for Craig Station. Using historical data, hypothetical shortages would have occurred for the Hayden Station in the dry months of August 1961, March 1962, September 1977, and September 2002) and for the Craig Station in the dry months of November 1963, September 1977, December 2002, and a few months in 1949.*

Nevertheless, SSI water users consider their water supply short when they must rely upon redundant water supplies. For example, some SSI water users considered the years 2002, 2003, 2012, and 2013 to be "water supply-short" or "borderline-short" due to their reliance on redundant supplies. Further discussions will take place regarding the most appropriate baseline conditions and shortage assessments in light of drought, climate change, and evolving power generation technologies[67]

Overall, the roundtable modeled nine M&I projects and methods, including conservation in Steamboat Springs, which the SWSI 2010 did not previously identify. The roundtable only modeled projects that identified a project proponent, a location, physical characteristics, and operations. It quantified acre-feet that are associated with eight of the projects, and that meet the potential needs of the energy industry. The total, newly quantified acre-feet to meet M&I needs adds up to 198,000.[68] In conclusion, the BIP identified projects that meet future M&I demands.

Meeting Colorado's Agricultural Needs

The agricultural gap is the difference between the status quo, which shows a reduction in irrigated acres in almost every basin (Figure 6.2-1, page 6-32), and what the State or a basin indicates it *wants to achieve* with regard to agriculture in accordance with its goals and measurable outcomes, minus the projects and methods that are *planned* to meet those needs.[69] While every basin indicated that maintaining viable agriculture is one of the most important aspects of its BIP, this definition allows for considerable variability between basins, which face different issues related to agriculture.

Colorado expects its irrigated acres to decline in almost every basin by 2050 (Figure 6.2-1, page 6-32)—but these projected declines have differing causes. Similarly, every basin has agricultural shortages. The BIPs work to address these challenges by identifying projects that could reduce shortages, maintain the agricultural economy and, in some cases, increase irrigated acres.

To address the challenges associated with shortages and declining irrigated acres, the CWCB has identified four statewide long-term goals:[70]

- *Ensure that agriculture remains a viable economic driver in Colorado by supporting food security, jobs, and rural communities while protecting private property rights.*
- *Meet Colorado's agricultural needs.*

- *Implement efficiency and conservation measures to maximize beneficial use and production.*
- *Protect and enhance Colorado's natural resources, and provide ecosystem services.*

Before exploring how the basins developed solutions within their BIPs to meet these and other local goals, it is important to understand some of the statewide issues related to shortages and the decline in irrigated acres. The CWCB expects irrigated acres to decline for three primary reasons:[71]

1. Urbanization of agricultural lands, which is primarily an issue in the South Platte and Colorado Basins;
2. Conversion of agricultural water rights to municipal rights in order to meet future municipal needs, which is mostly occurring in the South Platte, Colorado, and Arkansas Basins; and
3. Voluntary reductions in water use associated with sustainable groundwater supplies and compact obligations, which are ongoing in the Rio Grande and Republican Basins.

Underlying many of the reasons for agricultural decline are temporary and downward state, national, and international agricultural economic trends. However, by 2050, the CWCB expects the agricultural economy to be increasingly viable because of a global increase in the number of people who need food, and the number of people who can afford high-quality and high-protein agricultural products.[72] Colorado's agricultural production is also vital locally. As Chapter 3 describes, 50 percent of jobs are related to agriculture in some counties.

From a statewide perspective, it is important to provide options and incentives that help maintain, or even increase, Colorado's agricultural economy and production in light of the loss of irrigated acres. The "agricultural gap" described above will need to be addressed in order to meet the strategic position that

Headgates help water users control the flow of water throughout the state.

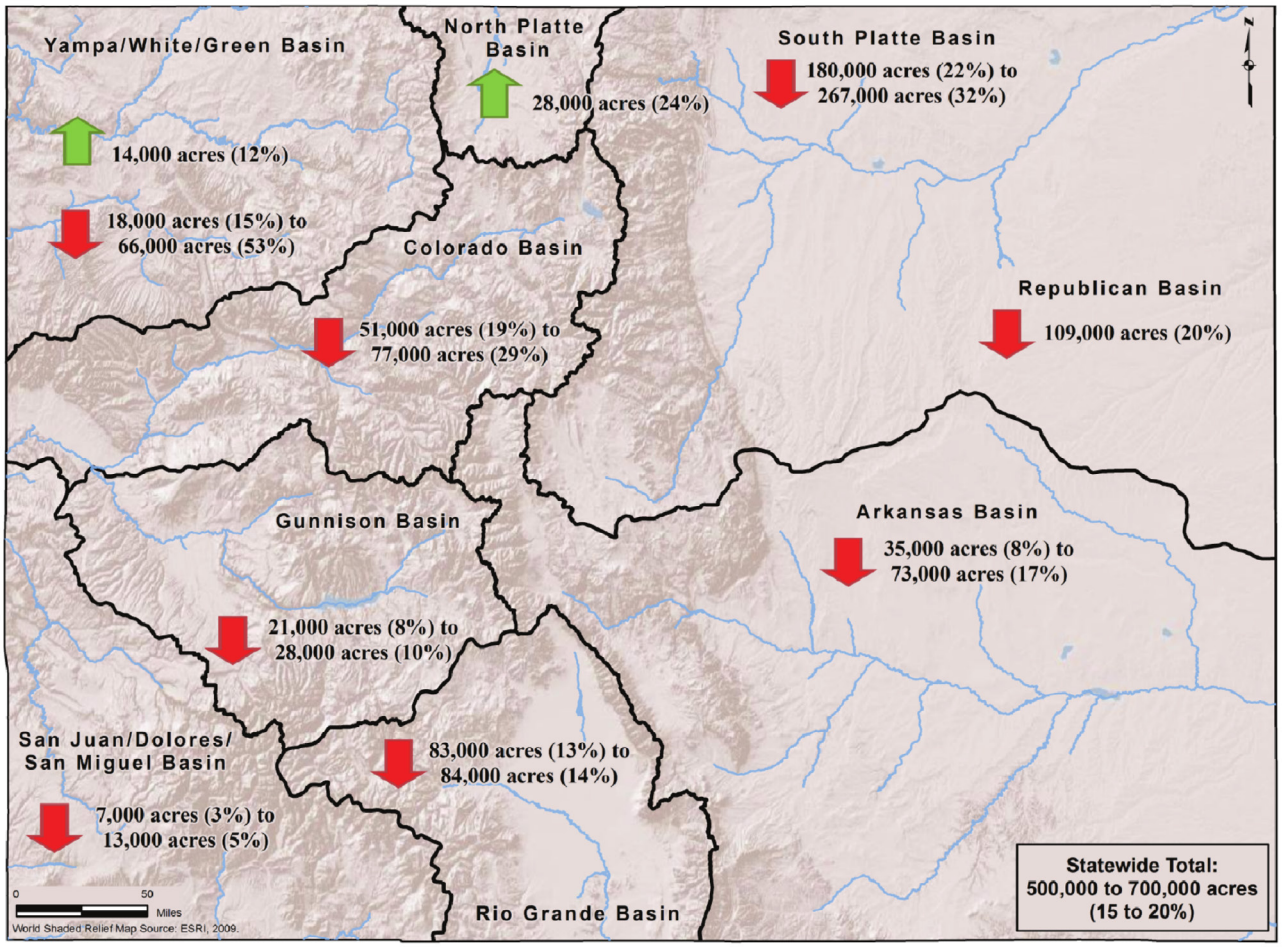
Colorado and the basins seek to achieve in 2050 from an agricultural perspective. Nevertheless, quantifying this prospective agricultural gap is difficult. As a result, many basins choose to reduce agricultural shortages or find alternative sources of water so that the transfer of agricultural water is not the default solution to meeting Colorado's growing needs.

Several basins discuss reduction of shortages, and it is therefore important to understand the definition of agricultural shortage. As the Gunnison BIP describes, three primary factors can cause agricultural shortages:[73]

> ***Physical shortages*** *are because of lack of physical supply. Such shortages are often seen later in the irrigation season principally by irrigators on smaller tributaries. Though irrigation water rights may be* in *priority, there is not enough supply. Although these shortages are exacerbated in dry years, on many of the tributaries physical flow is not sufficient to meet the crop irrigation requirement (CIR) for the entire growing season even in wet years.*
>
> ***Legal shortages*** *are those because of lack of legal supply; there may be physical supply at a headgate, but it must be bypassed to meet downstream senior water rights. This type of shortage is often seen later in the season by irrigators with junior water rights in average and wet years, and may be the situation for junior irrigators the entire growing season in dry years.*
>
> ***Irrigation practice "shortages"*** *result from specific irrigation practices; the irrigator may have physically and legally available supply but chooses not to irrigate. For example, some irrigators may need to reduce or cease irrigation to allow the land time to dry before haying or grazing. In addition, an irrigator may cease diverting because there is*

FIGURE 6.2-1 **POTENTIAL CHANGES IN IRRIGATED ACRES BY 2050**[74]

(↑ = increase in irrigated acres; ↓ = decrease in irrigated acres)



not enough time left in the growing season for an additional cutting. Note, though this [is] a very different type of shortage, it is equally important to document. Identification of shortages related to irrigation practices helps to quantify the difference between CIR and actual consumptive use in SWSI and other statewide planning efforts. In addition, since irrigation practice shortages cannot be addressed by increased water supply, their identification helps to focus on the implementation of projects that meet physical and legal shortages.

Due to variables such as economic viability, irrigation practice "shortages," and other factors, an agricultural shortage is not necessarily an agricultural gap. Colorado continues to have a healthy agricultural economy, despite shortages ranging between 17 and 45 percent statewide.

This subsection reviews information by basin, and Table 6.2-3 summarizes each basin's success in meeting its agricultural gaps as defined by its goals.

Arkansas

The Arkansas Basin has the third-highest acreage of irrigated land in Colorado and the highest percentage of shortages (45 percent) in comparison to other basins.[78] In addition, irrigated acres are likely to decline by 8 to 17 percent.[79] These estimated declines are primarily due to agricultural transfers from both within the basin and from municipal interests in the South Platte Basin. Still, as many as 3000 irrigated acres (1 percent) may urbanize.

Arkansas Goals and Measurable Outcomes

To address these pressures, in its BIP the Arkansas Basin Roundtable identified four goals related to sustaining agriculture.[80] These goals and their associated measurable outcomes are:

- *Sustain an annual $1.5 billion agricultural economy in the basin.*
  - *Increase in measured economic productivity by update of Colorado State University study in 2020.*
- *Provide augmentation water as needed to support increased farm efficiencies.*
  - *Document the baseline of current augmentation water available.*
  - *Track available storage facilities for augmentation sources.*
- *Develop a viable rotating fallow and/or leasing program between agriculture and municipal interests to address drought and provide risk management for agriculture.*
  - *Report on pilot projects underway as of December 2015.*
  - *Complete and present report by December 2015.*
  - *Survey of permanently retired acreage as of year 2020.*
- *Sustain recreational and environmental activities that depend on habitat and open space associated with farm and ranch land.*
  - *Measure the economic contribution of tourism to the basin economy within the CSU 2020 update.*
  - *Change of status for "protected" attributes as measured by nonconsumptive projects and methods in SWSI 2016 report.*
- *Increase surface storage available within the basin by 70,000 acre-feet by the year 2020.*
  - *Storage capacity and percentage of stored water annually from 2015 to 2020.*
- *Annual reporting of projects that have been permitted and/or constructed.*

Meeting the Arkansas' Agricultural Gap

The primary goal is to support the $1.5 billion agricultural economy in light of agricultural loss.[81] As the BIP indicates, a multipronged strategy is necessary:

> *To maintain that level of economic productivity, projects and methods described in [the BIP] focus on development of rotating fallowing, conservation easements, and increased storage capacity to allow agricultural water to sustain agricultural productivity. In particular, a three-pronged approach to understanding rotational fallowing within the Prior Appropriation Doctrine is underway — an administrative and accounting tool, pilot projects and public policy dialogue — and will continue.*[82]

The Arkansas Basin identified 89,000 new acre-feet associated with seven projects that focus primarily on agricultural needs, and four projects that focus on agricultural and M&I needs. One of the multipurpose projects, which meets both agricultural and M&I needs, will also irrigate 2000 new acres. Adaptive

TABLE 6.2-3 SUMMARY OF HOW EACH BASIN MET ITS AGRICULTURAL GAPS

Basin	Irrigated Acres[75]	Shortage (Acre-feet/Year)[76]	Potential New Acre-feet	# of New Projects	Summary of How BIPs Met Their Agricultural Goals/Gaps
Arkansas	428,000	30,000 – 50,000 (augmentation gap)[e]	89,000	22	Yes decrease shortages; potential to sustain agricultural $1.5 billion economy w/ actions; don't develop specific augmentation water projects; policies and projects support rotational fallowing, policies support agriculture- related recreational and environmental uses with conservation easements
Colorado	268,000	100,000	20,000	3	Partially decrease shortages; discuss some efforts to develop incentives and decrease urbanization and agricultural to urban transfers
Gunnison	272,000	116,000[77]	129,000	17	Yes decrease shortages, partially discourage agricultural transfers through policies
North Platte	117,000	110,000	12,000	12	Increase irrigated acreage to partially meet 17,000 acre goal; increase storage to partially meet 37,000 acre-feet goal
Rio Grande	622,000	428,000	800	1	Yes, improve infrastructure; partially improve agricultural economy
South Platte	1,381,000 (831,000 SP, 550,000 Republican)	434,000 (160,000 SP, 274,000 Republican)	0	0	Partially reduce permanent dry-up w/ conceptual ATMs and alternative sources, don't reduce urbanization or shortages
Southwest	259,000	198,000	20,000	6	Partially decrease shortages; Yes, increase efficiency w/ IPPs; discuss policy to minimize acres transferred, have no agricultural-sharing IPPs
Yampa / White / Green	119,000	54,000	25,000	3	Increase number of irrigated acres to partially meet 15,000 acre goal; partially decrease shortages by 46%
TOTALS	**3,466,000**	**1,470,000 – 1,490,000**	**296,000**	**64**	

[e] The Arkansas Basin Roundtable aspires to maintain the agricultural economy in the basin, and does not identify the agricultural gap in terms of irrigated acreage. Under the Arkansas River Compact, consumptive use is limited, so the roundtable believes that a gap expressed in terms of an "augmentation gap" is a more appropriate evaluation of needs.

Resources, Inc.[83] recently prepared a study for the Lower Arkansas Valley Water Conservancy District showing that the basin needs 25,000 to 30,000 acre-feet for augmentation today, and those needs will grow to more than 50,000 acre-feet by the year 2050. If the basin implements the identified projects it will meet its 2050 augmentation agricultural gap.

To meet its goal of increasing available surface storage by 70,000 acre-feet by 2020, the basin has identified the following actions in its BIP:

- *Implement a critical IPP.*
- *Work with the State Engineer's Office of Dam Safety to identify storage projects for restoration, rehabilitation, and increased capacity.*
- *Support funding, including grant contributions where appropriate, for storage restoration and expansion projects.*

These actions will work to meet both M&I and agricultural gaps.

Actions to meet the basin goal of providing augmentation-water to support increased farm efficiencies include:

- *Establish long-term sources of augmentation-water through leasing, water banks, or interruptible supply agreements.*
- *Construct recharge facilities to capture and re-time fully consumable water supplies.*

Colorado

The Colorado Basin has the fifth-highest acreage of irrigated land in Colorado and the lowest percentage of shortages as a basin (17 percent).[84] The CWCB expects irrigated acres to decline by 19 to 29 percent.[85] This likely decline is primarily due to urbanization, which accounts for 65 to 80 percent of the loss—and totals about 40,000 to 50,000 acres. The remaining agricultural loss is due to agricultural-to-municipal transfers.[86]

Colorado Goals and Measurable Outcomes

To address these pressures, in its BIP the Colorado Basin Roundtable identified four goals related to sustaining agriculture.[87] These goals and their associated measurable outcomes are:

- *Reduce agricultural water shortages.*
  - *Identify multi-purpose storage projects and methods that address the annual 100,000 acre-feet agricultural shortage.*
  - *Maintain existing irrigated agricultural acreage.*
  - *Research local agricultural shortage values in the Colorado River Basin.*
  - *Improve Colorado water law to encourage agricultural water efficiency practices without harming water right value.*
  - *Establish lease programs for excess water from existing supply projects in the M&I sector or multi-use projects.*
- *Minimize potential for transfer of agricultural water rights to municipal uses.*
  - *Identify farm improvements to develop strong sustainable farm economics.*
  - *Develop a set of quantifiable factors of agriculture pressures that can be measured and evaluated in the future to incentivize production and reduce trends towards transfers.*
  - *Adopt local land use codes to conserve water and reduce pressures for agricultural water transfers.*
  - *Promote conservation easements with the anticipated result that they will be more widely considered by the agricultural community.*
- *Develop incentives to support agricultural production.*
  - *Reimburse agriculture for value added to the environment including,water quality, wildlife, and views capes.*
  - *Track effectiveness of agricultural incentives in maintaining irrigated acres.*

- *Minimize regulatory disincentives such as overly stringent requirements for reservoir construction.*
- *Reduce taxes for true self-sustaining agriculture.*
- *Develop incentives that encourage continued agricultural production.*

- *Promote agricultural conservation that maintains agricultural production and viability.*
  - *Revise Colorado Water Law to allow agricultural conservation and improved efficiency measures without impacting water right value or risk of abandonment.*
  - *Strive towards a high level of conservation and efficiency within the agricultural industry.*

Meeting the Colorado's Agricultural Gaps

The Colorado Basin Roundtable identified 21 high-priority projects that meet basin theme 2: Sustain agriculture. The high-priority projects quantified a total of 20,272 acre-feet as meeting both agricultural and M&I gaps. While this amount is insufficient to fully address agricultural shortages in the basin, the Colorado BIP identified 41 projects with quantifications of acre-feet that could reduce agricultural shortages in the basin by a total of 453,000 to 483,000 acre-feet. These projects could eliminate the 100,000 acre-feet of shortages in the basin. However, neither a spatial nor a hydrological analysis has been done to confirm this. Furthermore, the number of projects the basin is likely to implement is unclear, as several of them lack active project proponents.

With regard to addressing agricultural losses due to urbanization, the BIP has several suggestions concerning land use. If these suggested actions are implemented, they could reduce urbanization, but the BIP has not quantified those effects. In addition, the BIP states a need to promote other activities to minimize agricultural loss from water rights transfers, improve agricultural efficiency, and support agricultural production. For policy implementation to occur, the BIP must provide more detail.

In summary, the basin will likely need to implement both high-priority projects and methods and some projects from the full projects list in order to fully address its agricultural shortages and partially address its other goals.

Gunnison

The Gunnison Basin has the fourth-highest acreage of irrigated land in Colorado and the second-lowest percentage of shortages as a basin (20 percent).[88] In addition, irrigated acres are likely to decline by 8 to 10 percent.[89] This anticipated decline is primarily due to urbanization, which could take 20,000 to 26,000 acres out of production.[90]

Gunnison Goals and Measurable Outcomes

To address these issues, the Gunnison BIP identified two goals related to sustaining agriculture.[91] These goals and their associated measurable outcomes are:

- *Improve agricultural water supplies to reduce shortages.*
  - *Reduce basin-wide agricultural shortages by developing 10 projects from the list of recommended solutions in the Gunnison BIP by the year 2030.*
  - *Implement the Inventory of Irrigation Infrastructure Improvement Needs projects from the list of recommended solutions in the Gunnison BIP by 2020.*
- *Discourage the conversion of productive agricultural land to all other uses within the context of private property rights.*
  - *Preserve the current baseline of 183,000 protected acres in the Gunnison Basin and expand the participation in conservation easements by five percent by 2030 through programs like the Gunnison Ranchland Conservation Legacy.*

The primary basin goal identified in the Gunnison BIP was to "Protect existing water uses in the Gunnison Basin." This goal framed much of the BIP discussion, especially with regard to meeting agricultural needs.

Meeting the Gunnison's Agricultural Gaps

The Gunnison Basin Roundtable identified 17 projects that it expects the basin to implement in the near term. If the basin implements these projects, it will reduce shortages by approximately 129,000 acre-feet. In addition, infrastructure improvement projects will improve agricultural efficiencies, even though they may not yield acre-feet. The Gunnison BIP also states a goal of protecting more irrigated acres. Currently,

based on data from the Gunnison Ranchland Conservation Legacy, 183,000 acres are protected through conservation easements. The Gunnison Basin Roundtable would like to see the protection of another 9,150 acres by 2030, but it is not clear if policies within the BIP will enable this to occur. Therefore, the BIP has partially met the second goal.

North Platte

The amount of irrigated land in the North Platte Basin has declined since the Supreme Court's Equitable Apportionment Decree, which states that the North Platte in Colorado can continue to irrigate at the historical levels the decree defines. The North Platte BIP has indicated an interest in irrigating more lands.[92]

North Platte Goals and Measurable Outcomes

To address this issue, the North Platte Basin Roundtable BIP contains two goals related to sustaining agriculture.[93] These goals and their associated measurable outcomes are:

- *Maintain and maximize the consumptive use of water permitted in the Equitable Apportionment Decree and the baseline depletion allowance of the Three State Agreement.*
  - *Develop three projects from the list of recommended solutions by 2020.*
  - *Incrementally bring up to 17,000 additional acres under irrigation by 2050.*
  - *Develop 37,000 acre-feet of additional storage (doubling of current storage) by 2050.*
- *Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies.*
  - *Develop three projects from the list of recommended solutions by 2020.*

Meeting the North Platte's Agricultural Gaps

The North Platte identified 12 projects, and associated estimates of acre-feet, acreage, or cubic feet per second. The basin has access to water volume information for six of the projects, and half of those projects do not reveal the amount of associated increase in acreage they would provide. The basin estimates that these projects could generate approximately 12,000 acre-feet. Similarly, nine potential projects provide information on the acreage they could serve, but six of the descriptions do not identify the number of acre-feet associated with the projects. In sum, the BIP identified an increase of more than 12,000 acres. The CWCB assumes that the three projects without associated acreage would add to that number, but given the available data, the North Platte BIP meets about 70 percent of its goal to increase acreage. Additionally, several listed projects are working to restore, maintain, and modernize water infrastructure in the basin; however, the roundtable identified projects that only partially meet the basin's goal to increase storage by 37,000 acre-feet.

Rio Grande

The Rio Grande Basin has the second-highest acreage of irrigated land in Colorado and the basin as a whole uses 67 percent of its crop-irrigation water requirement.[94] Agriculture is the primary water use and is the base of the economy. At the same time, the basin must correct the water balance to achieve sustainability between senior surface-water rights and the more junior groundwater rights. To achieve sustainability and protect senior water rights, the CWCB estimates that approximately 15 percent, or 80,000, of currently irrigated acres may be dried up. These issues will be addressed by either the new rules and regulations the DWR is develoing or through the formation of groundwater management subdistricts.[95] The purpose of the rules and regulations is as follows:

The overall objective of this subdistrict plan is to provide a water management alternative to state-imposed regulations that limits the use of irrigation wells within the subdistrict, that is, a system of self-regulation using economic-based incentives that promote responsible irrigation water use and management and insure the protection of senior surface water rights.[96]

Rio Grande Goals and Measurable Outcomes

To address these issues, in its BIP the Rio Grande Basin Roundtable identified two goals related to sustaining agriculture.[97] These goals and the their associated measurable outcomes are:

- *Operate, maintain, rehabilitate, and create necessary infrastructure to meet the basin's long-term water needs, including storage.*
  - *A database of existing water infrastructure including documentation of infrastructure condition including M&I facilities, storage*

reservoirs and major ditch diversions is created.

- *Reservoirs operate at full design capacity without restrictions.*
- *Diversion structures and conveyance systems function optimally.*

- *Manage water use to sustain an optimal agricultural economy throughout the basin's communities.*
  - *The cultural heritage of agricultural water use in the San Luis Valley is recognized.*
  - *Agriculturally supported jobs are sustained.*
  - *Rangeland is maintained and improved.*
  - *Soil health is enhanced and soil loss is minimized on both farmland and rangeland.*
  - *Alternative agriculture practices that improve soil health and/or reduce consumptive use without impacting crop yields are supported and implemented to the extent practicable.*

Meeting the Rio Grande's Agricultural Gaps

As a result of the Rio Grande Compact's delivery requirements to downstream states, as well as current unsustainable groundwater pumping, the Rio Grande seeks to better manage its agricultural water resources and economy. It aims to achieve this with the formation of groundwater subdistricts that reduce pumping and sustain aquifer levels. Consequently, most of the 12 agriculture-related projects the Rio Grande Basin Roundtable analyzed are not associated with new acre-feet. Six of the projects the basin identified in its BIP focus on monitoring, assessment, and planning. The storage improvement and expansion projects largely focus on improved augmentation and administration opportunities that will help meet irrigation as well as environmental and recreational water needs. In summary, the Rio Grande's BIP meets its defined agricultural gap.

South Platte (Including the Metro Area and Republican Basin)

The South Platte and Republican River Basins have the highest acreage of irrigated land in Colorado, and on average, experience shortages of 25 percent.[98] The basin projects a gap of 160,000 acre-feet in the South Platte and 274,000 acre-feet in the Republican. In addition, according to SWSI 2010, irrigated land is likely to decline by 22 to 32 percent in the South Platte Basin and by 20 percent in the Republican Basin.[99] Using past trends as a baseline, the South Platte Roundtable reexamined potential loss of irrigated lands in the South Platte Basin, and estimated a range of 10 to 20 percent loss, and could be as much as 50 percent under one of the scenarios described in the BIP.[100] These anticipated declines are primarily due to agricultural-to-municipal transfers, but the CWCB expects urbanization to account for 6 to 7 percent of the loss—the equivalent of 47,000 to 61,000 acres.[101] In the Republican Basin, the loss of more than 100,000 irrigated acres is related to factors associated with sustainable groundwater and compact-related issues.

South Platte Goals and Measurable Outcomes

To address these issues, in their BIP the South Platte Basin and Metro Roundtable identified one goal related to sustaining agriculture.[102] This goal and its associated measurable outcomes are:

- *Fully recognize the importance of agriculture to Colorado's future well-being, support continued success, and develop new voluntary measures to sustain irrigated agriculture.*
  - *Support strategies that reduce traditional and permanent dry-up of irrigated land; achieve this through implementation of other solutions, including conservation, reuse, successful implementation of local IPPs, successful implementation of ATM, and development of new Colorado River supplies.*
  - *Support municipalities' and other local and state land-use authorities' strategies to reduce loss of irrigated land due to urbanization.*
  - *Support strategies involving IPPs, new multi-purpose projects, and innovative measures to address agricultural water shortages and maximize use of available water supplies.*

- *Develop local tools and elicit political and community support for tools to sustain irrigated farmland.*
- *Encourage the maintenance of existing wetlands in focus areas associated with agricultural lands.*
- *Ensure that agricultural dry-up and other alternatives take environmental and recreational focus areas and attributes into consideration.*

Meeting the South Platte's Agricultural Gaps

The roundtables discussed several strategies to reduce agricultural shortages and minimize permanent agricultural losses. Conceptually, the BIP indicates that ATMs could meet 30,000 acre-feet of future municipal demands. However, the BIP also lists several barriers to ATMs that the basin must overcome. The BIP also includes recommendations for streamlining transaction costs for ATMs and ATM grant programs in the South Platte Basin. In addition, the roundtables discussed the need to preserve the option for developing additional TMD water, which would lessen the need for significantly more agricultural transfers. The roundtables have not identified any IPPs that explicitly address agricultural shortages. The BIP indicates that the basin roundtable would like to further investigate land-use options, which could increase urban densities and therefore reduce the urbanization of a number of agricultural acres. The BIP does not go into depth about developing local political tools or ensuring that the basin take environmental and recreational values associated with agriculture into account. Therefore, the BIP has partially met its goals and measurable outcomes.

Southwest

The basins in the Southwest have the sixth-highest acreage of irrigated land in Colorado and the third-highest percentage of shortages (34 percent).[103] In addition, irrigated acres are likely to decline by 3 to 5 percent.[104] These anticipated declines are primarily due to urbanization, although, if Colorado River supplies are not available, some agricultural-to-urban transfers may be necessary.[105]

Southwest Goals and Measurable Outcomes

To address these issues, in its BIP the Southwest Basin Roundtable identified three goals related to sustaining agriculture.[106] These goals and their associated measurable outcomes are:

- *Minimize statewide and basin-wide acres transferred.*
  - *Implement projects (e.g. ATMs, efficiency, among others) to help preserve agriculture and open space values, and to help address municipal, environmental, recreational, and industrial needs; while respecting private property rights.*
  - *Implement strategies that encourage continued agricultural use and discourage permanent dry-up of agricultural lands.*
  - *The water providers in the state that are using dry-up of agricultural land and/or pursuing a new TMD shall have a higher standard of conservation. The goal for these water providers is a ratio of 70 percent use occurs in-house while 30 percent use occurs outside (70/30 ratio).*
- *Implement efficiency measures to maximize beneficial use and production.*
  - Implement at least 10 agricultural water efficiency projects identified as IPPs (by sub-basin).
- *Implement IPPs that work towards meeting agricultural water supply shortages.*

Meeting the Southwest's Agricultural Gaps

The Southwest Basin Roundtable identified six projects that have a combined 20,000 of new acre-feet associated with them. Of these projects, only one is not also considered for M&I uses. These projects work toward reducing agricultural water supply shortages. As the BIP states, none of the projects supports agricultural-sharing or implements strategies that discourage permanent dry-up of agricultural lands. This is because the basin does not expect the agricultural transfers to meet future municipal needs

beyond urbanization of agricultural lands. Therefore, the BIP meets its defined agricultural gaps.

Yampa/White/Green

Of the Colorado basins, the Yampa/White/Green River Basin contains among the least number of irrigated acres, and the third-lowest percentage of shortages (23 percent).[107] In addition, irrigated acres could either increase by 12 percent with adequate investment, or decrease by 15 to 53 percent.[108] The CWCB's estimated potential losses are determined by whether oil shale or other energy interests grow into a large commercial industry and need to rely on agricultural transfers to meet their needs. However, these needs will likely be revised downward since all indications are that oil shale will not be at full-scale production by 2050. Additional declines in irrigated acres are related to urbanization of agricultural lands.[109]

Yampa/White/Green Goals and Measurable Outcomes

To address these issues, in its BIP the Yampa/White/Green Roundtable identified two goals related to sustaining agriculture.[110] These goals and their associated measurable outcomes are:

- *Improve agricultural water supplies to increase irrigated land and reduce shortages.*
  - *Reduce agricultural shortages basin-wide by 10 percent by the year 2030.*
- *Preserve the current baseline of 119,000 irrigated acres and expand by and expand by 12 percent by 2030. Protect and encourage agricultural uses of water in the Yampa-White-Green Basin within the context of private property rights.*
  - *Preserve the current baseline of approximately 119,000 protected acres and expand by 12 percent by 2030.*
  - *Encourage land use policies and community goals that enhance agriculture and agricultural water rights.*

Meeting the Yampa/White/Green's Agricultural Gaps

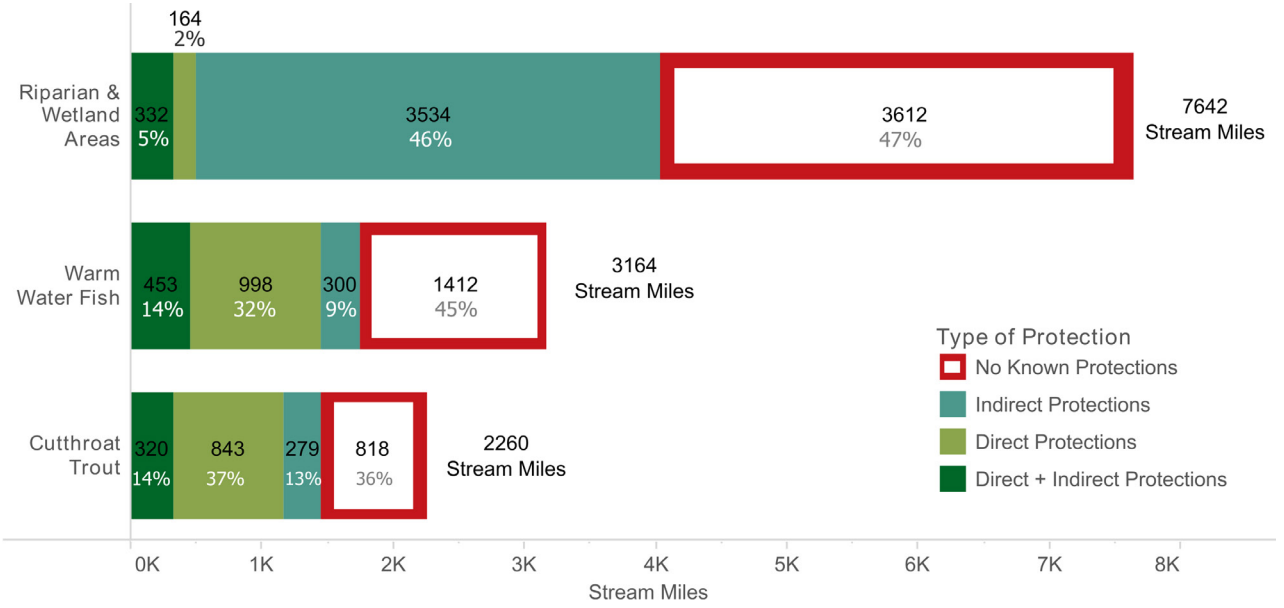
Three of the proposed agricultural projects include estimated acre-feet, totaling nearly 25,000 acre-feet. The projects address both agricultural needs as well as needs related to potential energy production and municipal growth. The planned energy project would meet many full-scale, oil-shale industry needs, and would therefore decrease the potential number of transferred irrigated acres for industrial purposes. On the other hand, some of these projects could cause additional shortages in the basin, although shortages are significantly reduced in the Yampa River between Craig and Maybell—an area with some of the most significant agricultural land in the basin. In addition, the identified projects would help develop some of the additional acreage the BIP included in its plans. While the document stresses the need for land-use policies that support agriculture, it identifies no specific policies. All in all, the BIP mostly meets its defined agricultural gaps, and the basin roundtable plans to continue to refine this work.

Meeting Colorado's Environmental and Recreational Needs

The water gap for environmental and recreational use is the difference between what a basin indicates it *wants to achieve* in accordance with its goals and measurable outcomes, and what projects and methods it *could implement* to meet those needs.[111] While every basin indicated that meeting its environmental and recreational needs is an important aspect of its BIP, this definition allows for considerable variability among basins, which face different issues related to the environment and recreation.

Colorado can meet its environmental and recreational needs through protection or restoration projects and methods. These projects and methods could include such components as flow, habitat, water quality, species connectivity, and non-native species management. In some cases, senior water rights holders help meet environmental and recreational needs upstream. Because of the diversity of the projects and methods that can help the environment and recreation, one often measures the water gap in stream-miles. With support from the CWCB, each basin roundtable developed focus-area maps as part of its 2011 needs assessment. These maps indicate the locations of significant species, recreational areas, and other environmental attributes. The CWCB then conducted a study to identify and determine the locations of existing and planned projects that meet the needs of some of the environmental and recreational focus areas each basin roundtable identified. From this data, stakeholders can identify areas with no known protections, compared to

FIGURE 6.2-2 PERCENT OF PERENNIAL STREAM-MILES STATEWIDE WITH PROTECTION FOR CUTTHROAT-TROUT SPECIES, WARM-WATER FISH, AND IMPORTANT RIPARIAN AND WETLAND FOCUS AREAS



areas with some type of protection (Figure 6.2-2, page 6-41). The Nonconsumptive Toolbox maps and features this information. Figure 6.2-3, page 6-41, shows an example.[112]

While a specific project or method may not sufficiently protect the stream in which it is implemented, and not every stream reach within the focus areas needs protection, these maps provide a good starting-point for assessing the locations of potential environmental and recreational gap areas. The CWCB is currently working to further refine this methodology and to include the additional projects and methods identified in the next update of SWSI.

To address the challenges of meeting Colorado's environmental and recreational needs, the CWCB identified five statewide long-term goals:[113]

- *Promote restoration, recovery, and sustainability of endangered, threatened, and imperiled aquatic and riparian-dependent species and plant communities.*
- *Protect and enhance economic values to local and statewide economies that rely on environmental and recreational water uses, such as fishing, boating, waterfowl hunting, wildlife watching, camping, and hiking.*
- *Support the development of multi- purpose projects and methods that benefit environmental and recreational water needs, as well as water needs for communities or agriculture.*
- *Protect, maintain, and improve conditions of streams, lakes, wetlands, and riparian areas to promote self-sustaining fisheries and functional riparian and wetland habitat, and to promote long-term sustainability.*

FIGURE 6.2-3 NONCONSUMPTIVE TOOLBOX

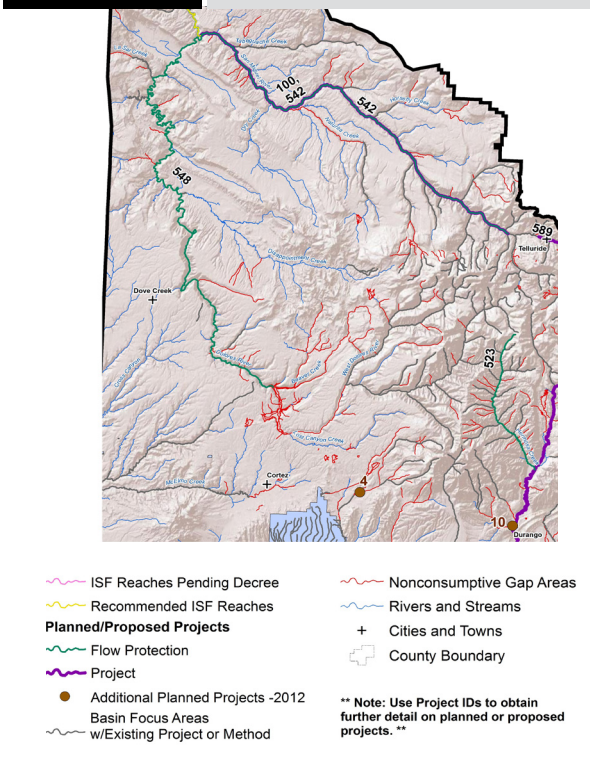


TABLE 6.2-4 SUMMARY OF HOW EACH BASIN MEETS ITS ENVIRONMENTAL AND RECREATIONAL GAPS*

Basin	Focus Area: Perennial Stream-miles	Number of Perennial Stream-Miles with No Known Protections	Quantified Stream-miles with New Projects or Methods	Number of New Projects with Stream-mile Info	Summary of How BIPs Met Their Environmental and Recreational Goals and Gaps
Arkansas	3,124	1,372 (44%)	380	15	Partially, through IPP support of greenback cutthroat trout, southern redbelly dace, Arkansas darter, and other target species
Colorado	1,762	844 (48%)	None identified	0	Partially, through support of projects and methods; did not identify new funding source or regional cooperatives that the basin deemed important
Gunnison	1,106	270 (24%)	None identified	0	Yes, through identification of 4 environmental projects, 30 multipurpose projects; support of federally listed endangered fish; explored some alternative funding sources
North Platte	954	231 (24%)	None identified	0	Mostly, through identification of more than 3 environmental and 2 multipurpose projects to be implemented; likely increases fishing, waterfowl hunting & viewing by 5 percent if implemented
Rio Grande	2,735	397 (15%)	410	11	Partially, through project implementation, but do not perform quantification of how to meet goals and measurable outcomes
South Platte	959	325	1 (plus 1,000 acre-feet)	3	Partially, through support of greenback cutthroat trout, boreal toad, common shiner, plains minnow, and other target aquatic species
Southwest	2433	1,009 (34%)	200	9	Partially, through project implementation, and will provide further quantification of how to meet goals and measurable outcomes
Yampa/ White/ Green	485	155 (32%)	370	16	Mostly, by quantifying and determining many projects that would support the current PBO on the Yampa, new PBO on the White, warm-water fish, riparian areas, and recreational boating; integrates consumptive and environmental and recreational interests
TOTAL	**13,558**	**4,601 (34%)**	**1,360**	**51**	

*NOTE: The percentage of streams with no known protections do not represent gaps for specific species or plant communities; those gaps may be larger

restoring watersheds that could affect critical infrastructure and/or environmental and recreational areas.

Arkansas

In the 2011 needs assessment, the Arkansas Basin Roundtable identified 342 perennial stream-miles containing Arkansas darter, 371 containing greenback cutthroat trout, and 1,811 featuring important riparian and wetland areas. There is protection for very few of the perennial stream-miles containing Arkansas darter. However, two-thirds of greenback cutthroat-trout stream-miles have some level of protection—whether

directly through flow protection or aquatic habitat restoration, or indirectly through land ownership geared toward wildlife protection, or riparian projects. Approximately one-third of riparian and wetland areas the basin roundtable identified have some level of protection, and most of those are indirect protections. In addition, 57 percent of the identified fishing areas and 22 percent of the identified waterfowl hunting and view areas have some level of protection.

Arkansas' Environmental and Recreational Goals

To address its environmental and recreational needs, the Arkansas Roundtable established nine goals:[114]

- *Maintain or improve native fish populations.*
- *Maintain, improve, or restore habitats for fish species.*
- *Maintain or improve recreational fishing opportunities.*
- *Maintain or improve boating opportunities, including kayaking, and other non-motorized and motorized boating.*
- *Maintain or improve areas of avian (including waterfowl) breeding, migration, and wintering.*
- *Maintain or improve riparian habitat and aquatic habitat, and restore riparian and aquatic habitat that would support environmental features and recreational opportunities.*
- *Maintain or improve wetlands, and restore wetlands that would support environmental features and recreational opportunities.*
- *Maintain, improve, or restore watersheds that could affect environmental and recreational resources.*
- *Improve water quality as it relates to the environment and/or recreation.*

Meeting the Arkansas' Environmental and Recreational Gaps

In its BIP, the Arkansas Roundtable lists 15 environmental and recreation projects with quantifiable stream improvements. Projects include, but are not limited to, water quality improvements, invasive species removal, and fish habitat restoration and passage across 380 stream-miles.

The Nonconsumptive Subcommittee has identified the following priority objectives. The subcommittee adapted these from previously mapped, 12-digit hydrologic unit codes, which outlined areas with high concentrations of environmental and recreational attributes in three primary locations: 1) the main-stem Arkansas River upstream of Pueblo; 2) Fountain Creek watershed; and 3) areas around major reservoirs on the Lower Arkansas River between Las Animas and Eads. Priority objectives include:[115]

- *Lake Isabel is an important fishing lake with multiple associated recreational activities that has insufficient water resources to cover evaporative loss. Because of limited water rights, the lake level has been lowered, thereby diminishing fishing and other recreational opportunities and risking deleterious impacts associated with this reduced water level. It is a priority to obtain additional water rights to allow the lake to be raised to its full, functioning level.*
- *Grape Creek is an important fishery that runs through the Grape Creek Wilderness Study Area, which adds to its importance as a nonconsumtive resource that has suffered from inadequate flow. Efforts are ongoing with DeWeese-Dye Ditch & Reservoir Company to re-operate the ditch to provide additional water flow through the stream during crucial periods.*
- *Important wetland resource evaluation needs to be accomplished. Although some information exists on the wetlands in this basin, it is not available basin-wide.*
- *Chilili Ditch, a canal that runs through the center of Trinidad in Las Animas County, is extremely outdated and in serious need of renovation to improve nonconsumptive resources. This priority would involve a project that addresses both consumptive and nonconsumptive*

needs, including an update to the ditch diversion to make it fish friendly through the use of fish ladders or other methods that allow fish to move up and down the stream more easily.

The Nonconsumptive Needs Subcommittee will continue to identify priority areas as it obtains additional data and information from current projects and studies, stakeholders, and the public.

The basin supports using the Gap Analysis Framework to evaluate the level of protection a project provides to environmental and recreation attributes.[116] The basin will first segment projects in the basin's IPPs list into the following categories: Information/Knowledge/ISF/RICD, Implementation, or Stewardship. Then, it will use the framework to analyze the projects and assign levels of protections to individual attributes.[117] Not all attributes require protection, and projects and methods may not be necessary at this time for select areas. The basin will support its analysis with input from stakeholders, subject-matter experts, and basin roundtable members.

Colorado

In the 2011 needs assessment, the Colorado Basin Roundtable identified 676 perennial stream-miles containing Colorado River cutthroat trout, and 435 stream-miles containing imperiled warm-water fish, including endangered fish species. The roundtable also identified an additional 1,098 perennial stream-miles of important riparian and wetland areas. A full two-thirds of the stream-miles containing warm-water fish species have some level of protection—much of it direct. Three-quarters of Colorado River cutthroat trout stream miles also have some level of protection. Similarly, approximately three-quarters of riparian and wetland areas the basin roundtable identified have some level of protection; however, most of these protections are indirect. In addition, more than 90 percent of the identified fishing areas have direct protection.

Colorado Basin's Environmental and Recreational Goals

To address its environmental and recreational needs, the Colorado BIP developed the theme, *"To protect and restore healthy streams, rivers, lakes, and riparian areas,"* and identified five goals. These goals and their associated measurable outcomes include:[118]

- *Protect and rehabilitate healthy rivers, streams, lakes, and riparian areas.*
  - *A map depicting high priority reaches that have insufficient or poorly timed flows (e.g., 15-Mile Reach, 303(d)) impaired streams, instream flows, monitoring and evaluation reaches, ecologically impacted, recreationally significant, reaches with existing dams.*
  - *Map or list of reaches where habitat has deteriorated as a result of non-flow related changes and could be restored.*
  - *Improve habitat conditions in all identified prioritized reaches to mitigate for harm caused by existing or additional water development.*
  - *Reduce the number of river miles where non-native invasive fish and invasive riparian species have degraded aquatic and riparian communities.*
- *Define water quality needs and at-risk water bodies (further described in Section 7.3).*
- *Preserve high quality recreational river and stream reaches with appropriate flows.*
  - *Maintain number of boater days on 28 reaches identified as recreation priorities by American Whitewater in cooperation with the Watershed Flow Evaluation Tool (WFET) work.*
  - *Protect access and flow levels for 28 popular recreational reaches.*
  - *Develop more recreational in-channel diversions (RICDs) structures and water rights on community and basin supported reaches to protect recreational flows.*
- *Develop a basin-wide funding system to meet basin environmental and recreational needs.*
  - *Establish a new funding agency or identify an existing agency for the basin or in every county in the basin to fund environmental and recreational management.*
  - *Leverage existing financial resources to*

further protect or restore all streams, rivers, and lakes that host prioritized recreational or natural attributes (determine source and scope of funding).

- *Fund the acquisition of conservation easements that retain agricultural purposes and current uses of water.*

- *Expand regional cooperation efforts to improve efficiencies, provide water supply flexibility, and enhance environmental and recreational amenities.*

  - *Establish regional water provider, ditch company and environmental and recreational advocate cooperatives focused on improving regional relationships, water supply redundancy and flexibility, water quality, coordinated efforts for multi-beneficial projects and addressing environmental and recreational needs.*

  - *Increase permanent interconnects between water providers where feasible.*

Meeting the Colorado Basin's Environmental and Recreational Gaps

The roundtable identified four top-priority projects that are explicitly environmental and recreational projects. The BIP listed 31 total projects, plus an additional 13 that address recreational needs, and 13 others that address water quality. Many of these are associated with the CRCA and the Windy Gap Firming Intergovernmental Agreement. Of these, approximately two-thirds are new projects and methods.

The roundtable recognizes that a basin-wide stream-management plan is a top priority, and the basin needs to better determine how to advance projects in ways that strategically meet the identified needs. The BIP states, "The most important project identified by the environmental and recreational PLT and the Colorado Basin Roundtable members is to continue assessing the systemic riverine environmental needs of the basin on-the-ground through the creation of a basin-wide stream management plan (SMP). The purpose of a SMP is to provide the framework for maintaining healthy stream systems while also protecting local water uses and planning for future consumptive and nonconsumptive water needs. SMPs identify environmental and recreational flow needs and assist in identifying areas where historical alterations of streamflows most likely affected the ecological resource conditions."[119]

The BIP further contends, "All basins statewide should make protecting and improving the health of our rivers and streams a top priority."[120]

At this point in time, it is not clear whether the dozens of identified projects would adequately address the environmental and recreational goals and measurable objectives, but these projects would at least partially meet the BIP's objectives. A streamflow management plan, if the basin implements it, would likely meet all of the objectives. One of the outstanding issues the BIP identified is the development of a new funding source within the basin.

Gunnison

In the 2011 needs assessment, the Gunnison Basin Roundtable identified 142 perennial stream-miles containing warm-water fish species, including federally listed species. Of these, more than 80 percent have some level of protection, and most of these stream-miles have one or more forms of direct protection. All of the identified 173 perennial stream-miles containing Colorado River cutthroat trout have some level of protection, with direct protection for approximately two-thirds of these miles. Nearly 90 percent of the

800 miles of identified perennial stream-miles with important riparian and wetland areas have some level of protection as well. However, nearly all of these protection methods are indirect.

Gunnison Basin's Environmental and Recreational Goals

To address its environmental and recreational needs, the Gunnison Roundtable identified two goals. As described in the BIP, these goals and their associated measurable outcomes are:[121]

- *Quantify and protect environmental and recreational water uses.*
  - *Meet identified environmental and recreational needs basin-wide by developing 10 projects from the list of recommended solutions in the Gunnison BIP by the year 2030.*
  - *Implement the Environmental and Recreational Project Identification and Inventory projects from the list of recommended solutions in the Gunnison BIP by 2020.*
  - *Improve the current baseline of native trout and endangered fish populations in the Gunnison Basin through the year 2050.*
- *Describe and encourage the beneficial relationship among agricultural, environmental, and recreational water uses.*
  - *Complete at least five new multi-purpose water projects, including two storage projects, in the Gunnison Basin by 2025 that demonstrate the beneficial relationship among agricultural, environmental, and recreational uses.*
  - *Explore and develop recommendations on alternative sources of funding from recreational users within the basin to support development of those multi-purpose water projects.*

Meeting the Gunnison Basin's Environmental and Recreational Gaps

The Gunnison Basin Roundtable reexamined its environmental and recreational needs, and added 27 focus segments. The roundtable added to the 21 segments identified in the Phase 2 NCNA process.[122] Many of these segments offer the opportunity for development of multipurpose projects that are beneficial to both nonconsumptive and agricultural and municipal interests. The roundtable designed four planned inventory projects in different sub-basins to assess the feasibility of specific potential projects in meeting the focus segments' needs. Within those segments, the BIP explored how well existing programs support the Colorado River Recovery Program for endangered fish species, cutthroat trout, and the three imperiled warm-water fish species: bluehead sucker, flannelmouth sucker, and roundtail chub.

The roundtable indicated that it supports the ongoing recovery program and the reoperation of the Aspinall Unit to meet environmental flow requirements in support of these species. In 2012, the Record of Decision for the Aspinall Unit Operations Final Environmental Impact Statement was implemented. Peak flow targets were first required in 2014, when hydrologic conditions were considered 'moderately wet.' The BOR will continue to monitor the reoperation and adapt to the needs of the endangered-fish species. The roundtable highlighted that non-native fish species are the most significant cause for concern in the Gunnison Basin, and recommended "that Colorado explore a must-kill policy for non-native fish control."

The roundtable indicated that ongoing work associated with the Colorado River Cutthroat Trout Conservation Strategy that Colorado, Utah, and Wyoming adopted was likely sufficient to meet cutthroat-trout habitat needs.

An interstate Three Species Agreement is in place to protect the three warm-water fish species: bluehead sucker, flannelmouth sucker, and roundtail chub, and CPW is in the process of developing a state strategy to manage the protection of these species. In support of this work, the BIP states, "It is imperative that fishery managers' work with water managers to continue to implement the actions articulated in the Three Species Agreement. In the Gunnison, flow protection provided by downstream senior water rights (e.g., the Redlands Water and Power Company water rights) becomes an important means of maintaining the native fishery."[123]

The roundtable identified several efforts in addition to these ongoing ones. Tier 1 features 49 projects and methods that are slated for completion by 2020. Of those, 30 feature nonconsumptive components that meet one or more of the BIP's identified environmental and recreational goals. The roundtable also identified 34 important and ongoing environmental and recreational protection and monitoring projects that meet one or more of the goals. Included in the tier 1 projects are many studies that would further develop additional nonconsumptive projects to meet each region's needs. The roundtable identified several types of projects the basin could implement while preserving existing agricultural uses. These include:[124]

- *Diversion infrastructure improvements that increase accuracy and reduce maintenance costs while preserving stream connectivity.*
- *Temporary and voluntary instream flow leasing arrangements that sustain flows during critical drought periods.*
- *Voluntary partial instream flow donations that maintain historical irrigation practices on a more limited basis.*
- *Multi-purpose storage projects that include operational flow agreements and/or dedicated environmental and recreational flow components.*

In summary, if the basin fully implements the BIP, it will fully satisfy its goals and measurable outcomes, and will meet its environmental and recreational gaps.

North Platte

In the 2011 needs assessment, the North Platte Basin Roundtable identified 222 perennial stream-miles, and named important fishing areas as the roundtable's top priority. Approximately one-third of these miles have some direct protection, and the remaining stream-miles have no known protections. Ninety-three miles of perennial streams feature waterfowl hunting and viewing, and 45 percent of these have some form of direct protection. More than one-quarter of the 220 miles of identified perennial stream-miles with important riparian and wetland areas have some level of protection as well.

North Platte Basin's Environmental and Recreational Goals

To address its environmental and recreational needs, the North Platte Roundtable identified two goals. As stated in the BIP, these goals and their associated measurable outcomes are below:[125]

- *Maintain healthy rivers and wetlands through the strategic implementation of projects that meet prioritized nonconsumptive needs.*
  - *Increase fishing user days by five percent by 2020.*
  - *Increase waterfowl hunting and viewing days by five percent by 2020.*
  - *Develop three projects from the list of recommended solutions by 2020.*
- *Describe and quantify the nonconsumptive benefits of agricultural use.*
  - *Complete at least two new multi-purpose water projects in the North Platte Basin by 2025 that meet multiple needs as identified in this report and other studies.*

Meeting the North Platte Basin's Environmental and Recreational Gaps

To better determine where the basin roundtable should focus its efforts, the roundtable developed a weighted attribute map. The map takes into account both the number of attributes and the priority rank the basin

roundtable gave during the needs assessment process. The BIP states, "This map will be used to help target projects to address identified environmental and recreational attributes in the basin, including both multipurpose projects and specific environmental and recreational projects."[126]

The roundtable identified 55 planned environmental and recreational projects, 33 of which are multipurpose. Of the potential projects on the list, the roundtable developed project summaries and methods for 14. Of these, five help maintain healthy rivers and wetlands, and four also demonstrate the connection among agricultural, environmental, and recreational values. The BIP describes these projects as follows:

- *Reservoir improvements to preserve a major water supply for the maintenance of habitat at the Arapahoe National Wildlife Refuge,*
- *The improvement of a major diversion structure to address fish connectivity while addressing other water user needs,*
- *Improvement of fisheries habitat at State Wildlife Areas (public access fishing), and*
- *Two inventory projects that could help identify other multipurpose project opportunities.*[127]

All in all, if the roundtable implements these projects, it will address the measurable outcomes calling for five projects that meet nonconsumptive needs. It is not clear whether these projects will reach the fishing and waterfowl hunting targets the BIP identified. However, the BIP mostly meets its identified environmental and recreational gaps.

Rio Grande

In the 2011 needs assessment, the Rio Grande Basin Roundtable identified 564 perennial stream-miles with Rio Grande chub, an imperiled fish species. Fifty-four percent of the stream-miles have some level of protection, most of which is direct. Another warm-water imperiled fish species is the Rio Grande sucker, which is listed as state-endangered. More than 60 percent of the 346 perennial stream-miles that support this species have some level of protection, though more than half of the protection is indirect. Nearly 40 percent of the identified 748 perennial stream-miles with Rio Grande cutthroat trout have some level of protection, although most of this protection is indirect. As of October 2014, the U.S. Fish and Wildlife Service (USFWS) determined that the Rio Grande cutthroat trout does not warrant an "endangered" listing, and that ongoing, extensive recovery efforts will continue for this species. Similarly, just over 40 percent of the 2,138 miles of identified perennial stream-miles with important riparian and wetland areas have some level of protection, most of it being direct.

Nevertheless, in the course of the BIP planning process, the Rio Grande's Environmental and Recreational Subcommittee chose to expand beyond the attributes previously identified in 2011 and undertake a more comprehensive approach. That approach uses updated geographic information systems (GIS) layers to determine where key environmental and recreation components exist in order to better determine their extent and conditions, identify where measures are in place to protect or restore those components, and identify where the basin needs to support action. Using these methods, the subcommittee has worked to identify the priority environmental and recreational attributes that need additional protection, restoration, and management.

For longer-term projects and methods, the Environmental and Recreational Subcommittee will continue to inventory, update, and quantify environmental attributes in relation to water needs. Through this process, the group will define and update maps of environmental and recreational focus areas in the Rio Grande Basin, and develop strategies to address needs and sustain their attributes.

The BIP also indicates that the San Luis Valley features approximately 200,000 acres of internationally important wetlands that provide critical habitat for endangered bird species as well as large numbers of migrating birds and waterfowl.

Rio Grande Basin's Environmental and Recreational Goals

To address its environmental and recreational needs, the Rio Grande Basin Roundtable identified four goals. As described in the BIP, these goals and their associated measurable outcomes are below:[128]

- *Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the basin.*
  - *Species that are listed by either the federal or state government as threatened, endangered, or candidate species are recovered or de-listed.*
  - *Additional species are prevented from being*

listed by the federal or state government.

- *Economic impact studies for environmental and recreational benefits are considered in the decision-making process for new water supply projects.*
- *Wildlife habitat needs are considered in the decision-making process.*
- *Natural resource agencies in the San Luis Valley (Rio Grande) coordinate and cooperate with each other to comply with the ground water rules and regulations and augmentation plans to benefit wildlife and recreation to the largest extent possible.*
- *Water needs for wildlife habitat are addressed in plans, databases and San Luis Valley-wide surveys of appropriate wildlife populations.*

- *Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.*
  - *Identify the needs for properly functioning wetlands and riparian areas.*
  - *Restore the ecological function of wetlands and riparian areas.*
  - *Develop and implement projects to restore, conserve, and sustain functioning wetlands, riparian areas, and associated habitats with a focus on incorporating species connectivity.*
- *Work to establish active river flows throughout the year in cooperation with water users and administrators to restore and sustain ecological function of the rivers and floodplain habitats within the context of existing water rights and compact obligations.*
  - *Negotiate active plans and cooperative agreements that enhance stream flows through re-operations while ensuring full compliance with Colorado water law.*
- *Maintain and enhance water dependent recreational activities.*
  - *Floatable flow levels are identified by reach.*
  - *Cooperative water management provides flows to extend recreational opportunities.*
  - *Recreational facilities are improved and/or enhanced.*
  - *Quality and quantity of fishing opportunities are improved.*
  - *Fish and boat passages are installed where appropriate.*
  - *Conservation pools are rehabilitated, secured and/or conserved as possible.*
  - *Quality and quantity of hunting (e.g., water fowl, small game, and big game) opportunities are improved.*
  - *Fish hatcheries have sustainable, secure, and adequate physical and legal water supplies.*
  - *Recognize economic benefits of recreation in decision-making processes.*

Meeting the Rio Grande Basin's Environmental and Recreational Gaps

Of the 18 projects the Rio Grande Basin Roundtable analyzed in its BIP, 12 help meet the goals above. The roundtable will analyze an additional 15 projects that address environmental and recreational information gaps, further clarifying those gaps. These projects add a total of almost 410 new stream-miles and 60,650 acre-feet. At this point in time, the BIP partially meets its environmental and recreational water gaps.

South Platte (Including Metro and Republican)

In the 2011 needs assessment, the South Platte and Metro Basin Roundtables identified 628 perennial stream-miles with warm-water imperiled plains fish species. Approximately two-thirds of these stream-miles have some level of protection. Approximately 90 percent of the 79 perennial stream-miles identified with greenback cutthroat trout have some level of protection, although more than half of this protection is indirect. Approximately half of the 628 miles of identified perennial stream-miles with important riparian and wetland areas have some level of protection, most of it direct. In addition, approximately half of the important fishing areas, and one-third of the waterfowl hunting and viewing stream-miles, have some level of protection.

South Platte Basin's Environmental and Recreational Goals

To address its environmental and recreational needs,

the South Platte Basin Roundtable developed a goal. As described in the BIP, this goal and its associated measurable outcomes are listed below:[129]

- *Fully recognize the importance of, and support the development of, environmental and recreational projects and multipurpose projects that support water availability for ecologically and economically important habitats and focus areas.*
  - *Promote restoration, recovery, and sustainabiability of endangered, threatened, and imperiled aquatic, riparian and wetland dependent species and plant communities:*
    - *Maintain or increase the habitat for federally and state-listed threatened and endangered species or plant communities.*
    - *Maintain or increase habitats in the environmental and recreational focus areas with imperiled species or plant communities and secure the species in these reaches as much as they can be secured within the existing legal and water management context.*
    - *Maintain or increase the wetland, lake, or stream habitat used by migratory and breeding birds.*
    - *Develop tools and methodologies to adequately assess what is needed to maintain or increase aquatic, riparian, and wetland habitats throughout the basin.*
  - *Protect and enhance economic values to local and statewide economies derived from environmental and recreational water uses, such as fishing, boating, waterfowl hunting, wildlife watching, camping, and hiking.*
    - *Maintain or increase the surface area, stream miles, or public access for recreational opportunities.*
    - *Maintain or increase the miles and general appearance of trails and greenways to promote aesthetic values and enhance quality of life.*
    - *Maintain or increase public access to fishing opportunities in lakes and streams.*
    - *Maintain or increase the total area for birding, waterfowl hunting, and wildlife viewing.*
    - *Maintain or improve the amount of river miles or flatwater surface acres available to river and flatwater boaters.*
    - *Develop tools and methodologies to adequately assess what is needed to maintain or improve recreational opportunities derived from ecosystems throughout the basin.*
  - *Protect, Maintain, and Improve Conditions of Streams, Lakes, Wetlands, and Riparian Areas to Promote Self-Sustaining Fisheries and Functional Riparian and Wetland Habitat to Promote Long-Term Sustainability.*
    - *Maintain or increase the number of stream miles or surface area of streams, lakes, wetlands, and riparian areas for self-sustaining aquatic species populations, and wetland/riparian habitat.*
    - *Maintain or improve fish habitat by providing habitat enhancements, eliminating dry up points, and promoting connectivity.*
    - *Maintain or improve watershed health through source water protection, wildfire mitigation, sedimentation control, and erosion control.*
    - *Encourage existing and develop new innovative tools to protect instream flows where appropriate.*
    - *Develop tools and methodologies to adequately assess what is needed to protect, maintain or improve conditions of aquatic, riparian, and wetland habitat throughout the basin.*

Meeting the South Platte Basin's Environmental and Recreational Gaps

Through the BIP process, the roundtable identified seven additional focus-area reaches that it added to the basin needs assessment maps. This work expands the number of areas in which a focus on addressing environmental and recreational needs is important. The roundtable also assessed dry up points within the South Platte Basin, identifying 15 areas that experience no flows during some years at some points in time.

These dry-up points affect species connectivity and habitat.

To determine the types of projects the basin will need to implement in order to address these environmental and recreational concerns, the roundtable assessed the types of projects the following regions need:

1. Headwater areas (upper mountain area)
2. Metro corridor
3. Boulder/Fort Collins (northern area)
4. Plains (lower South Platte)

For each of these regions, the roundtable developed a suite of project types—including instream flows, stewardship projects, species reintroduction, fish passages, modification or improvements to dry-up points or diversion structures that inhibit fish passage, stewardship programs, and instream flow programs with water rights components that dedicate historic, consumptive use to a downstream user while improving streamflows within a reach of concern. In addition, the BIP assessed the number of miles with existing or planned protections. The BIP only included measurable objectives for three of these projects. Collectively, 1,000 new acre-feet and one stream-mile were identified, although more stream-miles are likely associated with these projects.

To move forward with addressing the South Platte Basin's environmental and recreational needs, the roundtable indicates in their BIP that:[130]

- *The South Platte vision includes working to meet the M&I gap, while minimizing the impacts to agricultural uses, and while also providing protections and enhancements to environmental and recreational attributes in candidate focus areas.*
- *The South Platte Basin will continue working to identify cooperative and attribute specific projects that protect or enhance environmental and recreational attributes.*
- *The South Platte Basin will encourage funding and cooperation to leverage new projects, improvements to, or replacements of structures which help provide protections.*
- *The South Platte Basin will continue working to quantify the environmental and recreational 'gap' and to assess projects that protect or enhance environmental and recreational attributes.*
- *Storage within the basin is vital to meeting the needs of the basin, and including storage for environmental and recreational needs is imperative.*

The current BIP partially meets the environmental and recreational gaps the goals and measurable outcomes process identified.

Southwest

In the 2011 needs assessment, the Southwest Basin Roundtable identified 834 perennial stream-miles with imperiled warm-water fish species, including the flannelmouth sucker, bluehead sucker, and roundtail chub. The CWCB's work in 2011 indicated that nearly two thirds of these stream-miles have or plan to have some level of protection, although most of these protections are indirect. Approximately 70 percent of the identified 178 perennial stream-miles with Colorado River cutthroat trout have some level of protection, and most of this protection is also indirect. Just under 60 percent of the 762 miles of identified perennial stream-miles with important riparian and wetland areas have some level of protection, all of which is direct. The needs assessment report also identified various forms of recreation, such as fishing, waterfowl hunting, and viewing. Very few stream-miles have identified protections for these values.

Southwest Basin's Environmental and Recreational Goals

To address its environmental and recreational needs, the Southwest Roundtable identified three goals. As described in the BIP, these goals and their associated measurable outcomes are below:[131]

- *Maintain, protect, and enhance recreational values and the value to local and statewide economies derived from recreational water uses such as fishing, boating, hunting, wildlife watching, camping, and hiking.*
  - *Implement 10 IPPs to benefit recreational values and the economic value they provide.*
  - *At least 80 percent of the areas with recreational opportunities have existing or planned IPPs that secure these opportunities and supporting flows/lake levels within the contemporary legal and water management context. Based on*

the map of recreational attributes generated for SWSI 2010, 80 percent of each specific value equates to approximately 428 miles of whitewater boating, 185 miles of flat- water boating, 4 miles of Gold medal Trout Streams, 545 miles of other fishing streams and lakes, 3 miles of Audubon Important Bird Area, 143 miles of waterfowl hunting/viewing parcels, and 6 miles of Ducks Unlimited projects.

- *Address recreational data needs.*

- *Encourage and support restoration, recovery, and sustainability of endangered, threatened, and imperiled aquatic and riparian-dependent species and plant communities.*
  - *Implement 15 IPPs to directly restore, recover, or sustain endangered, threatened, and sensitive aquatic and riparian-dependent species and plant communities.*
  - *At least 95 percent of the areas with federally-listed water dependent species have existing or planned IPPs that secure the species in these reaches to the extent possible within the existing legal and water management context.*
  - *At least 90 percent of areas with identified sensitive species (other than Endangered Species Act species) have existing or planned IPPs that provide direct protection to these values. Based on the map of environmental attributes generated for SWSI 2010, this 90 percent of areas with identified sensitive species equates to individual species as approximately 169 miles for Colorado River cutthroat trout, 483 miles for roundtail chub, 794 miles for bluehead sucker, 700 miles for flannelmouth sucker, 724 miles for river otter, 122 miles for northern leopard frog, 921 miles for active bald eagle nesting areas, and 229 miles for rare plants.*

- *Protect, maintain, monitor, and improve the condition and natural function of streams, lakes, wetlands, and riparian areas to promote self-sustaining fisheries, and to support native species and functional habitat in the long-term, and adapt to changing conditions.*
  - *Implement 26 IPPs to benefit the condition of fisheries and riparian/wetland habitat.*
  - *At least 80 percent of areas with environ mental values have existing or planned IPPs that provide direct protection to these values.*

Meeting the Southwest Basin's Environmental and Recreational Gaps

The Southwest Basin identified nine environmental and recreational projects and methods that included stream-mile information for more than 200 miles of stream. However, the Southwest Basin indicated that it can provide additional stream-mile information. If the basin implements them, these projects are sufficient to meet the number of IPPs the roundtable has identified in the above categories. The roundtable has not conducted an analysis of the extent to which these projects meet the stream-mile goals.[132] In addition, to better identify environmental and recreational needs, the roundtable identified two efforts that would extend across the sub-basin:

1. *Evaluation of environmental and/or recreational gaps is planned to be conducted for improvement of non-consumptive resources and/or in collaborative with development of consumptive IPPs. The evaluations may be conducted by a subgroup of the roundtable or by individuals, groups, or organizations with input from the roundtable. The evaluation may use methodologies such as the Southwest attributes map, Flow Evaluation Tool, R2Cross, and any other tools that may be available.*

2. *Where environmental and/or recreational gaps are identified, a collaborative effort will be initiated to develop innovative tools to protect water identified as necessary to address these gaps.*

Until additional stream-mile information associated with the identified projects and methods is available, it will remain unclear how well the BIP has met its measurable outcomes.

Yampa/White/Green

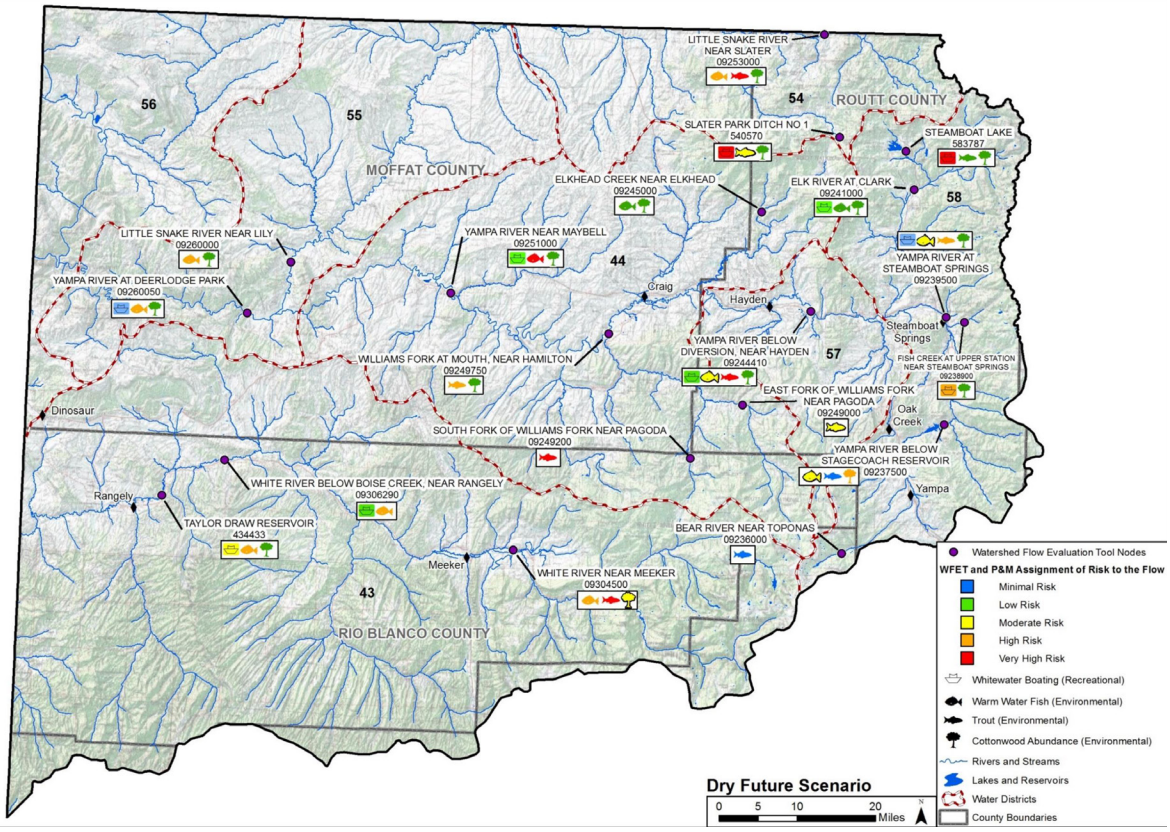
In the 2011 needs assessment, the Yampa/White/Green Basin Roundtable identified 218 perennial stream-miles with state-imperiled warm-water fish species, and 142 miles with federally listed warm-water fish species. Approximately 55 percent of these stream-miles have some level of protection, most of it being direct. Nearly two-thirds of the identified 35 perennial stream-miles containing Colorado River cutthroat trout have some level of protection, although most of this protection is indirect. More than three-quarters of the 275 miles of identified perennial stream-miles with important riparian and wetland areas have some level of protection as well, and nearly all of it is direct. The needs-assessment report also identified various forms of recreation. Very few stream-miles have identified protections for these values.

Yampa/White/Green Basin's Environmental and Recreational Goals

To address its environmental and recreational needs, the Yampa/White/Green Basin Roundtable identified two goals. As described in the BIP, these goals and their associated measurable outcomes and processes are below:[133]

- *Quantify and protect non-consumptive water uses.*
  - *To the extent that non-consumptive needs can be specified and projects can be analyzed, there will be projects for non-consumptive attributes within the existing legal and water management context.*
  - *Multi-purpose projects and methods will be researched and designed to meet the other goals enumerated here.*
  - *The Programmatic Biological Opinion (PBO) and its depletion coverage for the Yampa River Basin for existing and future expected and unexpected depletions will meet base flow targets in critical habitat areas and assist with endangered fish recovery.*
  - *A new PBO is planned for the White River Basin that provides certainty for existing and future anticipated and unanticipated depletions and that assists with endangered fish recovery.*
  - *The flow protection and any water leasing or re-operation of projects needed for native warm water fish, for cottonwoods, and for recreational boating on reaches with greater and overlapping flow alteration risks are integrated with the flow protection for endangered fish recovery and with projects to meet in- basin, consumptive needs. The flow needs of these non-consumptive attributes are otherwise met, including the avoidance of or offsetting the loss of minimum or optimal boating days that are related to multi-purpose projects and unrelated to drier or wetter hydrology.*
  - *The flow needs for all other non-consumptive attributes are quantified, integrated with projects to meet in-basin consumptive needs, and otherwise met through nonconsumptive IPPs. Multi-purpose projects will be researched and designed to improve riparian or aquatic ecology and bank stability without changing the existing flow regime while voluntarily modernizing irrigation diversion systems and reducing bedload. Similar projects will be researched and designed to improve recreational boating for existing flows while voluntarily modernizing irrigation systems.*
  - *The economic values of the relatively natural flow regimes of the Yampa and White River systems are recognized and protected, along with the economic values of consumptive water use.*
  - *Acres of restored riparian areas, degraded streams, and wetlands to restore natural water storage capacity, and improve water quantity and quality for non-consumptive needs.*
  - *Assess and quantify impact of IPP's on peak flows and ascertain whether further non-consumptive IPP's need to be identified.*
- *Develop an integrated system of water use,*

FIGURE 6.2-4 YAMPA/WHITE/GREEN BASIN IMPLEMENTATION PLAN - ASSOCIATED RISK IN DRY-FUTURE SCENARIO WITH IDENTIFIED PROJECTS AND PROCESSES IMPLEMENTATION



storage, administration, and delivery to reduce water shortages and meet environmental and recreational water needs.

- *Success in permitting and constructing in-basin storage projects.*
- *Reduction in consumptive shortages in drought scenarios.*
- *Reduction in identified non-consumptive shortages in drought scenarios.*
- *Administration and infrastructure improvements making decreed amounts of water available to diversion structures with reduced need for seasonal gravel dams in the river.*
- *Reduce the potential incidence of severe low flows in order for water users to exercise their water rights.*

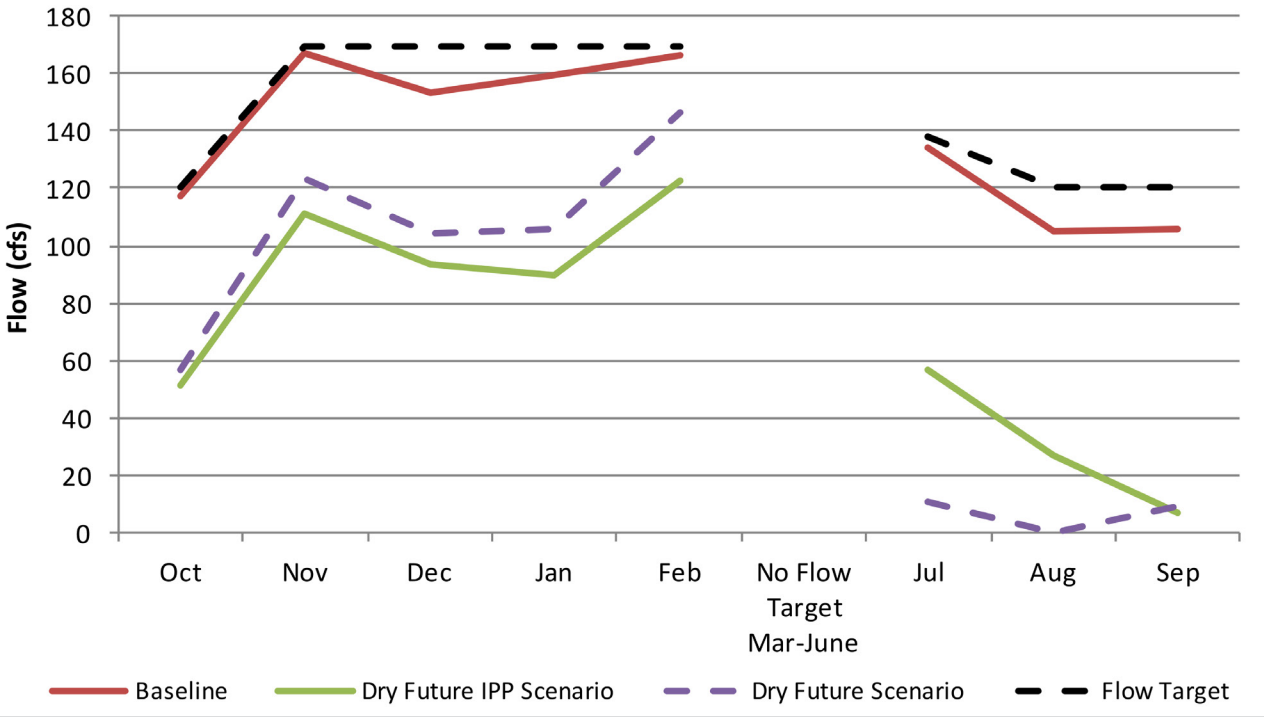
Meeting the Yampa/White/Green Basin's Environmental and Recreational Gaps

The previous Watershed Flow Evaluation Tool work examined whether cottonwood, warm-water fish, or cold-water fish were vulnerable to flow conditions within the basin roundtable's environmental and recreational focus areas. Additional analysis within the BIP assessed how often the basin was meeting instream flows and recreational in-channel diversions. These three efforts provide significant insight into how well the basin is currently addressing environmental and recreational needs. Furthermore, the roundtable overlaid potential future conditions within the basin to determine how future climate change and developing projects and processes would affect:

1. *The vulnerability of the species within the environmental and recreational focus areas,*
2. *The instream flow shortages, and*
3. *The recreational in channel diversion shortages*

For example, the BIP states that, "The modeling indicates that the implementation of the IPPs [in a

FIGURE 6.2-5 DEMONSTRATION OF HOW A DRY FUTURE COULD AFFECT THE YAMPA PROGRAMMATIC BIOLOGICAL OPINION, AND A DRY FUTURE WITH IMPLEMENTATION OF IDENTIFIED PROJECTS AND METHODS



dry future] would increase instream flow shortages by 27 percent on Trout Creek. The development of IPPs could reduce instream flow shortages on the following reaches: Oak Creek (by 1.4 percent, node 582290), Slater Creek (by 3.5 percent, node 542076), and Willow Spring and Pond (by 1.8 percent, node 582162)."[134] IPPs appear to have little effect on the environment for most locations (Figure 6.2-4), but could modestly influence endangered fish recovery flows in the Yampa River during the fall and winter (Figure 6.2-5).

The purpose of this analysis is to provide a course examination of potential environmental and recreational "shortages." This is the most thorough technical analysis any of the roundtables provided. In addition, the roundtable identified 16 environmental and recreational projects that include a measurable outcome, one of which is an agricultural project with some identified environmental and recreational benefits. The projects identify a total of 370 new stream-miles. As the BIP states, "The basin roundtable will continue to explore additional multipurpose opportunities where they may exist through future planning efforts."[135]

In summary, the BIP demonstrates progress towards meeting its future environmental and recreational needs and, if the basin supports the implementation of the projects, it will mostly meet the measurable outcomes listed above.

Other BIP-Identified Gaps

Other needs the basin roundtables identified in their BIPs include those associated with education, watershed health, and water quality. Section 9.5, 7.1, and 7.3 further explore these needs.

How Other States Have Worked to Meet Their Gaps

The challenges associated with meeting future water supply needs are not unique to Colorado's boundaries.

Other states across the West are facing the challenge of increased population and potentially limited water supplies. Other neighboring states have also undertaken water-planning efforts to increase certainty at both the intrastate and interstate levels.

State and federal water projects account for a substantial portion of the ongoing efforts around the West. For example, California's State Water Project, the Central Arizona Project, and the Lake Powell Pipeline all represent massive financial and political undertakings, with the goal of meeting future water supply needs. And efforts around water banking are underway in California. A key issue in the West is also the settlement of water rights concerns among tribes located throughout several states. Existing settlements in New Mexico and Arizona have provided a greater certainty to tribes and to water management agencies within those states. The State of Texas has invested large sums of capital into project implementation; Kansas has invested in corps-sponsored projects for storage; and the State of Utah has collaborated with the federal government on the Central Utah Project.

Appendix B contains more information on neighboring states' efforts to close water supply gaps.

ACTIONS

TABLE 6.2-5 STRATEGIES FOR IMPLEMENTATION OF THE BASIN IMPLEMENTATION PLANS

CATEGORY	CONSTRAINT	NEXT STEPS AND POTENTIAL ACTIONS
Project Evaluation	Conflict	• Partnerships • Cooperative Strategies
	Perception	• Public Education and Outreach • Incentive-Based Programs
	Regulations	• Cooperative Strategies • Effective and Efficient Permitting
Project Feasibility	Cost	• Creative Funding Mechanisms • Partnerships and Cooperative Strategies
	Water Availability	• Water Availability Analyses • Water Administrative Strategies
	Constructa-bility	• Feasibility Analyses • Engineering Design

The projects and methods in the BIPs met many of the identified gaps; however, gaps remain, even with the significant efforts described. Several next steps will help the basin round tables meet their needs. In its BIP, the Gunnison Roundtable summarized many of these next steps and potential actions; Table 6.2-5 illustrates this work.

A primary purpose of Colorado's Water Plan is to address Colorado's water gaps. To accomplish this, several of the next steps and potential actions include the following, as summarized in Table 6.2-5:

Partnerships and cooperative strategies are vital to overcoming conflict and building local con sensus so that a project can move forward. Section 9.4 further discusses this approach in the context of more effective and efficient permitting.

- Public education and outreach can also help inform people about Colorado's water needs and solutions. Section 9.5 explores avenues to better support water education throughout Colorado.
- Many sections of Colorado's Water Plan mention incentive-based programs. For instance, Section 6.3 explores opportunities to encourage conservation, reuse, and water-wise land-use practices. Section 6.4 explores opportunities to encourage ATMs.
- Funding is also a common theme throughout many of the BIPs. Section 9.2 further explores funding options.
- Many of the BIPs express concerns around permitting and other regulatory topics. Section 9.4 explores ways to make these processes more effective and efficient.

Colorado's Water Plan's success will ultimately be

measured by whether the municipal water supply and demand gap is closed. With increased efforts on conservation, storage, land use, alternative transfer methods, and reuse, Colorado can close its gap, balance Colorado's water values, and also address the water resource impacts of a changing climate. Colorado's Water Plan sets a measurable objective to identify proponents for new projects, processes, and initiatives by 2030 that would reduce the projected 2050 municipal and industrial gap from as much as 560,000 acre-feet to 0 acre-feet.

In SWSI 2010, the gap was calculated based on future water needs and the identification of projects and methods that water providers indicated they were planning to implement in order to serve future customers. The basin roundtables partially reduce this gap by identifying additional projects and methods within the BIPs, as Section 6.5 describes. However many of these additional projects and methods either do not have project proponents identified, or are insufficiently developed. Further development of these projects and methods, reductions in water use from conservation and changes in land-use practices, and refinement of additional options such as ATMs and regional reuse will address the remaining gap.

Colorado must identify and address its water gaps. The CWCB will take the following steps to accomplish this starting in 2016:

1. The CWCB will support the evaluation, feasibility, and completion of the BIPs through WSRA grants.

2. The CWCB will support increased consistency and technical support in the BIPs in the following ways:

   - Provide technical support for several of the BIPs through continued decision-support development and maintenance in order to explore municipal, agricultural, industrial, and environmental shortage analyses similar to those in the Yampa/White/Green BIP.
   - Provide technical support for several of the BIPs to explore the use of project information sheets and project tiering, similar to those delineated in the Rio Grande, North Platte, and Gunnison BIPs.
   - Support the further quantification of costs associated with projects and methods, development of new acre-feet, development of new irrigated acres, and protection of new stream-miles.

3. The CWCB will incorporate the BIP information into the next version of SWSI, and will reassess the municipal, industrial, environmental, recreational, and agricultural gaps at that time.

4. The CWCB will establish guidelines for basin-roundtable WSRA grants, enabling the basin roundtables to facilitate implementation of their BIPs in their basins. The purpose of the grants would be to foster the ability to meet municipal, industrial, agricultural, environmental, and recreational needs in a manner that is consistent with the BIPs.

Eastern Phoebe in
Chatfield State Park.