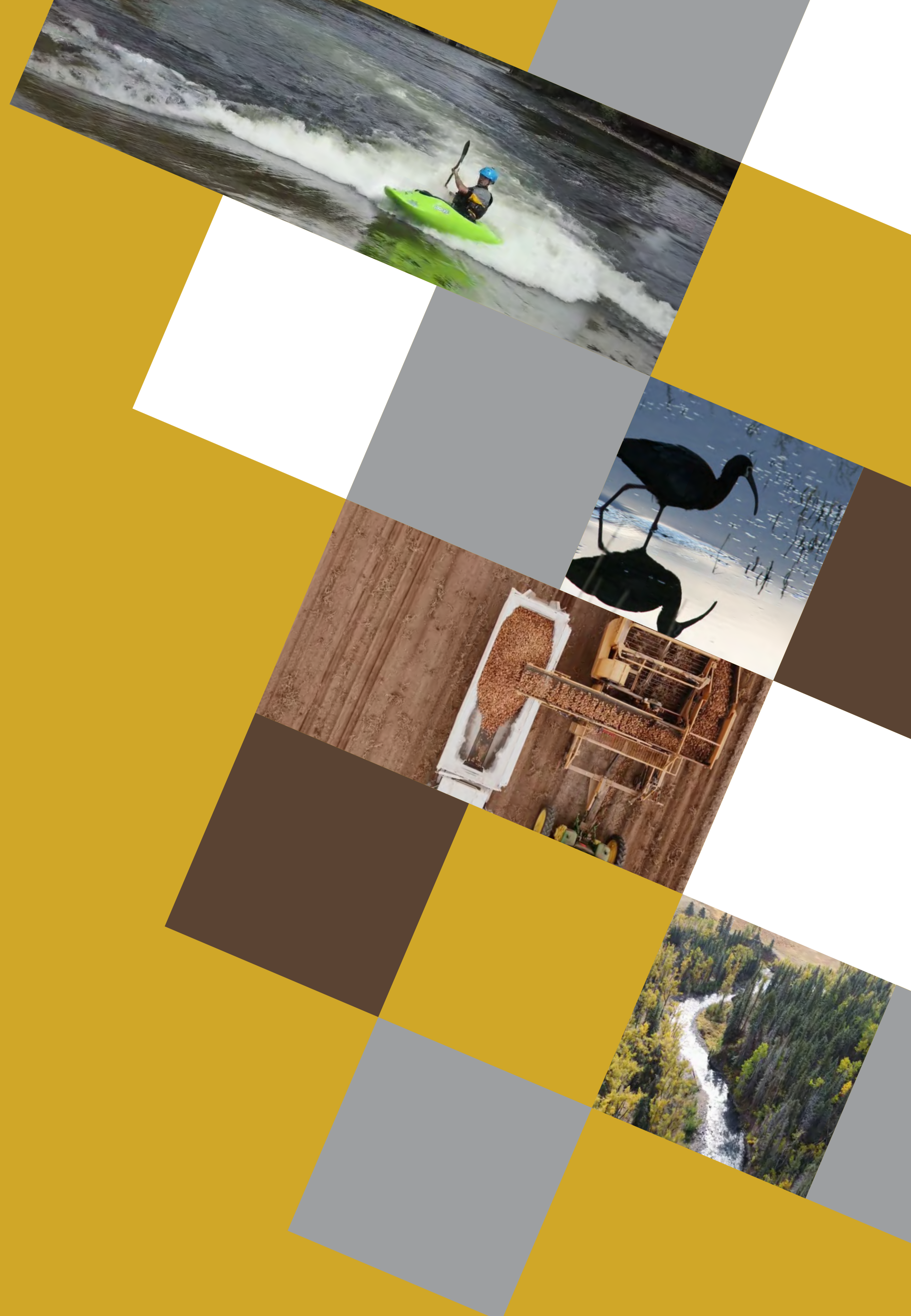


VOLUME 1 • JANUARY 2022

RIO GRANDE

Basin Implementation Plan

Basin Implementation Plan at a Glance

The Rio Grande Basin Roundtable (BRT) will continue to work together to create a resilient and healthy watershed and economy for generations to come while creating a culture of accessibility and inclusivity that reflects diverse communities and values.

KEY ACHIEVEMENTS

A diverse range of projects have been completed that support the BIP and Colorado Water Plan goals:

- Completion of stream management plans and watershed assessments
- Implementation of stream, wetland, and riparian conservation and restoration projects
- Implementation of tools for accurate streamflow forecasting
- Rehabilitation of irrigation infrastructure for multiple benefits
- Implementation of multi-purpose storage infrastructure improvements
- Completion of projects that enhance recreational opportunities
- Formation and operation of groundwater management subdistricts

CHALLENGES

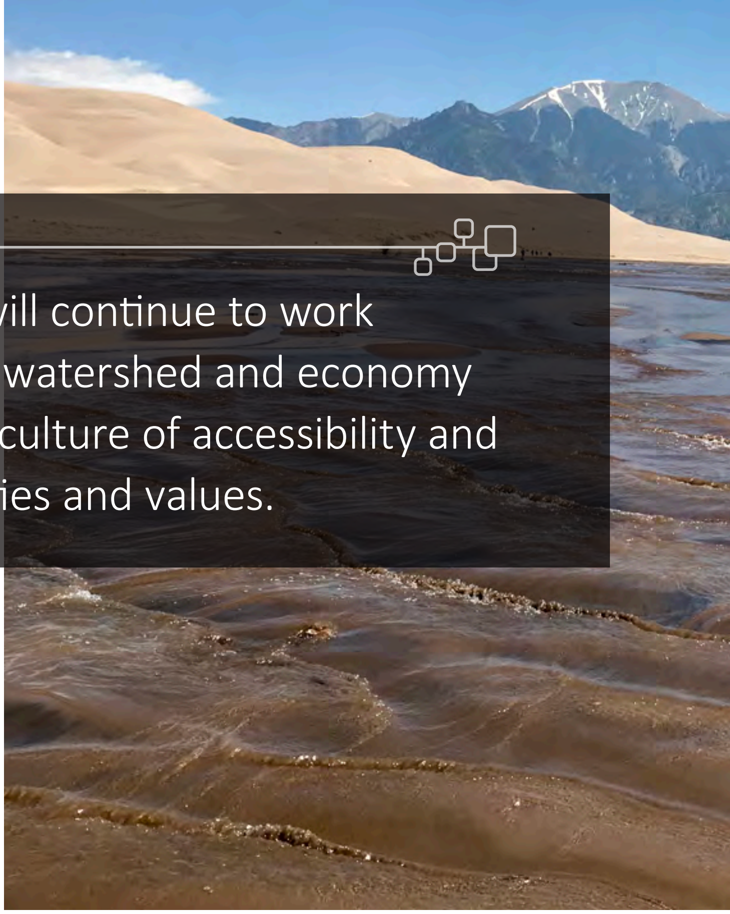
Water management challenges in the Rio Grande Basin are centered around groundwater sustainability, maintaining and providing surface and groundwater supply for new growth, and operating within the constraints of the Rio Grande Compact.

Additionally, project funding, increased pressure for transbasin water exports, and aging water infrastructure are all key challenges.

The effects of drought, climate change, and dust on snow on the timing and amount of water supply exacerbate these challenges.

OUTREACH STRATEGIES

The Rio Grande BRT's vision is to reach target audiences that include local community members, recreational visitors, and urban audiences to communicate values regarding the importance of agriculture, water management, collaboration among partner agencies, and natural resource stewardship.



Medano Creek flowing in Great Sand Dunes National Park (photo by Heather Dutton)

GOALS + OBJECTIVES

The Rio Grande BRT has
5 GOALS
centered around:

- ✓ **Healthy watersheds that provide critical ecosystem services, resiliency, improve water quality, and enhance local wildlife habitats**
- ✓ **Aquifers with sustainable supplies of groundwater**
- ✓ **Vibrant and resilient agriculture, recreation, municipal, and industrial economies**
- ✓ **Adaptive, flexible, and creative water administration**
- ✓ **Citizens who are engaged and informed on local, state, and regional water issues**

DEMAND, SUPPLY, POTENTIAL WATER NEEDS

Municipal and Industrial:
Between the years 2015 and 2050, the Rio Grande Basin population is projected to change between an 8 percent decrease in population to an increase of 46 percent. The anticipated population growth is the main driver for the modest increases in municipal and industrial demands in the planning scenarios.

Agriculture:
All future scenarios of basinwide agricultural demands are lower than Baseline because of irrigated acreage reductions required to meet aquifer sustainability requirements. Agricultural water users in the basin recognize that the baseline gap reflects current deficit irrigation practices; therefore, the agricultural water strategies for the basin focus on preventing future increases in the existing gap.

Environment and Recreation:
Climate change and altered hydrology are expected to impact environmental and recreational attributes. Spring runoff peak flows are expected to occur earlier in the future along with potential lower flows in the late summer. This shift could increase risk for cold-water fish species and adversely affect spawning windows. The shift will likely impact recreational fishing and boating opportunities. Finally, these changes in hydrologic conditions will decrease water availability for a variety of wetland and riparian habitats.

STRATEGIC VISION

The roundtable will pursue strategies that promote sustainability and resilience.

These strategies include:

- Supporting flexible and adaptive water management
- Implementing diverse and multi-purpose projects
- Addressing agricultural gaps through increased efficiency and upgrading water storage and other agricultural infrastructure
- Supporting environmental and recreational attributes through habitat conservation and restoration
- Conducting municipal water infrastructure upgrades
- Meeting potential future gaps

FUTURE PROJECTS

Nearly
$165 million
total estimated costs for project implementation*

75 Total Projects

28 Tier 1 Projects

51 Multi-purpose Projects

39 Projects meet agricultural needs

61 Projects meet environmental and recreational needs

** Total cost based on projects that provided cost information. Future basin projects include both consumptive and nonconsumptive projects that span all sectors of water use in the basin and are at various levels of development from conceptual to implementing.*

List of Roundtable Members

The Rio Grande Basin Implementation Plan reflects the hard work, collaboration, and advice provided by the Rio Grande Basin Roundtable and its subcommittees. With much gratitude, a special thank you is extended to the Rio Grande Basin Roundtable members who participated in the Rio Grande Basin Implementation Plan update:

- **Nathan Coombs –** *Chairperson, Conejos Water Conservancy District* (1,4)
- **Judy Lopez –** *Vice Chairperson, Conservation Easement representative, Colorado Open Lands* (1,2,4,5)
- **Bethany Howell –** *Secretary, Education representative, Rio Grande Watershed Conservation and Education Initiative* (5)
- **Jim Ehrlich –** *Alamosa County representative, Colorado Potato Administrative Committee* (1,5)
- **Chuck Finnegan –** *Conejos County representative*
- **Steven Romero –** *Costilla County representative*
- **Robert Hurd –** *Hinsdale County representative*
- **Heather Greenwolf –** *Mineral County representative, Headwaters Alliance* (1)
- **Nikita Christensen –** *Rio Grande County representative*
- **Edwin Nielsen –** *Saguache County representative*
- **Charlie Griego –** *Alamosa County Municipalities representative*
- **Gene Farish –** *Rio Grande County Municipalities representative*
- **Ann Bunting –** *Saguache County Municipalities representative, Town of Crestone* (3)
- **Dwight Martin –** *Alamosa-La Jara Water Conservancy District representative*
- **Ronda Lobato –** *Costilla County Conservancy District representative* (1)
- **Heather Dutton –** *San Luis Valley Water Conservancy District, CWCB Board Member* (1,2,3,4,5)
- **Cleave Simpson –** *Rio Grande Water Conservation District* (1, 4)
- **Wayne Schwab –** *Trinchera Water Conservancy District*
- **Karla Shriver –** *Legislative Appointee, Farmer* (1,4)
- **Ron Brink –** *Agricultural representative*
- **Keith Holland –** *Agriculture and Reservoirs representative, Santa Maria Reservoir Company, Farmer* (1)
- **Cindy Medina –** *Alamosa Riverkeeper representative* (2, 5)
- **David Marquez –** *Acequias representative*
- **James Henderson –** *Conejos Water Users representative/ Farmer/Rancher* (1)
- **Mike Gibson –** *At-large representative*
- **Rio De La Vista –** *Environmental representative, Salazar Rio Grande Del Norte Center at Adams State University* (1,2,5)
- **Charles Spielman –** *Industrial/Domestic representative, Interested Citizen* (3)
- **Kevin Terry –** *Recreation representative, Trout Unlimited* (2)
- **Travis Smith –** *Reservoirs representative/National Wild Turkey Federation* (1, 2)
- **Greg Higel –** *Rio Grande Water Users representative*
- **Mario Curto –** *San Luis Valley Well Owners representative*
- **Peter Clark –** *Water User representative, Farmer* (1)
- **Virginia Christensen –** *Water User representative, Farmer, Alamosa-La Jara Water Conservancy District* (1)
- **Emma Reesor –** *Watershed Health representative, Rio Grande Headwaters Restoration Project* (2)
- **Dale Pizel –** *Wildlife representative, Broken Arrow Ranch and Land Co* (2)

A special thanks to those who participated in the BIP subcommittees and are valued partners of the Rio Grande BRT:

- **Kate Zeigler –** *Zeigler Geologic Consulting, LLC* (1, 5)
- **Don Thompson –** *Community Member* (2)
- **Adam Moore –** *Colorado State Forest Service* (2)
- **Emily Chavez –** *Natural Resources Conservation Service and Bird Conservancy of the Rockies* (2)
- **Rick Basagoitia –** *Colorado Parks and Wildlife* (2)
- **Patrick Ortiz –** *San Luis Valley Great Outdoors* (2)
- **Cary Aloia –** *Wetland Dynamics* (2)
- **Ryan Unterreiner –** *Colorado Parks and Wildlife* (2, 4)
- **Jason Remshardt –** *Rio Grande National Forest* (2)
- **Daryl Kohut –** *Rio Grande National Forest* (2)
- **Tony LaGreca –** *Colorado Water Trust* (2)
- **Hallie Flynn –** *Natural Resources Conservation Service* (2)
- **Daniel Boyes –** *Rio Grande Headwaters Restoration Project* (2)
- **Connor Born –** *Rio Grande Headwaters Restoration Project* (2)
- **Erich Schwiesow –** *City of Alamosa* (3)
- **Deacon Aspinwall –** *City of Alamosa* (3)
- **Craig Cotten –** *Colorado Division of Water Resources* (4)
- **Sophia Sigstedt –** *Lynker Technologies* (4)
- **Rob Phillips –** *San Luis Valley Irrigation District* (4)
- **Travis Robinson –** *Colorado Division of Water Resources* (4)
- **Zena Buser –** *Adams State University* (5)
- **Liza Marron –** *San Luis Valley Local Foods Coalition* (5)
- **Kristie Borchers –** *Hinsdale County* (5)

1 – BIP Agricultural Subcommittee
2 – BIP Environmental and Recreation Subcommittee
3 – BIP Municipal and Industrial Subcommittee
4 – BIP Water Administration Subcommittee
5 – BIP Education and Outreach Subcommittee

Photo by Rio de la Vista

Table of Contents

DISCLAIMER

The Analysis and Technical Update to the Colorado Water Plan and the Basin Implementation Plan (BIP) provide technical data and information regarding Colorado's and the basin's water resources. The technical data and information generated are intended to help inform decision making and planning regarding water resources at a statewide or basinwide planning level. The information made available is not intended to replace projections or analyses prepared by local entities for specific project or planning purposes.

The Colorado Water Conservation Board (CWCB) and basin roundtables intend for the Technical Update and the BIP to help promote and facilitate a better understanding of water supply and demand considerations; however, the datasets provided are from a snapshot in time and cannot reflect actual or exact conditions in any given basin or the State at any given time. While the Technical Update and BIP strive to reflect the CWCB's best estimates of future water supply and demands under various scenarios, the reliability of these estimates is affected by the availability and reliability of data and the current capabilities of data evaluation. Moreover, the Technical Update and BIP cannot incorporate the varied and complex legal and policy considerations that may be relevant and applicable to any particular basin or project; therefore, nothing in the Technical Update, BIP, the associated Flow Tool, or Costing Tool is intended for use in any administrative, judicial, or other proceeding to evince or otherwise reflect the State of Colorado's or the CWCB's legal interpretations of state or federal law.

Furthermore, nothing in the Technical Update, BIP, Flow Tool, Costing Tool, or any subsequent reports generated from these datasets is intended to, nor should be construed so as to interpret, diminish, or modify the rights, authorities, or obligations of the State of Colorado or the CWCB under state law, federal law, administrative rule, regulation, guideline, or other administrative provision.

What is the Basin Implementation Plan?

The Basin Implementation Plan (BIP), developed in a collaborative process by basin stakeholders, focuses on the current and future water needs in the Rio Grande Basin, the vision for how individuals and organizations can meet future needs, and the goals/anticipated outcomes and projects that provide a pathway to success. The initial Rio Grande Basin Implementation Plan was completed in 2015, and this is the first update of that plan.

THE RIO GRANDE BASIN IMPLEMENTATION PLAN CONSISTS OF TWO VOLUMES:	
VOLUME 1:	A summary of the Rio Grande Basin and its current and future water resources, focusing on goals, projects, and a strategic vision to meet future water needs.
VOLUME 2:	Background information on the Rio Grande Basin, including history of water development, water administration, water needs, opportunities and constraints, and a path forward. Volume 2 does not include information on future demands and supplies.

Section 1. Basin Overview

The Rio Grande Basin (basin) is surrounded by three mountain ranges: the Sangre de Cristo to the east, the Culebra Range to the southeast, and San Juan Mountains and Continental Divide to the west, and is bound by the Colorado-New Mexico state line to the south. Between these mountain boundaries and the state line lies the San Luis Valley (SLV), a unique geographic feature (see Figure 1). The SLV is considered a high-elevation desert with an average elevation of approximately 7,500 feet and a precipitation rate of less than 8 inches per year. Despite the low precipitation on the valley floor, agriculture has long been the basis of the Rio Grande Basin economy. Snowmelt runoff and summer storms from the surrounding mountains supply the vast majority of water to streams and aquifers, which support irrigated agriculture, recreation, municipal and industrial uses, and important riparian and wetland ecosystems and wildlife habitat.

The northern third of the SLV is a closed basin, meaning runoff from the surrounding mountains and diversions from the Rio Grande recharge the basin's groundwater aquifers, rather than contribute to the surface water flow of the Rio Grande. Runoff from the surrounding mountains and diversions from the Rio Grande recharge the closed basin's unconfined and confined groundwater aquifers, rather than contribute to the surface water flow of the Rio Grande. Irrigated agriculture in the basin relies heavily on well pumping from the aquifers as well as surface deliveries supplied by the Rio Grande and Conejos Rivers. These diversions are applied directly to crops and, due to the nature of the closed basin, contribute to recharge of the unconfined aquifer.

The basin also has a long history of water resources development and holds many of the oldest adjudicated water rights in Colorado, including acequias. The Rio Grande Basin is made up of diverse communities with a rich cultural heritage. Many of these diverse water uses and management practices continue today. The Rio Grande Basin Roundtable (BRT) is committed to cultivating a culture of accessibility and inclusivity that reflects the basin's diverse communities and values. See Volume 2 Section 2.1 and 2.4 for a more detailed history of water development.

AGRICULTURE

- Agriculture is the primary economic driver in the basin with roughly 515,300 acres of irrigated land. Principal crops are potatoes, alfalfa, native hay grass, and barley. Other notable crops include wheat, oats, canola, hemp, quinoa, and vegetables like lettuce, spinach, and carrots.
- Both surface and groundwater are used for irrigation, and the practice of conjunctive use is common in the SLV, where groundwater is used to supplement the surface water supply.

WATERSHED

- The Rio Grande Basin is home to a rich diversity of natural assets, including 14,000-foot peaks; Great Sand Dunes National Park and Preserve; the Alamosa, Monte Vista, and Baca National Wildlife Refuges; public lands in the Rio Grande National Forest, Bureau of Land Management, and state wildlife areas; and the headwaters to the Rio Grande and Conejos River.
- The SLV's extensive wetlands and riparian habitats support abundant wildlife, including at least 13 threatened and endangered species and more than 160 species of birds, including the entire Rocky Mountain Population of Greater Sandhill Cranes.

MUNICIPAL AND INDUSTRIAL

- The combined municipal, rural residential, and commercial water use, which is primarily met with groundwater, represents a very small part of water use in the basin.
- Principal industrial water uses are for fisheries and agricultural processing. Water for solar generation is minimal.

COMPACTS, ADMINISTRATION, AND REGULATORY

- Interstate compacts and international treaties that affect water use include the Rio Grande Compact of 1938 and the Amended Costilla Creek Compact of 1963. The Rio Grande Compact establishes Colorado's obligations to ensure water at the New Mexico state line, with some allowance for credits and debits via accounts in the Elephant Butte Reservoir.

See Volume 2 for Groundwater Discussion: Volume, 2 Section 2 has a detailed discussion of the basin's groundwater resources, history, development, and administration. Figures 5 and 7 in Volume 2 show the aquifer and closed basin boundaries, respectively.

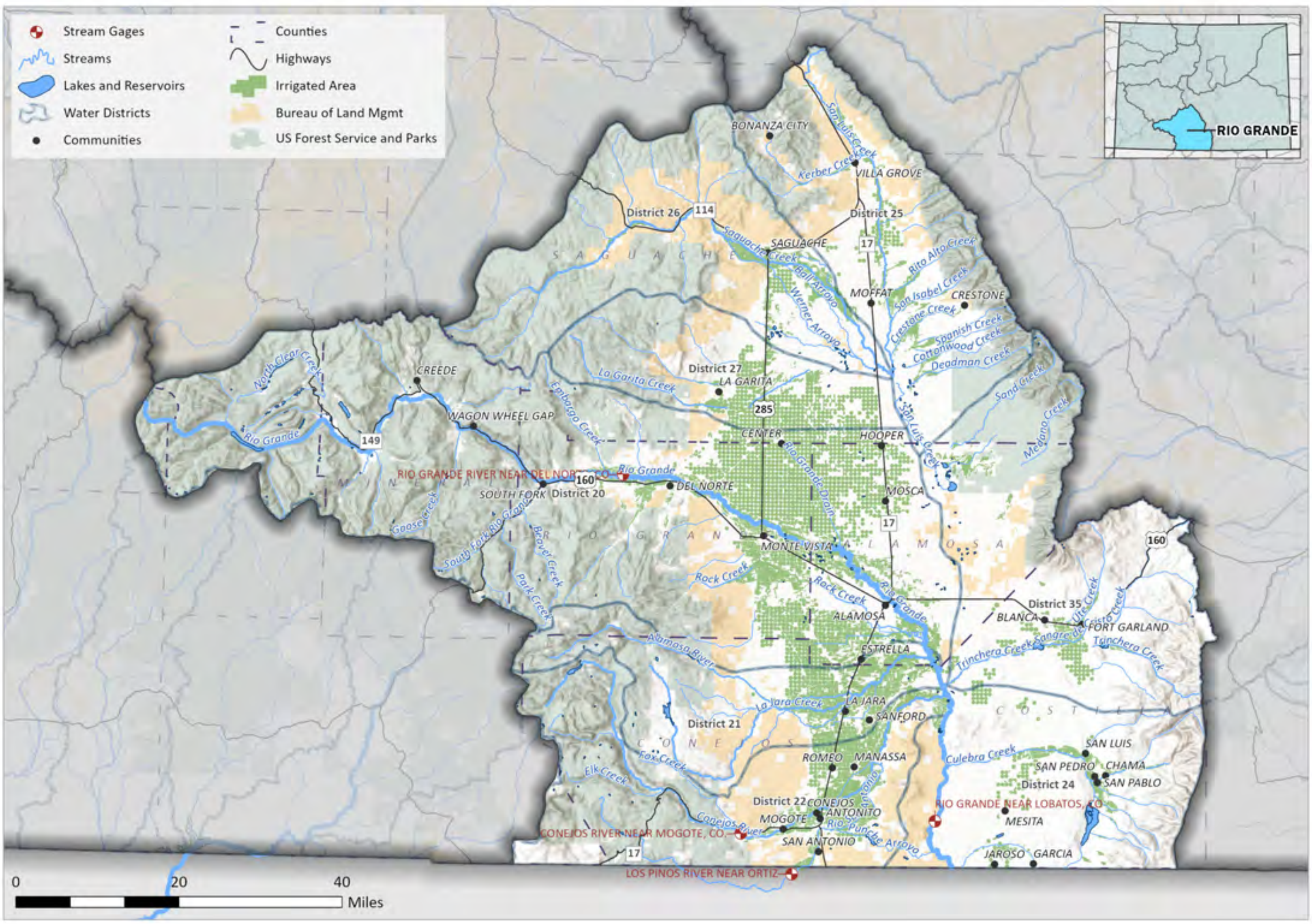


Figure 1. Basin Map

Section 2. Basin Challenges

The Rio Grande Basin water management challenges pertain mostly to groundwater supply, maintaining and providing supply for new growth, and managing the operating constraints of the Rio Grande Compact.

KEY CHALLENGE

Balancing surface and groundwater supply and demand.

Table 1. Key Future Water Management Issues and Challenges in the Rio Grande Basin

AGRICULTURE	WATERSHED	MUNICIPAL AND INDUSTRIAL	COMPACT, ADMINISTRATION, AND REGULATORY
• Currently, unsustainable groundwater use in the unconfined aquifer and overall diminishing aquifer supplies call for reduced pumping. • Mitigating potential economic fallout of the projected reduction in irrigated acres. • The scope and financial resources needed to replace and improve aging and inefficient irrigation infrastructure.	• Changing conditions of the watershed, including stream and wetland degradation, affect water supply, with direct impacts to environmental, recreational, and agricultural attributes. • Water-dependent wildlife species are being considered for, or are already listed as, “threatened” or “endangered” species under the Endangered Species Act.	• Most cities and towns are supplied by groundwater wells and must comply with the State Engineer’s Well Rules and Regulations. • Growth of commercial uses throughout the basin, new homes near Alamosa, and second homes in the surrounding mountains are creating a need for additional water supplies and well augmentation. • The scope and financial resources needed to upgrade aging municipal infrastructure and to comply with water quality standards.	• The continued operation of the Rio Grande and Costilla Creek Compacts and water rights administration under changing and variable hydrologic conditions.

CROSS-SECTOR CHALLENGES:

- Achieving confined and unconfined aquifer sustainability, as defined by the Colorado Division of Water Resources, Division 3 groundwater rules and regulations, within the timeline established by state-approved plans of water management.
- Prolonged and lingering drought, wildfires, beetle kill, ecosystem degradation, climate change, extreme weather, flooding, and dust-on-snow impacts on timing and amount of water supply. These large disturbances can cause severe and lasting impacts on watershed health, including current and future decreases in average streamflow and water tables.
- The need for updated and additional storage, and the costly and time-consuming permitting process of these water projects.
- Increased pressure for transbasin water exports.
- Adequate funding for project implementation.

More information and opportunities for overcoming these challenges can be found in Volume 2 Section 5.

Section 3. Achievements

Since 2015, the Rio Grande Basin has made significant progress toward implementing the Rio Grande BIP and the Colorado Water Plan through a diverse range of projects that help meet the basin's water needs; several examples are described in this section and organized alphabetically. With support from the Colorado Water Conservation Board (CWCB) through the Water Supply Reserve Fund (WSRF) and Colorado Water Plan funding, the following milestones were achieved:

- 30 projects funded by the Rio Grande BRT through the WSRF program
- 15 projects funded through the Colorado Water Plan grant program
- 7 studies completed, including watershed assessments, stream management plans, and other studies
- 8 education-focused projects
- 12,840 linear feet of stream restored
- 12 diversion structures rehabilitated
- 17 headgates replaced, 11 of which were automated
- 2,313 acres conserved through conservation easements
- 3 boat ramps installed on the Rio Grande
- A total of $5,587,987 in WSRF and Colorado Water Plan funds distributed

Conejos Diversions: Richfield to CONCONCO

Recently completed Richfield Canal diversion dam and automated headgate on the Conejos River (photo by Peyton Valentine)

This project continued the Conejos Whole River Strategy and includes automating the Richfield, Salazar, and Seladonia Valdez diversions and improving gauge measurements at the bifurcation of the north and south branches of the Conejos River (CONCONCO – stream gage name). During low flows, when accurate readings to meet Rio Grande Compact requirements are most needed, the CONCONCO gage does not function well, which limits the Division of Water Resources' ability to get a viable discharge measurement. This project upgrades the performance and accuracy of the flow sensors by building a low-flow conveyance structure and stabilizing and restoring stream health and connectivity.

PROJECT PROPONENTS: This project was a partnership between the Conejos Water Conservancy District and the water users of the Richfield, Salazar, and Valdez ditches.

TIMELINE: Start: March 2018; Completion: August 2021

COST: $547,000

Del Norte Riverfront Project

Del Norte Riverfront Park (photo by Emma Reesor)

The project was a community-led effort to improve public access, create recreation infrastructure, and enhance aquatic and riparian habitat along the Rio Grande in Del Norte. The overall purpose of the Del Norte Riverfront Project was to create connectivity between the communities and visitors of the SLV and the river that sustains it. The new Riverfront Park includes a whitewater playwave, boat ramp, fish habitat structures, pedestrian river access, parking area, an Americans with Disabilities Act accessible picnic shelter, and interpretive signage. The project has provided a significant positive benefit to the community of Del Norte and SLV by creating a welcoming, safe space for community members, boaters, and anglers, while also improving river health.

PROJECT PROPONENTS:
The Del Norte Riverfront Project was led by the Rio Grande Headwaters Restoration Project in collaboration with the Town of Del Norte, Del Norte Trails Organization, Riverbend Engineering, Trout Unlimited, San Luis Valley Water Conservancy District, Colorado Parks and Wildlife, local businesses, and countless community members.

TIMELINE: Start: January 2017; Completion: September 2020

COST: $720,000

Five Ditches Project

Rio Grande #2 Ditch (photo by Christi Bode)

The Five Ditches Project replaced aging and inefficient diversion infrastructure for the San Luis Valley Canal, Centennial Ditch, Consolidated Ditch, Rio Grande #2 Canal, and Pace Ditch, while improving streambank and channel conditions at each diversion. The project included the construction of three diversion dams, four headgates, and 4,000 linear feet of stream improvements, which resulted in improved diversion efficiencies and reduced maintenance, enhanced water quality, improved riparian condition, increased capacity for sediment transport, improved aquatic and wildlife habitat, and improved public safety and recreation opportunities by ensuring diversions are passable by fish and boats where appropriate.

PROJECT PROPONENTS: The Five Ditches Project was a partnership among the Rio Grande Headwaters Restoration Project, the Rio Grande #2 Canal shareholders, Consolidated Ditch and Headgate Company, Pace Ditch, San Luis Valley Canal Company, Centennial Irrigating Ditch Company, National Resource Conservation Services, and Riverbend Engineering.

TIMELINE: Start: June 2017; Completion: May 2020

COST: $2.99 million

Groundwater Management Subdistricts and Aquifer Sustainability

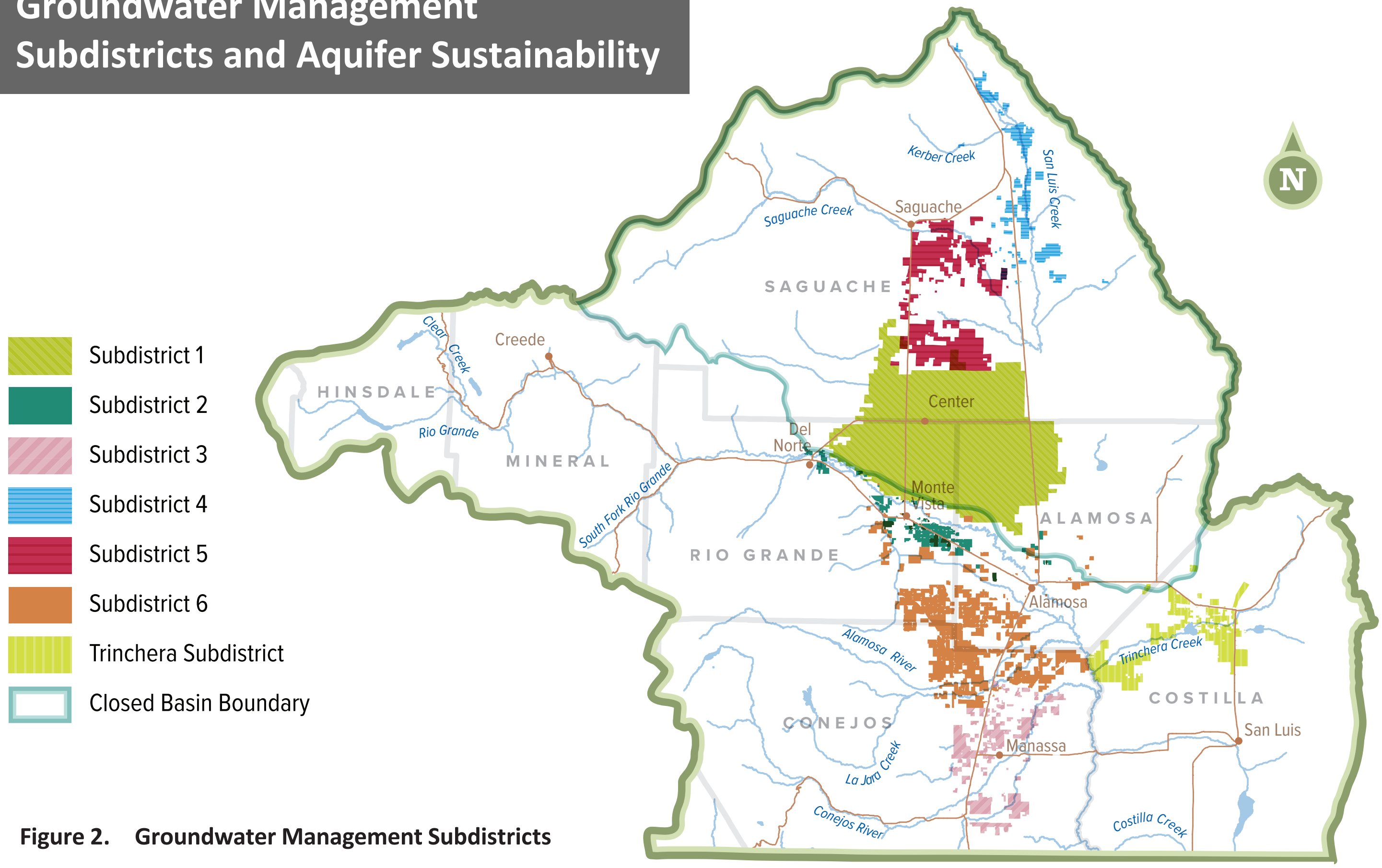


Figure 2. Groundwater Management Subdistricts

To date, seven Groundwater Management Subdistricts (Subdistricts) have been formed (see Figure 2): Subdistricts 1 through 6 of the Rio Grande Water Conservation District and the Trinchera Groundwater Management Subdistrict, which is managed under the Trinchera Water Conservancy District. All Subdistricts are operating under approved plans of water management. See Table 2 for more information on the Groundwater Management Subdistrict status.

PROJECT PROPONENTS:
Rio Grande Basin Groundwater Management Subdistricts

TIMELINE: Start: 2015; Completion: Ongoing

Table 2. Status of Subdistricts as of August 1, 2021

Subdistrict	Date Formed	Operating Under an Approved Plan of Water Management?	Operating Under a State-approved Annual Replacement Plan?	Meeting Aquifer Sustainability Requirements?	Number of Wells*	Average Annual Groundwater Withdrawals (acre-feet)
Subdistrict 1	2006	Yes	Yes	No	3,520	239,333
Subdistrict 2	2016	Yes	Yes	Yes	261	12,488
Subdistrict 3	2017	Yes	Yes	Yes	158	26,688
Subdistrict 4	2017	Yes	Yes	No	156	11,066
Subdistrict 5	2017	Yes	No	Yes	213	38,218
Subdistrict 6	2018	Yes	Yes	Yes	529	89,661
Trinchera Subdistrict	2008	Yes	Yes	Yes	174	27,817

**Note: total number of wells includes both petitioned and contracted wells. The total may change on an annual basis depending on the number of contracted wells.*

Kerber Creek Restoration Project – Middle Parcel

Mine waste areas after restoration using phytostabilization and revegetation

The Kerber Creek Restoration Project is the most recent phase of the long-term stream restoration and mine reclamation. The project is a partnership among government agencies, landowners, and local non-profit organizations, with the goal to restore the Kerber Creek watershed in northern Saguache County through collaborative efforts and community involvement. Historic mining activities in the upper Kerber Creek watershed introduced into the stream system harmful contaminants, including acid mine drainage, which limited the ability of aquatic organisms to survive. Since 2007, project partners have implemented restoration methods to improve fish habitat, stabilize stream banks, and remediate soils, which addressed all the environmental issues that resulted from legacy mining activities.

The Kerber Creek Restoration Project–Middle Parcel funded the restoration of 5 acres of mine tailings contained within the floodplain adjacent to Kerber Creek through phytostabilization and revegetation. These efforts coincided with 5,900 feet of adjacent in-stream improvements that were completed by the National Resources Conservation Service. Both soil treatments and in-stream structure installations improved the overall stream health of this section of Kerber Creek.

PROJECT PROPONENTS: Trout Unlimited
TIMELINE: Start: August 2015; Completion: November 2015
COST: $272,000

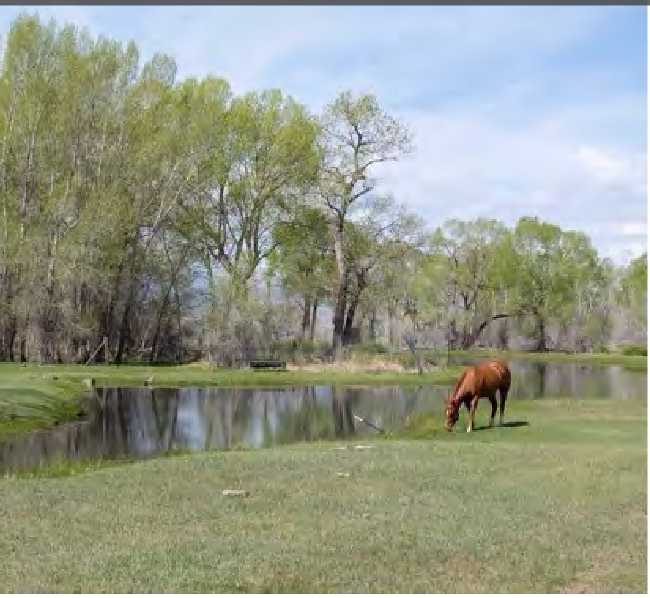
Mountain Home Reservoir Dam Outlet Works Rehabilitation

New reservoir outlet works for the Mountain Home Reservoir dam (photo by Wayne Schwab)

The outlet works at Mountain Home Reservoir had reached the end of their designed functionality and were experiencing significant leakage as high as 2,250 acre-feet (AF) a year. Phase I of this project granted Trinchera Irrigation Company funds to conduct a feasibility study, which included an underwater inspection to capture video data that was analyzed to help determine the best way to repair the gates and outlet works. Phase II funded the engineering designs for the repairs, and Phase III funded the replacement of the existing gate valves, repairs to the existing concrete within the outlet tunnel, and installation of a hydraulic operation system and the actuators for each valve.

PROJECT PROPONENTS: Trinchera Irrigation Company
TIMELINE: Start: September 2014; Completion: March 2018
COST: $1.4 million

Paulson Ranch Conservation Easement



Wetland on the Paulson Ranch easement
(photo by Allen Law)

This project funded a conservation easement on the Paulson Ranch in Rio Grande County. The easement conserved 180 acres of land with 2.83 cubic feet per second total water rights. The working ranch is agriculturally productive, and it is also important habitat for big game like mule deer and elk, waterfowl, and the federally endangered Southwestern willow flycatcher. The parcel is adjacent to two other conservation easements and contributes to the RiGHT's goal of creating a corridor of conserved lands along the Rio Grande.

PROJECT PROPONENTS: Rio Grande Headwaters Land Trust (RiGHT)

TIMELINE: Start: 2017; Completion: 2020

COST: $605,000

Radar Monitoring and Hydrologic Modeling in the Upper Rio Grande Basin

San Luis Valley Doppler radar tower in Alamosa
(photo by Emma Reesor)

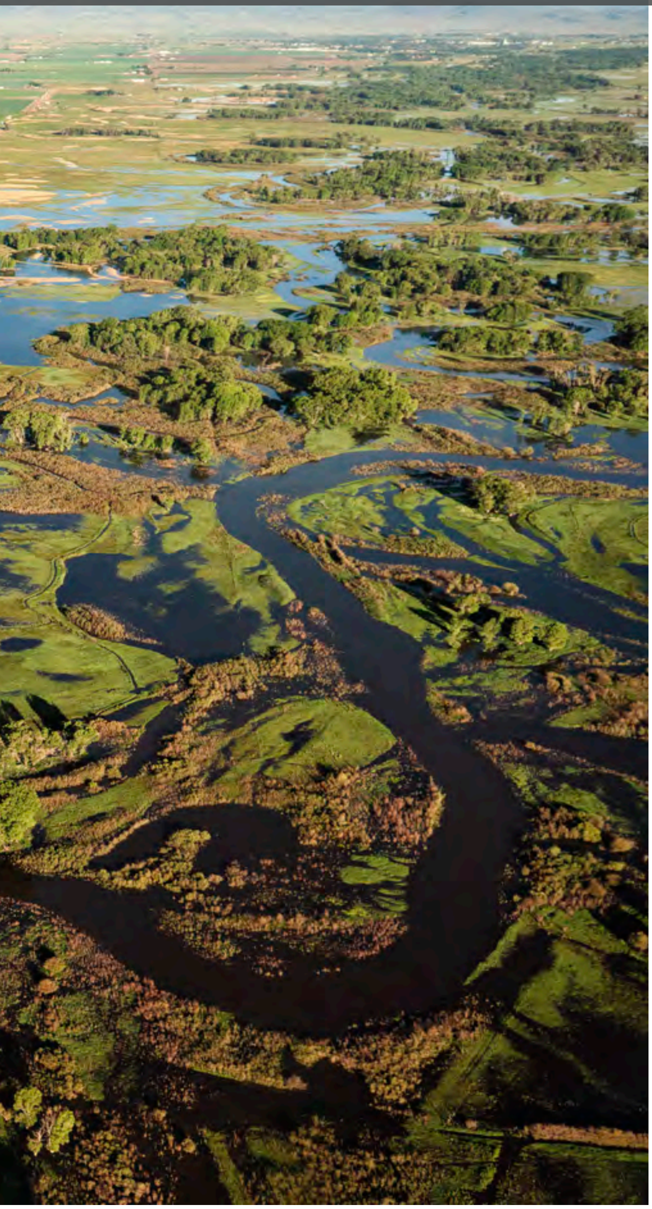
Water managers rely on the accuracy of precipitation forecasts by the Division of Water Resources as the basis for their decisions on the storage, release, schedule of Rio Grande Compact deliveries, and beneficial use of water, but these forecasts were often inaccurate due to a lack of data. Funded in 2013, this project installed temporary Doppler radar units to improve water supply forecasting and to collect and integrate data and evaluate modeling methods used for water supply forecasting. Ultimately, this project proved the need for a permanent Doppler radar system, which was realized in 2019 through the collaboration of a large group of local, state, and federal entities.

PROJECT PROPONENTS: Conejos Water Conservancy District in collaboration with a large group of local, state, and federal entities.

TIMELINE: Start: September 2014; Completion: March 2018

COST: $1.4 million

Rio Grande, Conejos River, and Saguache Creek Stream Management Plans



Rio Grande during 2019 runoff (photo by Christi Bode)

The recently completed Rio Grande, Conejos River, and Saguache Creek stream management plans (SMP) are stakeholder- and data-driven stream condition assessments that provide management recommendations to maintain and improve stream health. Using a combination of existing and newly collected remote sensing and targeted sampling data, the SMPs characterized the physical and biological condition of each stream, assessed flow regimes, and determined current recreational boating opportunities on the Rio Grande and Conejos Rivers using the Boatable Days flow evaluation tool. The SMP stakeholder group used the stream condition assessments and Boatable Days evaluation to identify and prioritize a diverse set of projects and action items aimed at improving stream health, agricultural water use efficiency, and recreational opportunities.

The Boatable Days Flow Evaluation, a project originally identified in the 2015 BIP, provided important baseline information relating to streamflows and recreational use. The analysis identified flow preferences and calculated the number of boatable days on 11 segments of the Rio Grande and Conejos Rivers under typical wet, average, and dry hydrological year types. The assessment followed the State of Colorado's BIP guidance documents for quantifying nonconsumptive recreational needs.

PROJECT PROPONENTS: This project was led by the Rio Grande Headwaters Restoration Project with guidance from the SMP Technical Advisory Team.

TIMELINE: Start: May 2018; Completion: June 2020

COST: $230,005

Rio Grande Cooperative Project

Reservoir release from the recently installed Rio Grande Reservoir outlet works (photo by Rob Phillips)

The Rio Grande Cooperative Project involves water rights owned by private/public interests who wish to achieve a common goal: optimize water supplies on the Rio Grande to meet future needs. The project involved the repair of both Rio Grande and Beaver Creek Reservoirs to address seepage issues and improve outlet works. With upgraded infrastructure for the storage and release of water, project partners have sought to maximize the benefits of timed reservoir releases. By strategically scheduling the storage and release of partners' water rights, the project has optimized flows to benefit aquatic habitat, irrigation supplies, augmentation demands, and Rio Grande Compact compliance.

PROJECT PROPONENTS: San Luis Valley Irrigation District, Colorado Parks and Wildlife, and the CWCB

TIMELINE: Start: 2012; Completion: July 2020

COST: $30 million

San Luis Valley Wetland and Wildlife Conservation Assessment

Sandhill cranes at the Monte Vista National Wildlife Refuge (photo by Cary Aloia)

The SLV Wetland and Wildlife Conservation Assessment details the history of changes in wetlands across the SLV to guide cooperative conservation goals for monitoring, management, and land conservation for natural resource agencies and organizations. The assessment utilized a GIS analysis developed by the Intermountain West Joint Venture, which included over 30 years of satellite imagery, to identify baseline hydrologic characteristics in the SLV. The assessment expanded upon the model to identify spatial patterns in wetland locations. Based on the findings, a framework was developed to optimize nonconsumptive water use on public lands. The framework consists of the GIS modeling effort and assessment of existing and supporting data, including historic and current information related to wetland extent, water use, and wildlife use. Although the assessment focused on public lands, it also provided information to help land trusts and landowners determine priorities and conservation values when pursuing conservation easements. Ultimately this assessment identified potential future management actions, identified potential new partnerships, and outlined ways the information may be used by other agencies and organizations to help prioritize projects.

PROJECT PROPONENT: Wetland Dynamics, LLC, a small, women-owned business serving SLV, Colorado, and Intermountain West. Its mission is to provide management, monitoring, and outreach services that improve the quality and health of a wide range of habitat types for wetland-dependent wildlife populations through collaboration with a variety of partners.

TIMELINE: Start: October 2016; Completion: May 2019

COST: $309,500

Upper Rio Grande Watershed Assessment

RGHRP staff and volunteer conducting a pebble count (photo by Emma Reesor)

The Upper Rio Grande Watershed Assessment (URGWA) is a comprehensive document that details the ecological condition of the mainstem of the Rio Grande and its major tributaries from the headwaters to the town of South Fork. The URGWA identified causes of concern and developed a list of prioritized projects that will improve the function of uplands and riparian and aquatic ecosystems. The assessment included studies of the riparian habitat, geomorphology, aquatic habitat, recreational impacts, flow regime, water quality, adjacent uplands, and infrastructure in the study area.

PROJECT PROPONENTS: This project was a partnership between the Rio Grande Headwaters Restoration Project and the URGWA Technical Advisory Team, which included partners from state and federal agencies, water user groups, and local non-profit organizations.

TIMELINE: Start: September 2016; Completion: December 2018

COST: $220,500

Section 4. Updated Goals and Objectives

Each of the BRTs across Colorado developed goals and strategies or actions to achieve their goals during the development of their 2015 BIPs. The structure and naming convention of goals, objectives, strategies, and actions slightly vary across roundtables, but they all include a discrete set of high-level targets (described as goals and/or themes) with supporting objectives, actions, strategies, or processes that will help each BRT and their stakeholders achieve their respective basin targets.

Rio Grande Basin goals ultimately strive for resilient and healthy watersheds and communities for generations to come.

The Rio Grande BRT subcommittees developed goals, anticipated outcomes, and supporting strategies to achieve their goals. The Rio Grande BRT's goals are consistent with the Colorado Water Plan agenda and strive for healthy watersheds, sustainable aquifers, and vibrant thriving communities.

The Rio Grande BRT identified five primary goals. Each goal includes a success framework. Except for Goal 5, each goal has anticipated outcomes and supporting strategies that will lead to the success of each outcome, and, therefore, goal. Goal 5 was developed by the BIP Education and Outreach Subcommittee. Instead of outcomes and strategies, they identified key topics on which to focus education and outreach efforts.

BASIN GOALS

- **Healthy watersheds that provide critical ecosystem services, are resilient to disturbances, and benefit from ongoing efforts to protect water sources, improve water quality, enhance aquatic, riparian, wetland, and upland habitat, and maintain connected ecosystems.**
- **Aquifers with sustainable supplies of groundwater for farmers and ranchers, towns, and wildlife habitat.**
- **Vibrant and resilient agriculture, recreation, municipal, and industrial economies that support thriving communities.**
- **Water administration that is adaptive, flexible, and creative while complying with state statutes and the doctrine of prior appropriation, and fully utilizing Colorado's compact entitlements under the Rio Grande and Costilla Creek compacts.**
- **Engaged and informed citizens who understand the scope and urgency of local, state, and regional water issues and participate in robust and diverse educational opportunities.**

Section 5.2 in Volume 2 describes basin opportunities and some potential options for how they may be addressed. The basin opportunities informed the creation of the "anticipated outcomes" described in this section.

1 Healthy watersheds that provide critical ecosystem services, are resilient to disturbances, and benefit from ongoing efforts to protect water sources, improve water quality, enhance aquatic, riparian, wetland, and upland habitat, and maintain connected ecosystems.

Anticipated Outcome	Supporting Strategies to Achieve Goal:
Progress is made toward improved forest health and reduced risk of high-severity wildfire and potential water quality and water quantity impacts in alignment with the Rio Grande National Forest Plan and Colorado Forest Action Plan.	• Continue implementing forest health treatments, including selective thinning, harvesting, fuels reduction, and prescribed burning. • Use the Shared Stewardship approach to forest restoration. • Conduct pre-disturbance planning to assess and mitigate potential wildfire impacts, with an emphasis on protecting ecosystem services and values at risk. • Analyze and support appropriate post-disturbance restoration treatments.
The extent and function of streams, wetlands, riparian areas, and associated ecosystems that contribute to watershed resiliency are protected, restored, conserved, and maintained.	• Inventory and continue monitoring wet meadows and other headwaters ecosystems. • Implement conservation easements. • Implement riparian fencing/livestock water infrastructure projects. • Implement small-scale grazing management projects. • Implement wetland and wet meadow restoration projects that provide habitat, filter pollutants, and restore and maintain surface and groundwater tables. • Implement floodplain reconnection projects that improve the connectivity and sustainability across floodplain habitats. • Implement a wide variety of river and riparian restoration projects, including both low-tech and hi-tech solutions that improve habitat quality and resiliency. • Implement projects and maintain historic practices that benefit multiple stakeholders and work toward habitat and agricultural sustainability.
Water management strategies include water quality benefits, such as mitigating potential impairments (e.g., temperature fluctuations and pollution) while meeting agriculture and augmentation needs in compliance with decrees and compacts. (Applies to Goal 3 as well)	• Promote voluntary water management agreements and programs that enhance streamflows to address and prevent water quality impairments. • Explore natural water storage and pollution mitigation techniques.

Sunrise and sandhill cranes at the Monte Vista National Wildlife Refuge (photo by Cary Aloia)

Anticipated Outcome	Supporting Strategies to Achieve Goal:
Where possible, water rights are managed to benefit environmental and recreational streamflows while meeting agriculture and augmentation needs in compliance with decrees and compacts. The duration and extent of dry-up on the Rio Grande and Conejos River during the irrigation season (April-November) is minimized.	• Promote voluntary water management agreements, such as the Winter Flow Program, that enhance streamflows to promote sustainable aquatic and wildlife habitats and recreation while meeting decreed uses. • Install remote measurement systems (e.g., ditch, reservoir, and stream gage telemetry) for optimized system operations. • Use existing statutory tools to protect and restore flows in streams. • Complete additional modeling and data collection, as needed, to optimize water rights and flow benefits. • Use reservoir conservation pools and other agreements to keep water in reservoirs. • Promote conservation easement language that supports the objective. • Use information from Rio Grande and Conejos River SMP Boatable Days Flow Evaluation to meet the objective. • Work with federal land agencies to support water-based recreation through the Land and Water Conservation Fund.
Habitats that support healthy terrestrial and aquatic wildlife populations are maintained, enhanced, and restored.	• Implement riparian and aquatic habitat enhancement projects that restore and conserve riparian vegetation, multi-aged cottonwood galleries, and aquatic habitat. • Implement restoration and enhancement projects that maintain wetland habitats. • Incorporate aquatic organism passage into diversion infrastructure retrofits, where appropriate, to increase aquatic habitat connectivity. • Install and maintain fish migration barriers to protect priority fisheries and native fish populations, where applicable. • Follow recommendations and implement identified actions of local, regional, and state wildlife habitat plans.

2 Aquifers with sustainable supplies of groundwater for farmers and ranchers, towns, and wildlife habitat.

Anticipated Outcome	Supporting Strategies to Achieve Goal:
Aquifer sustainability is reached and maintained as defined by legislation, decrees, and plans of water management.	• Continued operation of Groundwater Management Subdistricts and augmentation plans. • Additional data collection and integration into the Rio Grande Decision Support System (RGDSS) groundwater model. • Continuously update the RGDSS groundwater model as new information is generated. • Implement groundwater conservation easements.

Land and water management projects and initiatives are developed and implemented that support healthy ecosystems and contribute to sustainable aquifer levels.	• Maximize wildlife and environmental benefits through managed and natural recharge.
	• Implement wetland and wet meadow restoration projects that provide habitat, filter pollutants, and restore and maintain surface and groundwater tables.
	• Implement floodplain reconnection projects, where appropriate, that improve connectivity and sustainability across floodplain habitats.
	• Implement a wide variety of river and riparian restoration projects, including both low-tech and hi-tech solutions, that improve habitat quality and resiliency.
	• Implement conservation easements, including groundwater conservation easements.
	• Implement infrastructure Improvement projects:
	  ◦ Existing reservoir storage infrastructure repair and enhancement
	  ◦ Diversion structures rehabilitation
	  ◦ Headgate replacement and/or automation

Center pivot sprinkler irrigates cropland near Del Norte (photo by Heather Dutton)

3 Vibrant and resilient agriculture, recreation, municipal, and industrial economies that support thriving communities.

Anticipated Outcome	Supporting Strategies to Achieve Goal:
Reservoirs are constructed, rehabilitated, and maintained to provide agricultural, recreational, and aquatic ecosystem benefits.	• Support ongoing dam maintenance and other infrastructure repairs and/or improvements. • Implement storage recovery projects. • Promote collaborative operations of conservation pools and provide recreational and environmental benefits.
Quality, sustainability, and safety of water-based recreational opportunities are improved. Fish hatcheries have sustainable, secure, and adequate physical and legal water supplies.	• Expand private lands hunting programs. • Use existing Colorado Parks and Wildlife programs. • Conserve and restore wetland and other wildlife habitat. • Develop augmentation plans for facilities that use non-exempt groundwater sources.
Municipal potable water supplies are adequate to meet current and future needs (30-year planning horizon), while sustaining and supporting agricultural, recreational, and environmental water use.	• Municipal water providers and industrial water users continue to comply with groundwater rules and regulations, and secure additional augmentation supplies, as needed. • Towns and cities create, periodically update, and implement water efficiency plans. • Towns and counties create comprehensive plans and/or master plans that address existing and future water supply needs, along with opportunities to partner with agriculture and develop additional environmental and recreational assets.

People recreate at the Del Norte Riverfront Park (photo by Sinjin Eberle)

Anticipated Outcome	Supporting Strategies to Achieve Goal:
Municipal water infrastructure, including storage, delivery systems, and wastewater treatment systems, are fully functional and meet all necessary standards and current and future needs.	• Towns and cities create, periodically update, and implement water efficiency plans that include infrastructure needs within the 30-year planning horizon.
Municipalities and municipal water resources are resilient to natural disturbance.	• Implement projects, such as the Colorado WaterWise handbook for municipalities, that protect municipalities and municipal water resources from natural disturbances. • Complete wildfire decision support system assessments as needed. • Update Federal Emergency Management Agency floodplain mapping as needed.
Municipal water efficiency is improved through best management practices.	• Develop municipal programs and incentives for water-efficient appliances and water-smart landscaping. • Towns and cities create, periodically update, and implement water efficiency plans.

The future agricultural water supply gap is reduced.	• Implement diversion infrastructure improvements:
	  • Rehabilitate diversion structures
	  • Replace/automate headgates
	• Repair and enhance existing reservoir storage infrastructure.
	• Implement groundwater conservation easements.
	• Seek new reservoir storage opportunities (e.g., Conejos River system storage project).
	• Additional Natural Resources Conservation Service or other water conservation programs and aquifer recharge opportunities.
	• Implement alternative transfer methods.
	• Implement Groundwater Management Subdistrict programs, including:
	  • Forbearance agreements
	  • Conservation Reserve Program (CRP)
	  • Conservation Reserve Enhancement Program (CREP), which is currently limited to Subdistrict 1
	  • Well purchase program
	  • Well permit acquisition (fallowing programs)
	• Implement ditch lining and/or pipelines, where appropriate.

Reservoirs operate at full decreed capacity without any legal or physical restrictions.	• Implement projects to recover storage lost due to physical and legal limitations. • Implement infrastructure improvement projects that address storage restrictions. Assist reservoir companies in maintaining and repairing reservoir infrastructure.
Surface water diversion structures are rehabilitated to improve function and provide multiple benefits to water users and stream health.	• Implement multi-benefit diversion infrastructure projects. • The Project Database currently includes 17 headgate replacement projects and three headgate automation projects.
Projects are developed and implemented to maintain and improve public and private lands, with an emphasis on soil health.	• Maintain active livestock management that promotes healthy ecosystems. • Support monitoring of land conditions and implementation of responsive management. • Use techniques that improve soil health in farming operations, including crop rotations, alternate crop types, use of green manure, reduced tillage, use of compost or biochar amendments, and other techniques that build organic matter, microbe communities, and water-holding capacity. • Install soil moisture sensors to inform irrigation schedules/amounts, where possible. • Use alternative crop types.

4 Water administration that is adaptive, flexible, and creative while complying with state statutes and the doctrine of prior appropriation, and fully utilizing Colorado's compact entitlements under the Rio Grande and Costilla Creek compacts.

Anticipated Outcome	Supporting Strategies to Achieve Goal:
• Continued compliance with the Rio Grande and Costilla Creek Compacts' annual deliveries with minimal over- and under-deliveries. • Continued compliance with Colorado water law and the prior appropriation system for all water administration and water supply projects. • Improved accuracy of streamflow forecasting	• Use available technology and tools for consistent, reliable, and adaptive streamflow forecasting. • Install remote measurement systems (e.g., ditch, reservoir, and stream gage telemetry) for optimized system operations. • Continue development of snowpack measurement tools.

Irrigation ditch measurement structure (photo by Rio de la Vista)

5 Engaged and informed citizens who understand the scope and urgency of local, state, and regional water issues and participate in robust and diverse educational opportunities.

Irrigation Infrastructure tour (photo by Heather Dutton)

See Section 8 for details on education and outreach strategies.

The Rio Grande BRT and its partners work toward educating the general public and water users on key topics such as:

- Surface and groundwater administration, management considerations, and water supply challenges and strategies.
- The importance and basinwide benefits of municipal and industrial water use objectives and strategies.
- Agriculture objectives and the benefits and cultural significance of agriculture to the community.
- The importance of expanding awareness of programs and opportunities to complete multi-purpose projects, such as the rehabilitation of agricultural infrastructure for multiple benefits, and fostering public/private partnerships that provide multiple benefits.
- Water-based recreation, environmental concerns, and stewardship values.
- Environmental priorities, particularly collaborative efforts of Rio Grande Basin stakeholders to address present and future challenges.
- The utility and basinwide benefits of multi-faceted and cooperative approaches to water management under which water managers work collaboratively to use existing water supplies to meet multiple needs (i.e., do more with less).

Section 5. Demand, Supply, and Potential Water Needs

Water in the Basin

Irrigated acreage in the Rio Grande Basin, particularly in the SLV, is inherently tied to the basin's unique surface and groundwater supplies. The northern third of the SLV is a closed basin, meaning runoff from the surrounding mountains and diversions from the Rio Grande recharge the basin's groundwater aquifers, rather than contribute to the surface water flow of the Rio Grande. Irrigated agriculture in the basin relies on groundwater withdrawals from the aquifers as well as surface water deliveries from rivers and streams. Surface water supplies diverted from streams fed by snowmelt are highly variable from year to year, with annual runoff in high flow years yielding up to eight times more than in drought years. Groundwater from the upper unconfined aquifer and the deeper confined aquifer provides a more consistent irrigation supply. Although recharge to the unconfined aquifer occurs quite quickly, decades of withdrawals greater than recharge have severely depleted it. Although the deeper confined aquifer supplies fewer wells than the unconfined aquifer due to its depth, it also experiences withdrawals that exceed recharge. More information on the surface water and groundwater hydrology in the Rio Grande Basin can be found in Volume 2, Section 2.3.

Daily administration of the Rio Grande Compact, which primarily restricts surface water diversions through curtailment to meet compact deliveries, further impacts water availability in the basin. Combined, surface and groundwater supplies support the irrigation of approximately 515,000 acres in the basin, predominantly in potatoes, grass, alfalfa, and small grains; however, the future of agriculture in the basin is threatened by more frequent periods of drought and declining aquifer levels. Agriculture is the basis of the Rio Grande Basin's economy, and abundant public lands support a thriving tourism economy. Much of the tourism industry is water-dependent, with popular activities including angling, hunting, wildlife and bird watching, winter sports, camping, rafting, paddling, and boating.

Water demands, supplies, and potential future water needs were quantified in the Technical Update (Section 4.7). The analyses in the Technical Update were enhanced with new data during the BIP update. This section summarizes demands, supplies, and potential water needs based on the new input data.

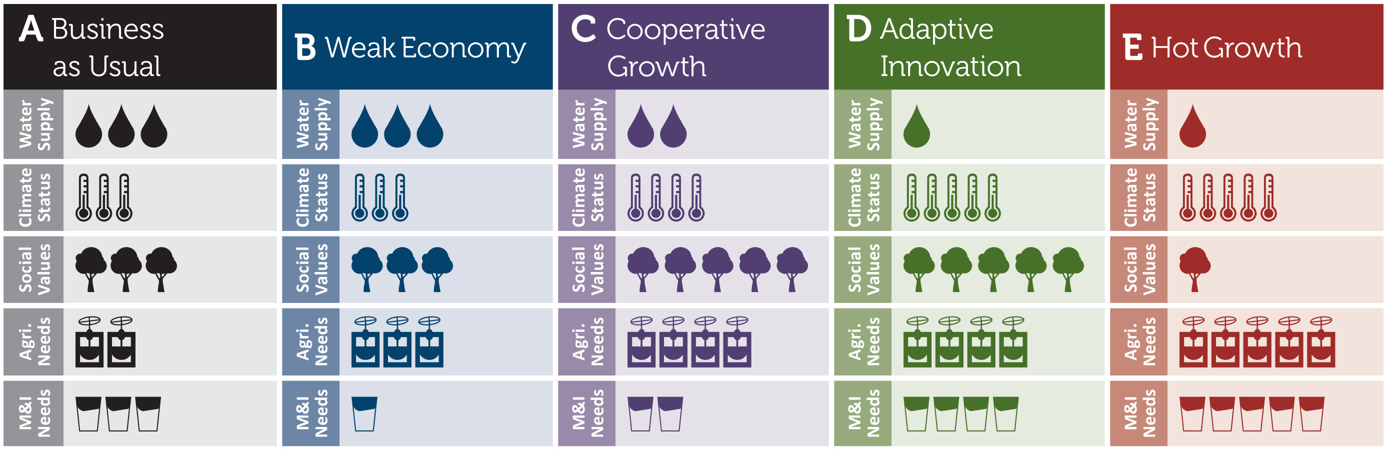
Planning Scenarios

The Analysis and Technical Update to the Colorado Water Plan (Technical Update) published in 2019 quantified the current and potential future water demands, supplies, and additional water needs associated with the Rio Grande Basin under five alternative future scenarios. A key enhancement to Colorado's water planning processes has been the incorporation of scenario planning. The Colorado Water Plan identified five different but plausible future conditions for the year 2050. The scenarios each consider several water resources drivers and how the drivers may change. The drivers included population, urban land use, climate change, industrial water needs, agricultural conditions, and adoption of municipal and agricultural water conservation measures.

For the purposes of the Basin Implementation Plan, it was assumed that, due to compact constraints, there are no available water supplies now or in the future that can meet new demands in the Rio Grande Basin.

Potential future water needs, aka gaps, were estimated for each planning scenario. Gaps are a characterization of the potential risk that water supplies will not be adequate to meet future demand.

Refer to the Technical Update, Sections 2.1.3 and 2.1.4, for more details on the scenarios and drivers (**https://cwcb.colorado.gov/colorado-water-plan/technical-update-to-the-plan**).



A Business as Usual

- Population growth increases at trends predicted by the State Demography Office.
- Future hydrology, per capita water demands, and adoption of conservation measures are similar to what has recently occurred.

B Weak Economy

- The world's economy slows, and the state's population growth is less than predicted.
- Hydrology is similar to recent patterns.
- This scenario puts the least amount of stress on future water supplies and is a bookend for scenarios.

C Cooperative Growth

- Statewide population is similar to State Demography Office predictions but is distributed differently across the state.
- Climate is moderately warmer, and irrigation demands increase.
- People seek to mitigate increased demands by more aggressively adopting water conservation.

D Adaptive Innovation / E Hot Growth

- Both scenarios assume that population growth is higher than projected, and both assume a much warmer and drier future climate.
- The scenarios' primary differences revolve around conservation. In the Adaptive Innovation scenario, the state aggressively adopts conservation measures in both municipal and agricultural sectors. In the Hot Growth scenario, conservation is not a focus.

THE FUTURE WATER CONDITIONS DESCRIBED FOR THE RIO GRANDE BASIN WILL BE IN THE CONTEXT OF THE FIVE PLANNING SCENARIOS.

Refinements to Technical Update Modeling

During the BIP update process, some basins identified enhancements to the Technical Update data, modeling, and analyses. Enhancements included incorporating better municipal water use data, updating operating protocols for basin storage facilities, and revising potential future industrial water demands. The following revisions were made since the 2019 Technical Update of the Rio Grande Basin. Municipal demand was revised based on water usage data provided by the City of Alamosa and the Town of Crestone. While this resulted in a slight decrease to municipal and industrial (M&I) demand and gap, no impacts to agricultural demand or gap were identified.

Discussed in the 2019 Technical Update, the Rio Grande Basin benefits from the delivery of a small amount of imported transmountain diversion (TMD) supplies from the Southwest Basin via the San Juan River Basin. Revisions to this source basin's supplies did not impact the TMD deliveries, and information presented in the 2019 Technical Update for this aspect remains unchanged.

Additional information on the refinements to the Technical Update modeling is provided in Appendix A.

Sandhill Cranes at Russel Lakes State Wildlife Area (photo by Cary Aloia)

Municipal and Industrial Demands

POPULATION PROJECTIONS

The Rio Grande Basin currently includes less than 1 percent of the statewide population. Between 2015 and 2050, it is projected to change from approximately 46,000 people to between 42,000 and 67,000 people in the low- and high-growth projections, respectively. This ranges from an 8 percent decrease in population to an increase of 46 percent. Table 3 shows how population growth is projected to vary across the planning scenarios.

A surface water allocation model is not currently available in the Rio Grande Basin. As such, detailed hydrographs of projected water supplies and storage volume could not be developed.

DEMANDS

The Rio Grande Basin municipal baseline and projected diversion demands provided in Table 3 show the combined effect of population and per capita demands. Systemwide, per capita demands are projected to decrease relative to the Baseline except for Hot Growth. Municipal demands are projected to change from approximately 10,200 acre-feet per year (AFY) in 2015 to between 9,000 AFY and 15,300 AFY in 2050. Alamosa County accounts for around one-third of the baseline demand, followed by Conejos and Rio Grande Counties, each at about one-quarter of the basin demand.

The baseline and projected demands are shown on Figure 3, which also shows how the population varies across scenarios. All the projection scenarios, except for Weak Economy, result in an increase in systemwide demand relative to the Baseline.

The Rio Grande Basin includes about 4 percent of the statewide industrial diversion demand. Industrial demands in this basin are associated with large industry (fish and aquaculture, agricultural product processing) and energy development (solar power generation and future oil and gas development). A minor amount of snowmaking occurs, but the amount of water is very small on a basinwide scale, and it was not considered in the demand analysis.

Rio Grande Basin's combined M&I demand projections for 2050 range from approximately 17,300 AFY in Weak Economy to 25,300 AFY in Hot Growth, as shown on Figure 4. Industrial demands account for about 40 percent to 50 percent of the M&I demands.

The following are observations on the M&I diversion demands:

- Municipal diversion demand and industrial diversion demand contribute nearly evenly to total M&I diversion demand, with municipal demand accounting for just a little more than half. This is unique among Colorado's river basins.
- Population growth is the main driver for the modest increases in M&I demands in the planning scenarios, as per capita water use decreased for every scenario except Hot Growth.

GAPS

The M&I gap for each scenario was estimated as the difference between the projected diversion demands and the current levels of municipal diversions and pumping. The diversion demand and gap results for M&I uses in the Rio Grande Basin are also illustrated on Figure 4. Time series of M&I gaps were not developed in the Rio Grande Basin, because a Colorado Decision Support System (CDSS) water allocation model is not available at this time.

The following are observations on the M&I diversion gaps:

- Projected maximum annual M&I gaps in the Rio Grande Basin range from 0 AF in Weak Economy to 7,900 AF in Hot Growth.
- For Hot Growth, the M&I gap is much larger than other scenarios, at 31 percent of demand.
- Figure 4 shows that gaps can increase significantly during dry periods, especially in Adaptive Innovation and Hot Growth (the scenarios most severely impacted by future climate assumptions). Projects and water management strategies will be needed to meet periodic maximum M&I gaps.

Table 3. Summary of Baseline and 2050 Projected Municipal and Industrial Water Demands and Gaps

	Baseline[1]	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Population	46,000	55,100	42,300	52,100	63,000	67,300
Systemwide Per Capita Demands (gallons per capita per day) [1]	201	188	192	183	172	203
Municipal Diversion Demand (AFY) [2]	10,200	11,600	9,000	10,600	12,200	15,300
Industrial Diversion Demand (AFY) [2]	7,300	9,200	8,300	9,200	9,200	10,000
Total M&I Diversion Demand (AFY) [2]	17,500	20,800	17,300	19,800	21,400	25,300
Average Annual Gap (AFY)	-	3,300	-	2,400	3,900	7,900
Maximum Annual Gap (AF)	-	3,300	-	2,400	3,900	7,900

[1] *Baseline year is 2015.*

[2] *M&I demands may vary slightly from the M&I Demand section of the Technical Update (Section 4.7.5) due to differences in geographic distribution of demand for counties that lie in multiple basins.*

Calculation methodologies and assumptions for M&I water demands are available in the Technical Update documentation.

https://cwcb.colorado.gov/colorado-water-plan/technical-update-to-the-plan

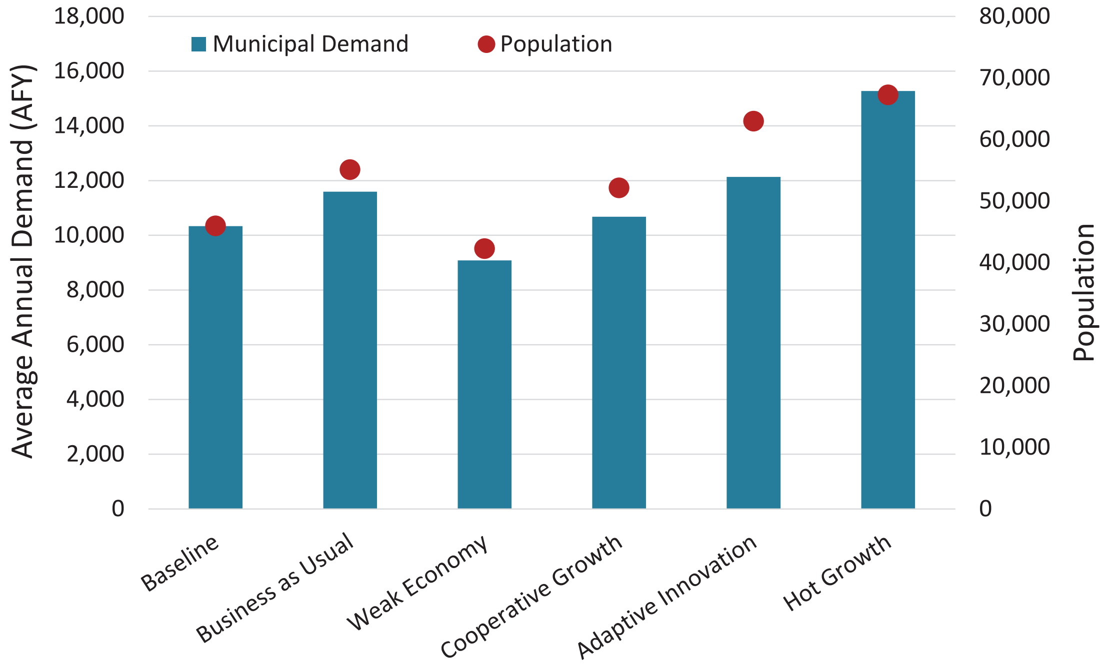


Figure 3. Baseline and 2050 Projected Population and Municipal Demand

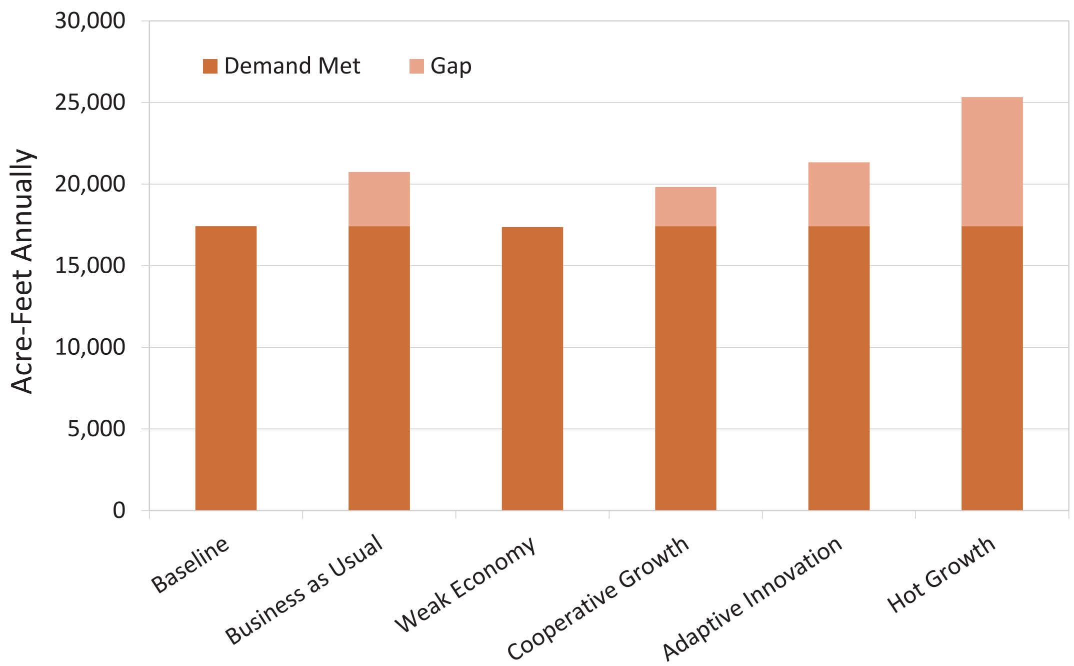


Figure 4. Baseline and 2050 Projected Maximum Annual M&I Demand Met and Gaps

Agricultural Demands

DEMAND

Table 4 summarizes the acreage, irrigation water requirement (IWR), and the agricultural diversion demand for surface water supplies in the Rio Grande Basin for Baseline conditions and the five planning scenarios. All scenario demands are lower than Baseline because of irrigated acreage reduction required to meet aquifer sustainability requirements. Overall diversion demand in climate-impacted scenarios (Cooperative Growth, Adaptive Innovation and Hot Growth) is lower than in Business as Usual and Weak Economy because compensation for reductions in irrigated acreage is assumed to be implemented. On-farm irrigation demand on remaining acreage, however, would be higher because of a warmer and drier future climate.

The following are observations on agricultural diversion demands:

- Business as Usual and Weak Economy do not include climate-adjusted hydrology or demands; therefore, changes in these scenarios are related to projected reductions in irrigated acres and that impact on average annual demand.
- As shown on Figure 5, agricultural diversion demand is expected to decrease under all scenarios because of a reduction in irrigated acres and the implementation of more efficient irrigation practices. As a result, Adaptive Innovation has the lowest agricultural diversion demand.

Agriculture diversion demand represents the amount of water that would need to be diverted or pumped to meet the full crop irrigation water requirement. The diversion demand does not reflect historically applied irrigation amounts because irrigators often operate under water-short conditions and do not have enough supply to fully irrigate their crops.

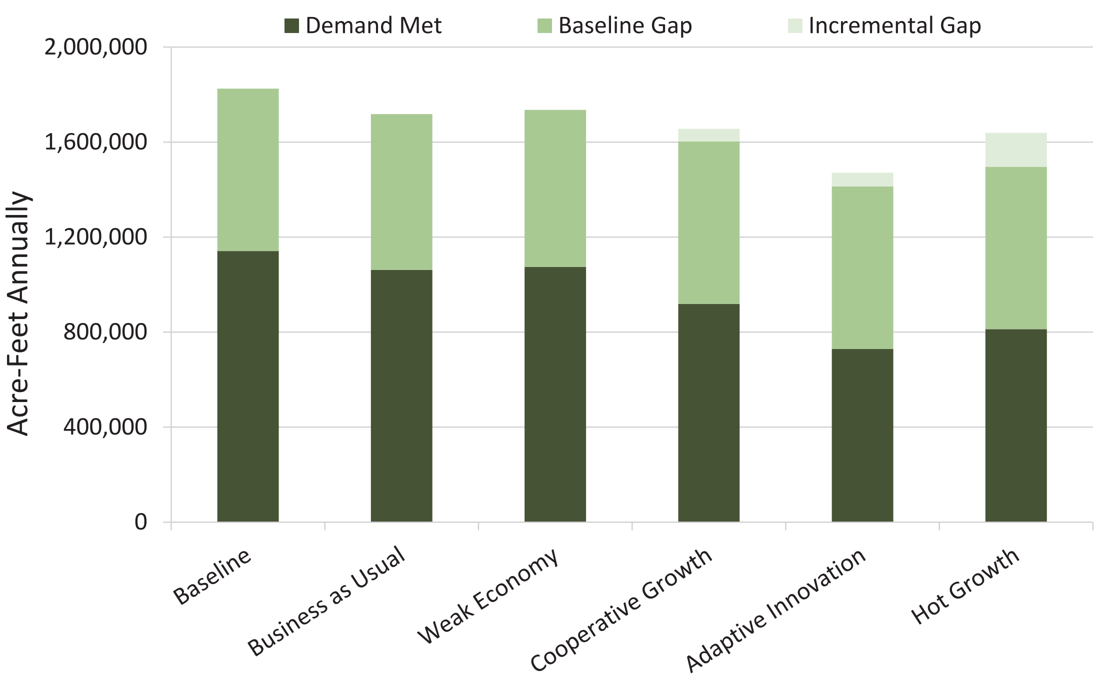


Figure 5. Baseline and 2050 Projected Average Annual Agricultural Diversion Demand, Demand Met, and Gaps

GAPS

Because the Rio Grande Compact limits agricultural water use and the system is over-appropriated, current water supply was assumed to be equal to historical diversions and groundwater withdrawals, with no additional supply available. The current baseline agricultural gap was estimated as the difference between the current agricultural diversion demand and the combined historical diversions and groundwater withdrawals for wet, dry, and average years.

The Incremental Average Annual Gap quantifies the degree to which the basinwide gap could increase beyond what agriculture has historically experienced under water-short conditions.

An annual time series of gaps in terms of percent of demand that was unmet is shown on Figure 6.

The following are observations on agricultural diversion gaps:

- Despite reduced demand, the size of the agricultural gap is projected to increase relative to Baseline in the three scenarios that are climate-impacted because the available supply is forecasted to be reduced.
- Current and future agricultural gaps persist throughout the simulation results and increased in dry periods, as shown on Figure 6.

Table 4. Summary of Baseline and 2050 Projected Agricultural Diversion Demands and Gaps

	Baseline[1]	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Irrigated Acreage (acres)	515,300	466,300	470,300	396,500	385,200	385,200
Average IWR (AFY)	1,021,000	941,000	949,000	913,000	819,000	910,000
Average Annual Demand (AFY)	1,825,200	1,717,800	1,735,700	1,656,300	1,471,400	1,638,900
Average Annual Gap (AFY)	683,900	655,800	661,500	737,400	741,900	826,400
Incremental Avg. Ann. Gap (AFY)	-	-	-	53,500	58,000	142,500
Maximum Annual Gap (AFY)	1,059,700	1,017,400	1,026,400	1,112,700	1,111,000	1,238,500

[1] *Baseline agricultural demands were estimated using a model that used "current" irrigated acreage and cropping patterns and incorporated historical weather patterns.*

The Rio Grande has challenges related to achieving sustainable aquifer levels, particularly in the unconfined aquifer in Subdistrict 1. A detailed discussion on this topic can be found in Section 6.

Calculation methodologies and assumptions for agricultural water demands are available in the Technical Update documentation

https://cwcb.colorado.gov/colorado-water-plan/technical-update-to-the-plan

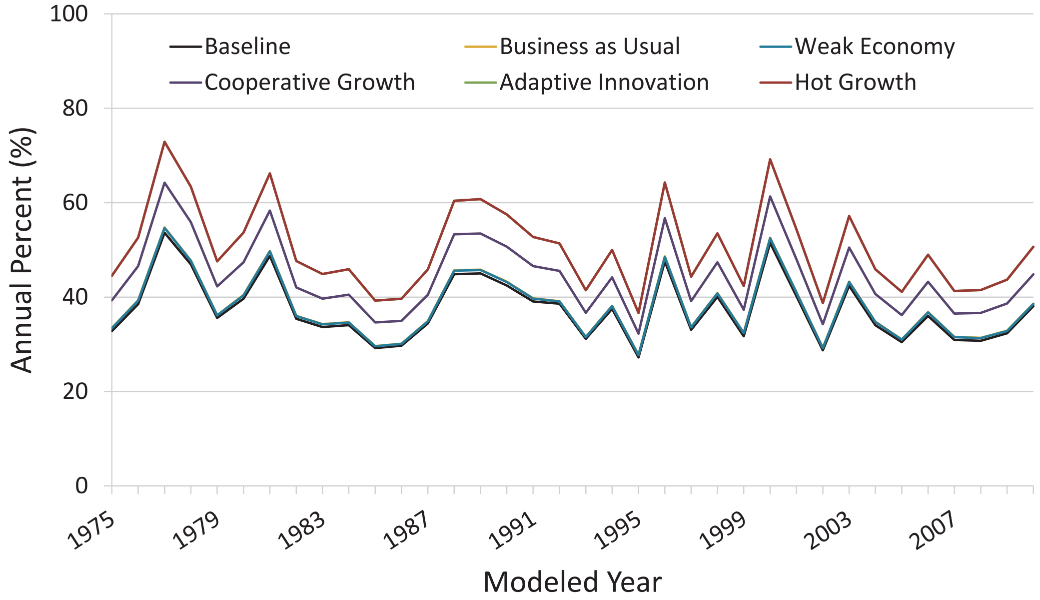


Figure 6. Modeled Annual Agricultural Gaps (expressed as a percentage of demand unmet) by Planning Scenario

The baseline gap is the difference between the amount of available water used for irrigation versus the amount that would be used if irrigators had more supply and were able meet the full crop irrigation water requirement (see Figure 5). The basin's agricultural water users view the baseline gap as an inherent condition that the Rio Grande Basin has and will continue to live with into the future. Note that even though the baseline gap is not considered a gap by the water users, it is reported as such for this effort for consistency purposes across the State. Because the basin's agricultural water users recognize that the baseline gap reflects current deficit irrigation practices, agricultural water strategies are focused on meeting the incremental gap rather than the baseline gap.

Environment and Recreation

During the Technical Update, current and potential future risks to environment and recreation (E&R) attributes in the Rio Grande Basin were evaluated using the Colorado Environment and Recreation Flow Tool (Flow Tool). The Flow Tool was developed to help basin roundtables evaluate their portfolios of E&R projects by fostering an improved understanding of potential streamflow-related risks (both existing and projected) to E&R attributes throughout their respective basins.

The Flow Tool uses streamflow data from CDSS, modeled streamflow data for various planning scenarios, and established flow-ecology relationships to assess risks to flows and E&R attribute categories at preselected gages across the state. The Flow Tool is a high-level tool that is intended to provide guidance during stream management plan and BIP development.

A surface water allocation model is not currently available in the Rio Grande Basin. As a result, hydrologic datasets in the Flow Tool include naturalized flows as impacted by climate change. A total of six water allocation model nodes, all in the mountains and foothills west of the SLV, were selected for the Flow Tool, as shown on Figure 7. Figure 7 also shows the subwatershed (at the 12-digit HUC level) and the relative number of E&R attributes located in each sub-watershed.

- Rio Grande at Wagon Wheel Gap (08217500)
- South Fork Rio Grande at South Fork, CO (08219500)
- Pinos Creek Del Norte, CO (08220500)
- Conejos River Below Platoro Reservoir, CO (08245000)
- Conejos River Near Mogote, CO (08246500)
- Alamosa River Below Terrace Reservoir, CO (08236500)

These sites were selected because they are above major supply and demand drivers where future flow changes would likely be associated with only climate change factors. Management drivers impact river flows in areas downstream of mountainous areas in the basin. These data do not represent changes in flow due to irrigation, transmountain imports, and/or storage.

In the 2021 iteration of modelling, two Flow Tool nodes were added: Conejos River Near Mogote, and Alamosa River below Terrace Reservoir. The E&R subcommittee identified a need to compare the Mogote gage node to the Platoro gage node. The Mogote gage is downstream of Platoro and captures several large tributaries to the Conejos mainstem. Additionally, the subcommittee was interested in understanding the potential risk to a robust trout fishery on the Conejos River near Mogote. The Alamosa River below Terrace Reservoir gage was added because there is interest in an improved understanding of environmental and recreational flows on the Alamosa River below Terrace Reservoir. Results and observations from the Flow Tool analyses are described in Table 5.

The identification of future risks to environmental and recreational attributes helps facilitate discussions about projects or strategies that can be implemented to reduce the risks. This type of discussion is similar to, and integrates with, roundtable strategies that focus on reducing the risk of experiencing municipal or agricultural gaps.

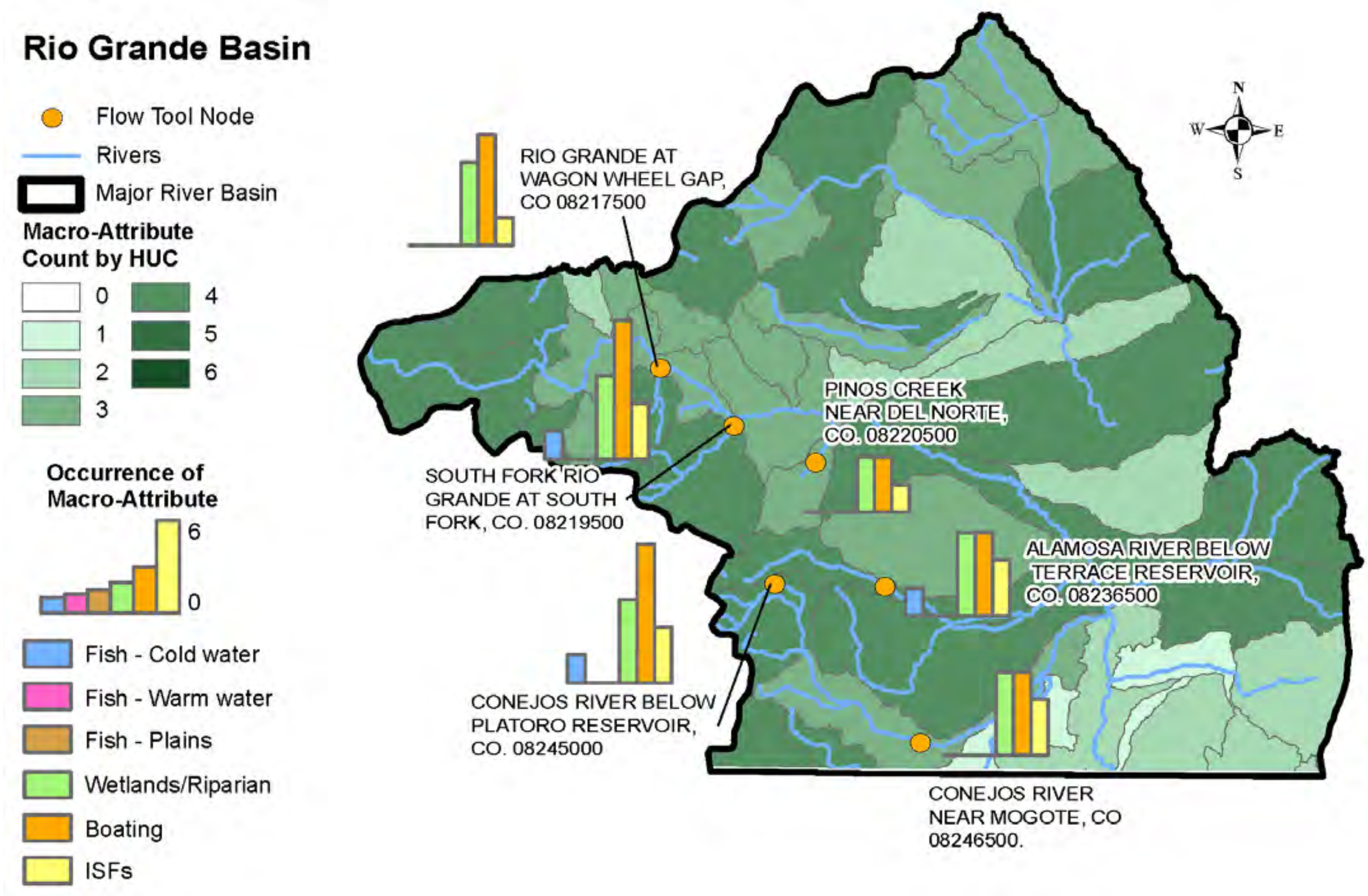


Figure 7. Flow Tool Nodes Selected

Table 5. Summary of Flow Tool Results

Category	Observation
Projected Flows	• Annual flows under climate-impacted scenarios (Cooperative Growth, Adaptive Innovation, Hot Growth) are projected to be variable compared to Baseline, Business as Usual, and Weak Economy. Some years, climate-impacted scenarios are projected to have greater annual flow and some years less compared to Baseline, mostly during drier years. • Overall, spring runoff peak flows are projected to occur earlier in April and May for the climate-impacted scenarios (Cooperative Growth, Adaptive Innovation, and Hot Growth) compared to the peak occurring in June for Baseline, Business as Usual, and Weak Economy scenarios. Subsequently, mean monthly flows are less for climate-impacted scenarios for all other months (July through March). July streamflow is projected to be roughly half on the Rio Grande and tributaries and less than half on the Conejos River for the climate-impacted scenarios.
Ecological Risk	• Peak-flow-related risk for riparian/wetland and fish habitat is projected to remain low or moderate for most planning scenarios, although there are some indications that risk could increase in smaller streams. • Due to the shift in mean monthly peak flows for the climate-impacted scenarios to an earlier spring peak runoff and lower mid- to late-summer flows, shorter spawning windows and summer low-flow conditions could adversely affect various fish species. Lower flow conditions combined with warmer air temperatures due to climate change could result in warmer water temperatures that would negatively impact cold-water fish species.
Instream Flows and Recreational In-channel Diversions	• Several instream flows throughout the basin and recreational in-channel diversions are unlikely to be met if June-August flows decrease as projected under climate-impacted scenarios.
E&R Attributes	• Because future flows under the five scenarios have not been modeled in the Rio Grande Basin, projected changes to flow and associated changes in risk to E&R attributes within the Flow Tool are attributable only to projected changes in climate. These climate-induced changes—earlier peak flow and reduced mid- and late-summer flows—are similar to the general pattern seen in many parts of Colorado.

Focus Area Mapping

Since the 2005 passage of the Colorado Water for the 21st Century Act, the nine basin roundtables and the CWCB have worked to characterize Colorado's E&R water needs. The effort has included extensive inventory, analysis, and synthesized mapping of each basin's environmental and recreational attributes. Through this process, each basin created Focus Area maps that identify streams or watersheds where E&R attributes are located and/or where these attributes may be at risk. The Focus Area maps were included in the 2010 version of the Statewide Water Supply Initiative and were updated by some basins during the development of the 2015 BIPs.

During the current BIP update effort, the Rio Grande BRT's E&R subcommittee did not identify specific streams or watersheds to add to the Focus Area maps; however, the subcommittee would like to update the E&R attribute mapping used to identify focus areas. The subcommittee recommended that, in the future, the attribute mapping and the resulting focus areas be updated. Figure 8 shows the current Focus Area Map for the Rio Grande BRT.

The Focus Area maps were created to:

1. **Help guide water supply planning**
2. **Help identify where projects could reduce risks to E&R attributes**
3. **Identify potential collaborative projects**

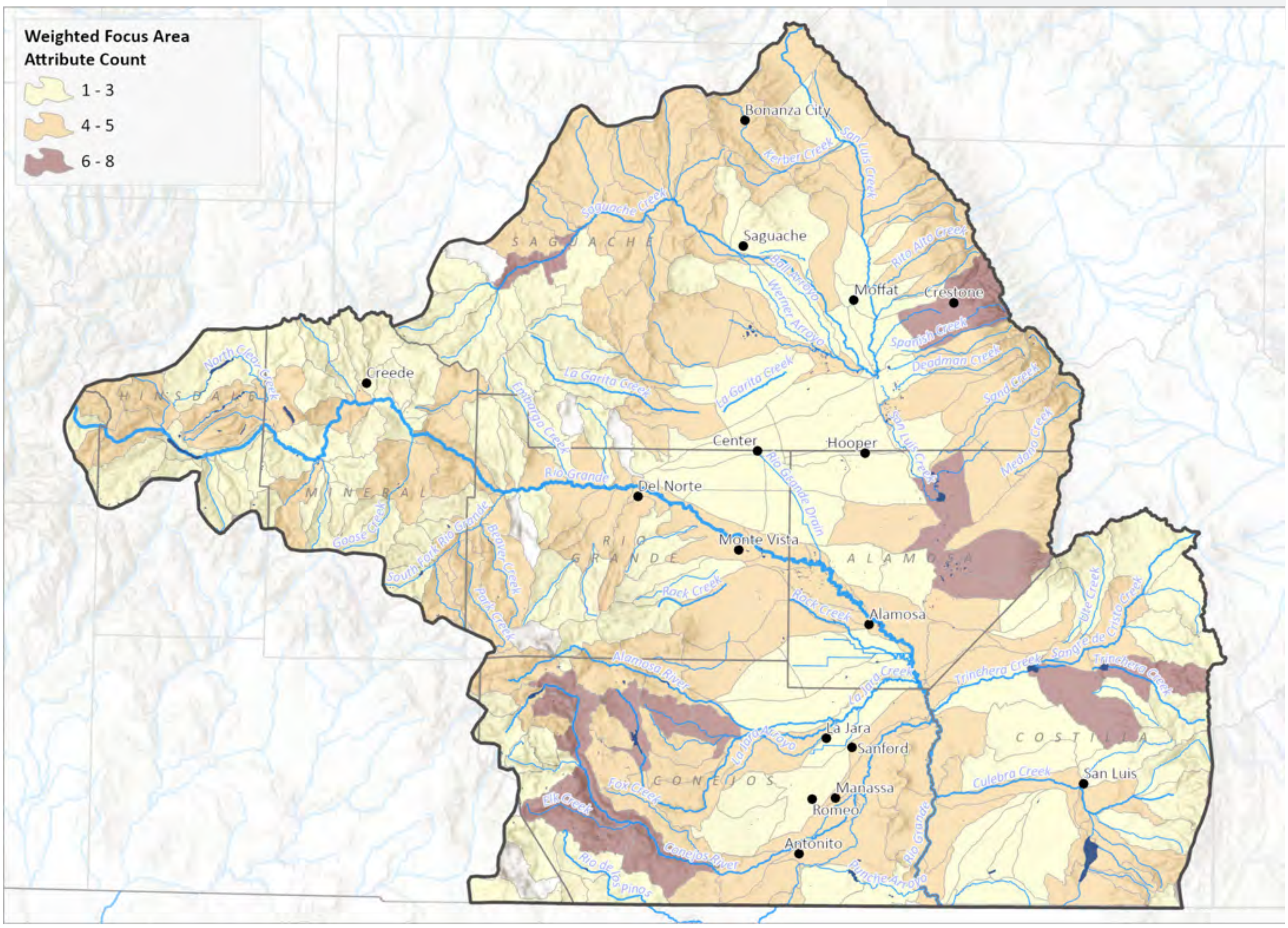


Figure 8 **Focus Area Map of the Rio Grande Basin**

Section 6. Strategic Vision for the Future

The goals, anticipated outcomes, and strategies described in Section 4 provide a long-term vision for the Rio Grande Basin and the steps that stakeholders can engage in to help protect existing water uses in the basin. This section provides overarching strategies where the Rio Grande BRT will focus efforts in the near-term to make progress toward these goals and ensure that projects supported and funded through the Rio Grande BRT align with the goals.

Volume 2 Section 4 has detailed discussion basin needs. These needs helped inform the creation of the strategic vision for the future described in this section of Volume 1.

Summary of Strategies

The Rio Grande Basin faces significant water resources challenges now and into the future. To help meet the basin's current and future water needs, the Rio Grande BRT, stakeholders, and the community will employ adaptive strategies that promote resilience and allow for flexible water-sharing agreements, within the context of Colorado's water laws.

The strategies described below work toward a long-term vision of achieving a sustainable water future for a variety of water users and uses. Implementation of future strategies will require continued coordination, innovation, and a focus on achieving multiple benefits for a diverse group of water users and stakeholders. Basin stakeholders recognize that water meets multiple needs as it flows through the Rio Grande Basin, as illustrated in Figure 9. The Rio Grande BRT and its partners will continue seeking a diverse set of funding opportunities to implement these projects and strategies.

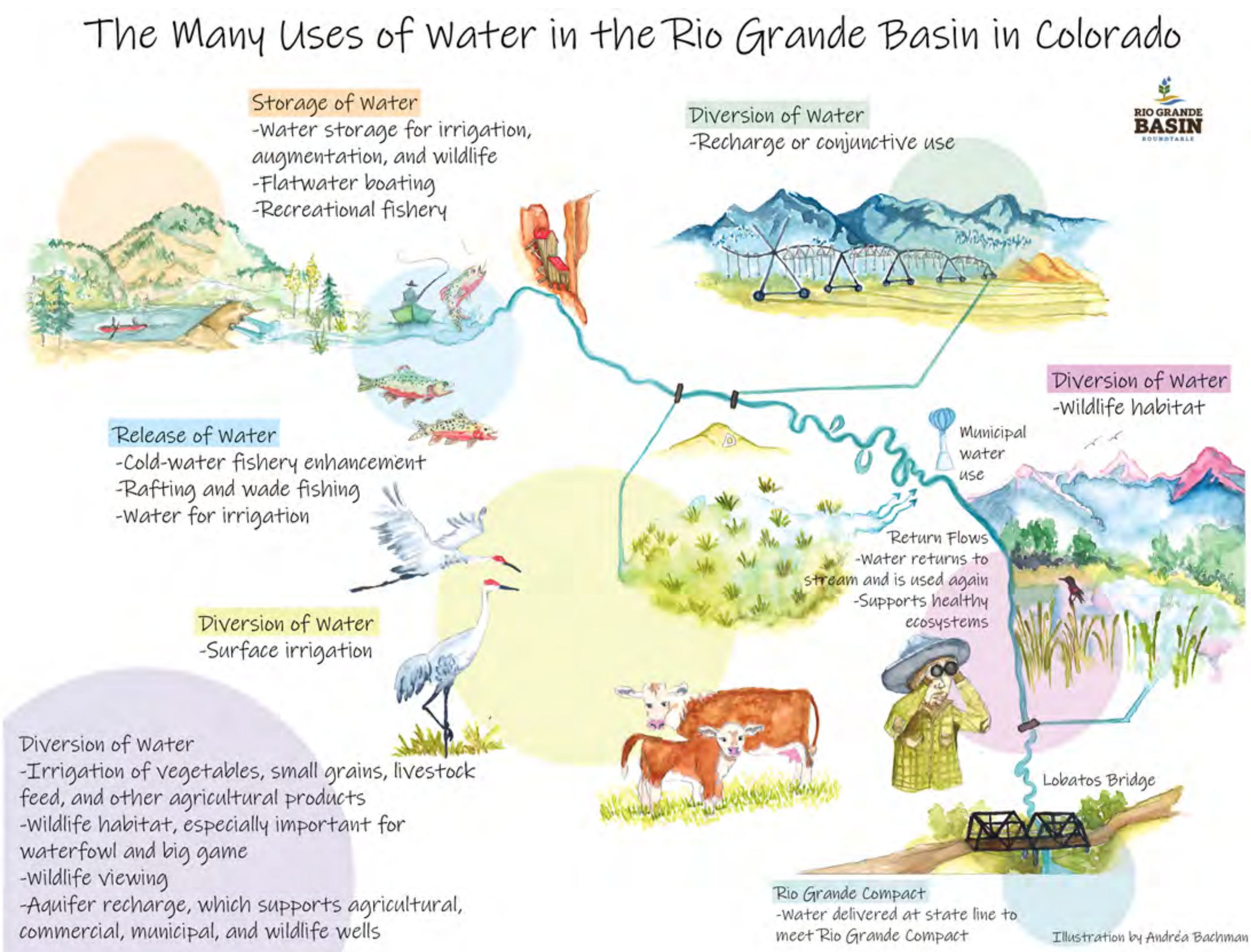


Figure 9. The Many Uses of Water in the Rio Grande (illustration by Andréa Bachman)

1 PROJECT IMPLEMENTATION STRATEGY

The Rio Grande BRT will continue to support the implementation of projects that meet basin goals, particularly those that provide multiple benefits. Project implementation will advance nearly all the goals and anticipated outcomes identified in Section 4. The projects are designed to help minimize the impacts on agriculture and the SLV way of life while protecting E&R uses and represent a holistic approach to water management. Healthy watersheds and soils, along with fully functional reservoirs and diversion structures, can provide the resiliency needed to adapt to changing conditions and lead to a sustainable water future for multiple users. Future projects identified during the BIP update are shown on Figure 10 and described in Table 6 and summarized in Section 7. Note: Figure 10 and Table 6 do not include projects identified during the 2015 BIP that are still being completed.

Implementing relevant projects is a crucial step in the development of the Rio Grande Basin's path forward. The Rio Grande BRT recognizes that identifying and prioritizing projects is a dynamic process, changing as opportunities and constraints present themselves. Projects that meet multiple basin needs and a greater number of goals may have a higher priority for funding.

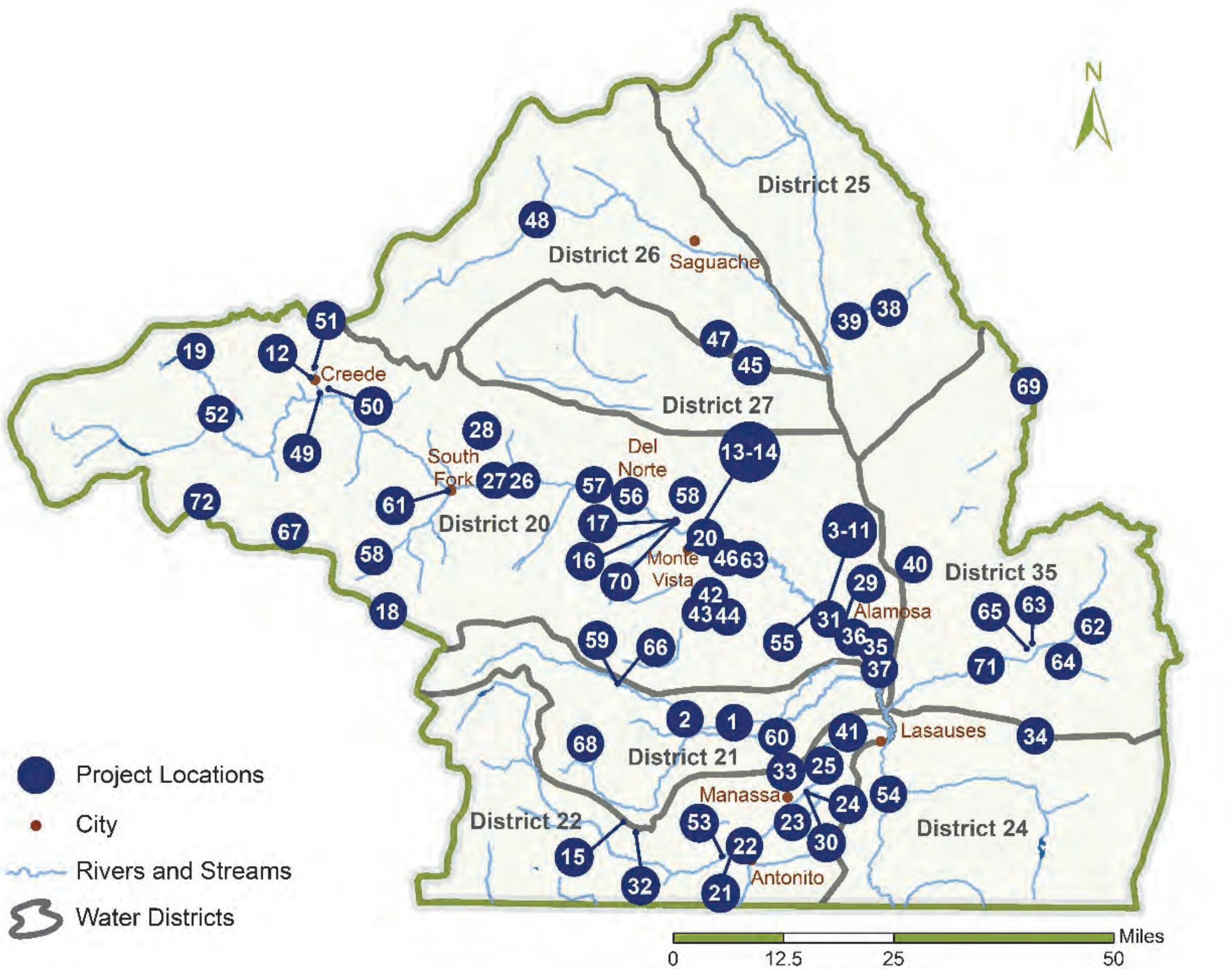


Figure 10. Locations of Future Projects Identified During the BIP

Table 6. Summary of Future Projects Identified During the BIP

Project No.	Project ID	Lead Proponent	Project Name	Municipal and Industrial	Agriculture	Environmental and Recreational	Water Administration
1	RG-2020-0001	Alamosa-La Jara Water Conservancy District	Alamosa River Water Delivery Improvement Project – Phase II		●	●	●
2	RG-2020-0002	Alamosa-La Jara Water Conservancy District	Creek Canal Pipeline Project		●		●
3	RG-2020-0003	City of Alamosa	Alamosa Levee Recertification and Revitalization	●	●	●	●
4	RG-2020-0004	City of Alamosa	Increasing Efficiencies in the Distribution and Collections Systems of Alamosa - Phase 1	●			●
5	RG-2020-0005	City of Alamosa	Increasing Efficiencies in the Distribution and Collections Systems of Alamosa - Phase 2	●			●
6	RG-2020-0006	City of Alamosa	Increasing Efficiencies in the Distribution and Collections Systems of Alamosa - Phase 3	●			●
7	RG-2020-0007	City of Alamosa	Producing a Master Infrastructure Plan for the City of Alamosa - Phase 1	●			●
8	RG-2020-0008	City of Alamosa	Producing a Master Infrastructure Plan for the City of Alamosa - Phase 2	●			●
9	RG-2020-0009	City of Alamosa	Producing a Master Infrastructure Plan for the City of Alamosa - Phase 3	●			●
10	RG-2020-0010	City of Alamosa	Studying Existing Turf Irrigation and Implementing Efficiencies in the City of Alamosa - Phase 1	●		●	●
11	RG-2020-0011	City of Alamosa	Studying Existing Turf Irrigation and Implementing Efficiencies in the City of Alamosa - Phase 2	●		●	●
12	RG-2020-0012	City of Creede	City of Creede Collection System I&I Improvement Project – Phase 1c	●		●	●
13	RG-2020-0013	City of Monte Vista	Monte Vista Municipal Wastewater Treatment Plant Improvement Project	●		●	●
14	RG-2020-0014	City of Monte Vista	Monte Vista Water Distribution Improvement Project - Phase 1	●			●
15	RG-2020-0015	Colorado Open Lands	Conejos Ranchland Initiative		●	●	●
16	RG-2020-0016	Colorado Open Lands	Helping Communities Understand the Values of Private Land Conservation Using Environmental Social Goals	●	●	●	●
17	RG-2020-0017	Colorado Open Lands	San Luis Valley River & Aquifer Recovery & Enhancement (RARE) Partnership Implementation		●	●	●

Table 6. Summary of Future Projects Identified During the BIP (continued)

Project No.	Project ID	Lead Proponent	Project Name	Municipal and Industrial	Agriculture	Environmental and Recreational	Water Administration
18	RG-2020-0018	Colorado Parks and Wildlife	Alberta Park Reservoir Dam Improvement Project			●	●
19	RG-2020-0019		Rito Hondo Reservoir Dam Improvement Project			●	●
20	RG-2020-0020	Colorado Rio Grande Restoration Foundation	Billings Ditch Rehabilitation Project		●	●	●
21	RG-2020-0021		Chacon Ditch No. 1 Improvement Project		●	●	●
22	RG-2020-0022		Conejos River at Guadalupe - Stream and Riparian Restoration	●	●	●	●
23	RG-2020-0023		Conejos River Partnership Project – Phase II		●	●	●
24	RG-2020-0024		Cottonwood Ditch Improvement Project		●	●	●
25	RG-2020-0025		East Bend Ditch Improvement Project		●	●	●
26	RG-2020-0026		Ehrowitz Ditch Improvement Project		●	●	●
27	RG-2020-0027		Minor Ditch Improvement Project		●	●	●
28	RG-2020-0028		Rio Grande National Forest Wet Meadow Restoration Project - Phase 2			●	
29	RG-2020-0029		Rio Grande Riparian Stabilization Project - Phase 6			●	
30	RG-2020-0030		Trogillio Ditch Improvement Project		●	●	●
31	RG-2020-0031		Westside Ditch Improvement Project	●	●	●	
32	RG-2020-0032	Conejos Water Conservancy District	Conejos Cooperative Storage Project	●	●	●	●
33	RG-2020-0033		Manassa Land and Irrigation Conveyance Project	●	●	●	●
34	RG-2020-0034	Costilla County Conservancy District	Upper Culebra Watershed Assessment – Project Implementation	●	●	●	●

Table 6. Summary of Future Projects Identified During the BIP (continued)

Project No.	Project ID	Lead Proponent	Project Name	Municipal and Industrial	Agriculture	Environmental and Recreational	Water Administration
35	RG-2020-0035	Ducks Unlimited, Inc.	Alamosa National Wildlife Refuge (NWR) – Mumm Well Restorations			●	
36	RG-2020-0036	Ducks Unlimited, Inc.	Alamosa NWR – Rio Grande Riparian Restorations			●	
37	RG-2020-0037	Ducks Unlimited, Inc.	Alamosa NWR – Units C1, T, O and Restorations			●	
38	RG-2020-0038	Ducks Unlimited, Inc.	Baca NWR – Crestone Creek Riparian Restorations			●	
39	RG-2020-0039	Ducks Unlimited, Inc.	Baca NWR – Wet Meadow Restorations			●	
40	RG-2020-0040	Ducks Unlimited, Inc.	McIntire Springs – Riparian Restorations			●	
41	RG-2020-0041	Ducks Unlimited, Inc.	McIntire-Simpson – Riparian Wetland Restorations			●	
42	RG-2020-0042	Ducks Unlimited, Inc.	Monte Vista NWR – Spring Creek Restoration			●	
43	RG-2020-0043	Ducks Unlimited, Inc.	Monte Vista NWR – Units 14, 15 and 16 Restoration			●	
44	RG-2020-0044	Ducks Unlimited, Inc.	Monte Vista NWR – Units 18 and 24 Restoration			●	
45	RG-2020-0045	Ducks Unlimited, Inc.	Northern SLV Water Table Study on Conserved Lands		●	●	●
46	RG-2020-0046	Ducks Unlimited, Inc.	Rio Grande State Wildlife Area – Wetlands and Water Restoration			●	
47	RG-2020-0047	Ducks Unlimited, Inc.	Russell Lakes State Wildlife Area – Wetlands and Water Restoration			●	
48	RG-2020-0048	Ed Nielsen	Upper Saguache Creek Bank Stabilization and Restoration		●	●	
49	RG-2020-0049	Headwaters Alliance	Lower Willow Creek Floodplain Stream Restoration, Habitat Enhancement and Recreational Development Project	●		●	●
50	RG-2020-0050	Headwaters Alliance	Mineral County Water Use Project	●	●	●	●
51	RG-2020-0051	Headwaters Alliance	North Creede Stream Stability and Flood Mitigation	●		●	●
52	RG-2020-0052	Headwaters Alliance	Upper Rio Grande Tributary Flow Volume Project			●	●
53	RG-2020-0053	Mefford Ranch	Mefford Ranch Bank Stabilization/ Stream restoration		●	●	

Table 6. Summary of Future Projects Identified During the BIP (continued)

Project No.	Project ID	Lead Proponent	Project Name	Municipal and Industrial	Agriculture	Environmental and Recreational	Water Administration
54	RG-2020-0054	Salazar Rio Grande del Norte Center at Adams State University	Rio Grande Natural Area – Rangeland Analysis Platform (RAP) Assessment		●	●	
55	RG-2020-0055		Water Education Initiative: Phase II	●	●	●	●
56	RG-2020-0056	San Luis Valley Irrigation District	Farmers Union Canal Headgate Automation Project	●	●	●	●
57	RG-2020-0057		North Branch Splitter Rehabilitation Project	●	●	●	●
58	RG-2020-0058	San Luis Valley Water Conservancy District	Shaw Reservoir Rehabilitation	●	●	●	●
59	RG-2020-0059	Terrace Irrigation Company	Terrace Reservoir Outlet Works Analysis and Repair- Phase II	●	●		
60	RG-2020-0060	Town of La Jara	Town of La Jara Wastewater Treatment Facility Project	●			●
61	RG-2020-0061	Town of South Fork	Town of South Fork Municipal Water Infrastructure Improvements – Phase 2	●			●
62	RG-2020-0062	Trinchera Irrigation Company	Indian Creek Ditch Project		●	●	●
63	RG-2020-0063		Levy Diversion and Headgate Rehabilitation Project		●		●
64	RG-2020-0064		Mountain Home Reservoir Spillway Project		●		●
65	RG-2020-0065		Ute Creek Parshall Flume Project		●		●
66	RG-2020-0066	Trout Unlimited	Alamosa River Instream Flow Restoration			●	
67	RG-2020-0067		Goose Lake Reservoir Management Plan and Repair		●	●	
68	RG-2020-0068		Jim Creek Electric Fish Barrier			●	
69	RG-2020-0069		Medano Ditch Fish Screen		●	●	
70	RG-2020-0070		Rio Grande Cutthroat Reintroduction Studies			●	
71	RG-2020-0071		Smith Reservoir Storage Recovery Feasibility Study		●	●	
72	RG-2020-0072		Trout Lake Reservoir - Wilderness Infrastructure Repair		●	●	

2 VISION FOR ADDRESSING AGRICULTURAL GAPS

With agricultural water use currently exceeding supply, significant challenges lie ahead. Of particular importance to the basin is achieving aquifer sustainability while incurring minimal impact to its economy. As shown on Figure 11 (also shown in Section 5, Figure 5), the Technical Update accounted for the need to reduce consumptive use to reach water use levels in the basin that the aquifers can sustainably support, noting that if drier conditions persist, further adaptations in water use would be required.

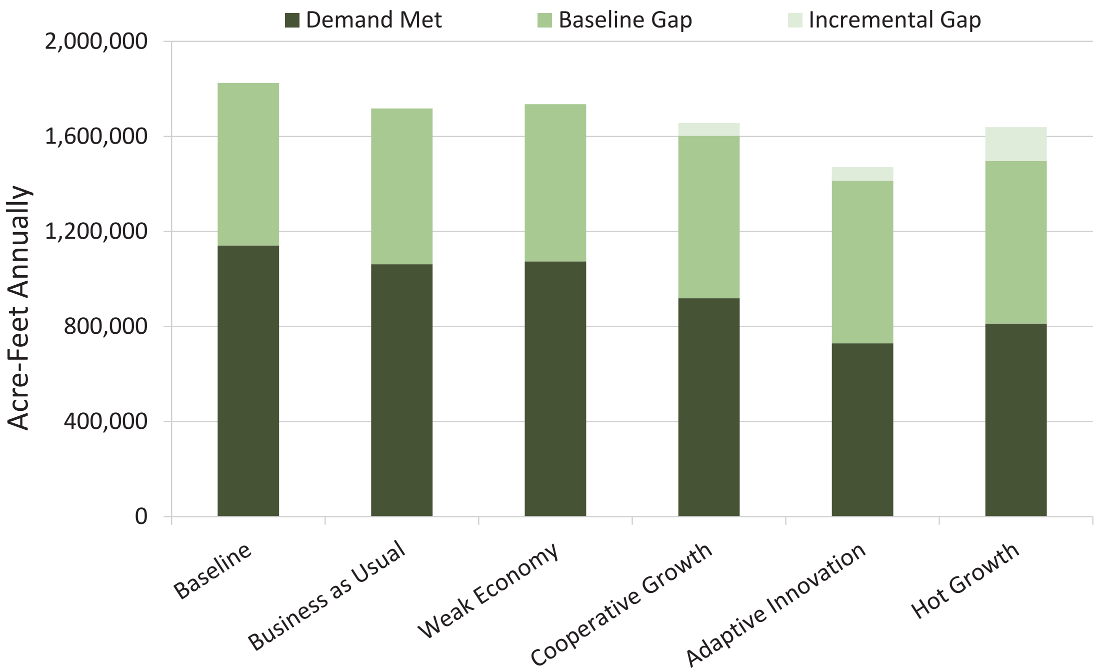


Figure 11. Baseline and 2050 Projected Average Annual Agricultural Diversion Demand, Demand Met, and Gaps

Aquifer levels have continued to decline to varying degrees across the basin since the Technical Update effort, which indicates the need for additional reductions in water usage. Figure 12 reflects the portion of the agricultural demand met under each planning scenario, with a highlight of additional reductions in water use needed to sustain aquifer levels.

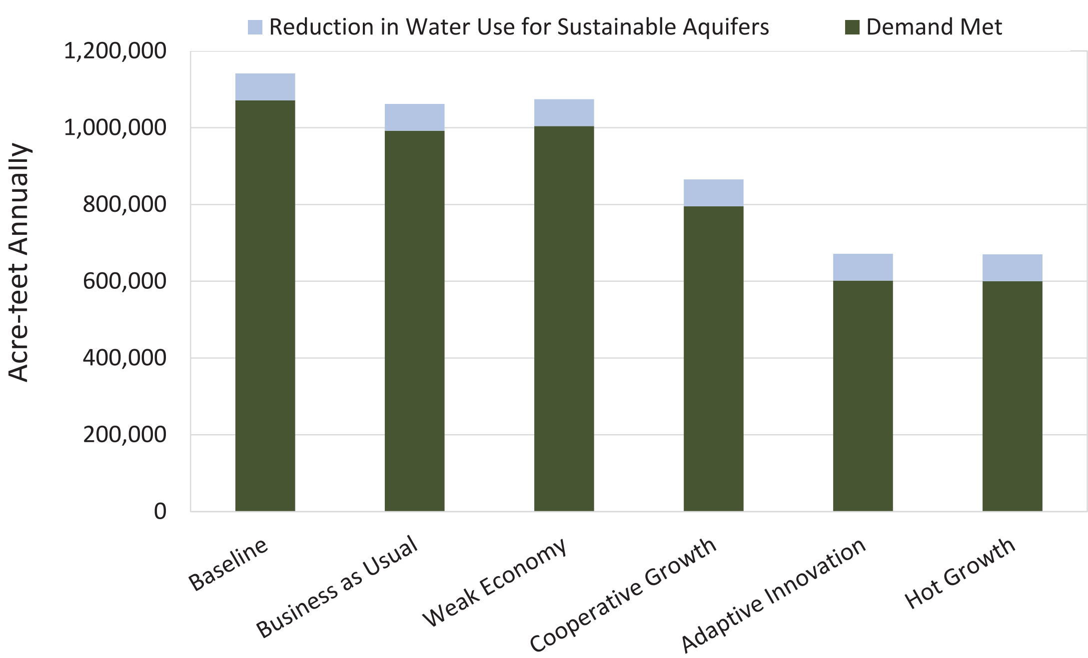


Figure 12. Baseline and 2050 Projected Average Annual Agricultural Demand Met to Address Aquifer Sustainability

It is important to note that while Figures 11 and 12 represent basinwide baseline and projected agricultural diversion demand and gaps, the aquifer and surface water conditions vary significantly by region (i.e., by water district and groundwater management subdistrict (subdistrict)). Of the seven subdistricts in the Basin, Subdistrict 1 accounts for a vast majority of the needed reductions highlighted in Figure 12.

Subdistrict 1 is faced with recovering the unconfined aquifer in the closed basin region of the San Luis Valley. Storage in the unconfined aquifer has declined over 1.1 million acre-feet since the early-1990s due to high groundwater pumping, sustained droughts, and reduced recharge. In order to reach sustainability, Subdistrict 1 must recover groundwater levels in the unconfined aquifer to within -200,000 to -400,000 acre-feet of the 1976 storage levels by 2031. The State Engineer has been monitoring the declining aquifer level and has warned that "the division engineer and the state engineer will be put in the unenviable, but required position of curtailing groundwater diversions from Subdistrict 1 wells if the Subdistrict does not remedy the storage deficit." Figure 13 reflects unconfined aquifer levels in the unconfined aquifer since 2012 and the approximate path water levels in the aquifer would need to take over the next decade to meet the 2031 sustainability goal.

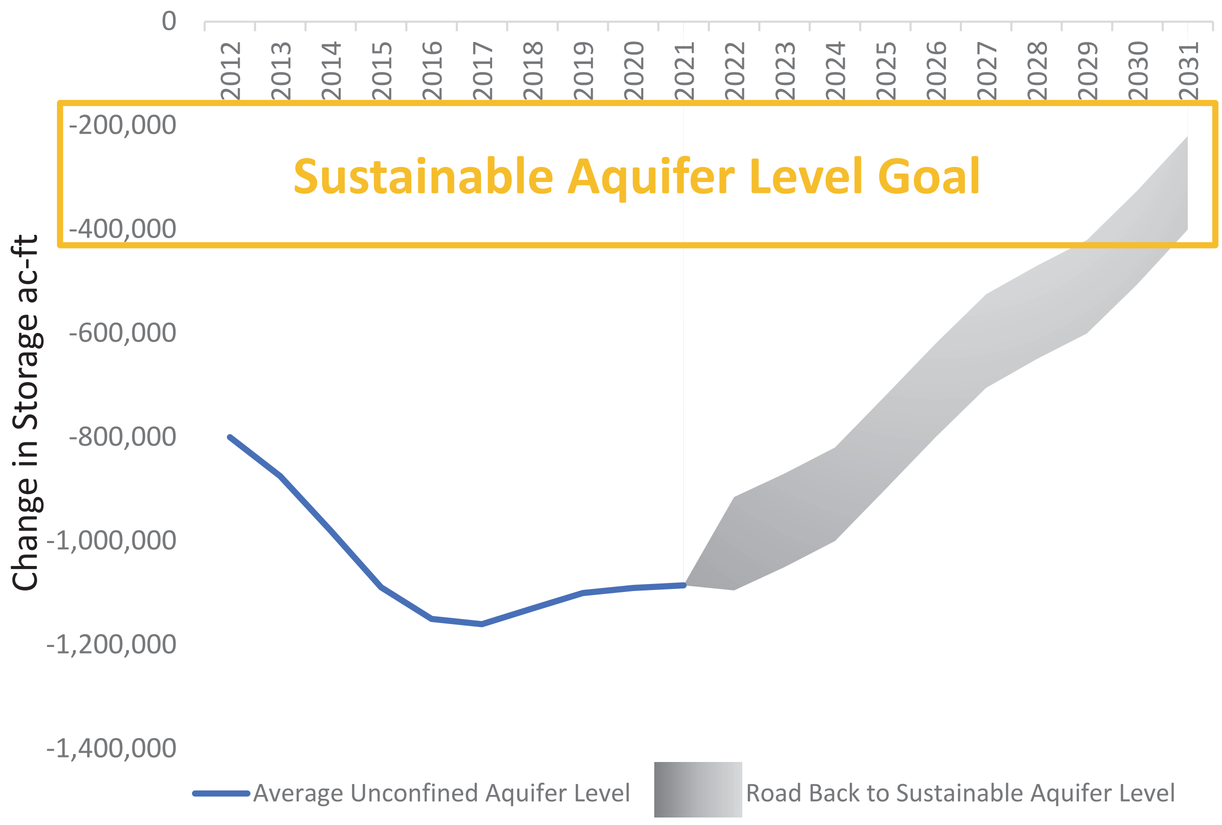


Figure 13. Needed Trajectory to Address Unconfined Aquifer Sustainability in Subdistrict 1

To reach the sustainability goal within 10 years, approximately 600,000 to 700,000 acre-feet of water is needed to fill the storage deficit, which equates to between 80,000 to 100,000 acre-feet increase in aquifer levels per year. However, actual annual aquifer recovery may vary significantly depending on climatic conditions. Figure 14 reflects Subdistrict 1 pumping levels over the 2015 to 2020 period and the projected annual pumping totals needed over the next decade to achieve sustainable aquifer levels.

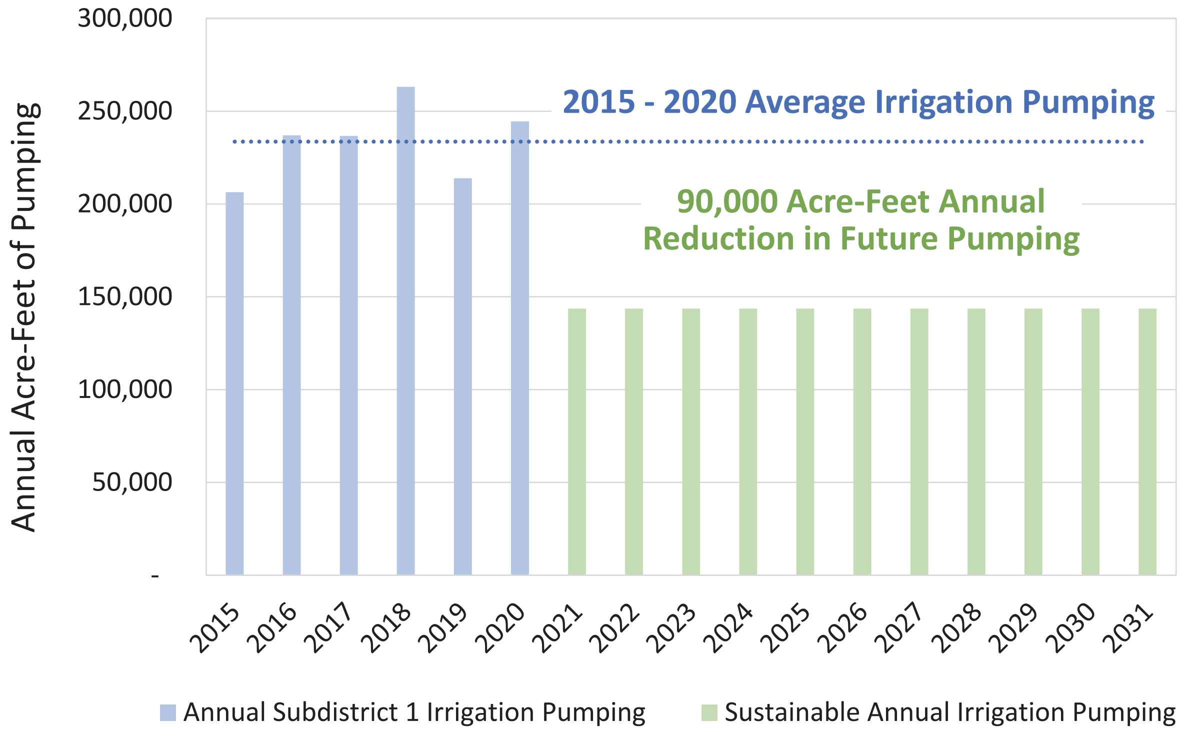


Figure 14. Recent Subdistrict 1 Irrigation Pumping and Projected Pumping Levels to Address Aquifer Sustainability

Since its formation in 2006, Subdistrict 1 has made substantial efforts to reduce groundwater withdrawals and has spent $69 million implementing the following strategies:

- Enrolled 10,386 acres in the Conservation Reserve Enhancement Program (CREP).
- Enrolled 7,000 acres in Subdistrict 1's Fallow program, which was entirely funded by farmers.
- Reduced pumping by approximately 30% since Subdistrict 1's formation.
- Implemented crop rotation strategies for improved soil health.
- Introduced less water consumptive crops such as hemp and quinoa.
- Removed sprinkler end guns, when possible.
- Assessed producer fees for groundwater withdrawals.
- Recharged the unconfined aquifer using surface water canals.
- Developed and implemented various additional water conservation programs for over 10 years.
- Conducted significant public outreach and education regarding aquifer conditions and economic impacts.

Despite the substantial efforts undertaken, under the existing decree for Subdistrict 1, irrigators must reduce their current water use by approximately 30 percent in order to recover aquifer levels over the next decade. Additionally, it is important to note that the reductions shown in Figures 13 and 14 are based on Subdistrict 1's current Plan of Water Management (POWM). Subdistrict 1 is actively seeking ways to shift its operations and strategies to achieve sustainability and these shifts may result in an updated POWM and thus a change in the reductions detailed in Figures 13 and 14.

Irrigators in Subdistrict 1 will employ many different management options to support sustainable aquifer levels. The strategies that have and will continue to be utilized to reduce water use are depicted in Figure 15, include: permanently fallowing acreage, switching to crop types that use less water, rotationally fallowing some fields, or a combination of these and other actions.

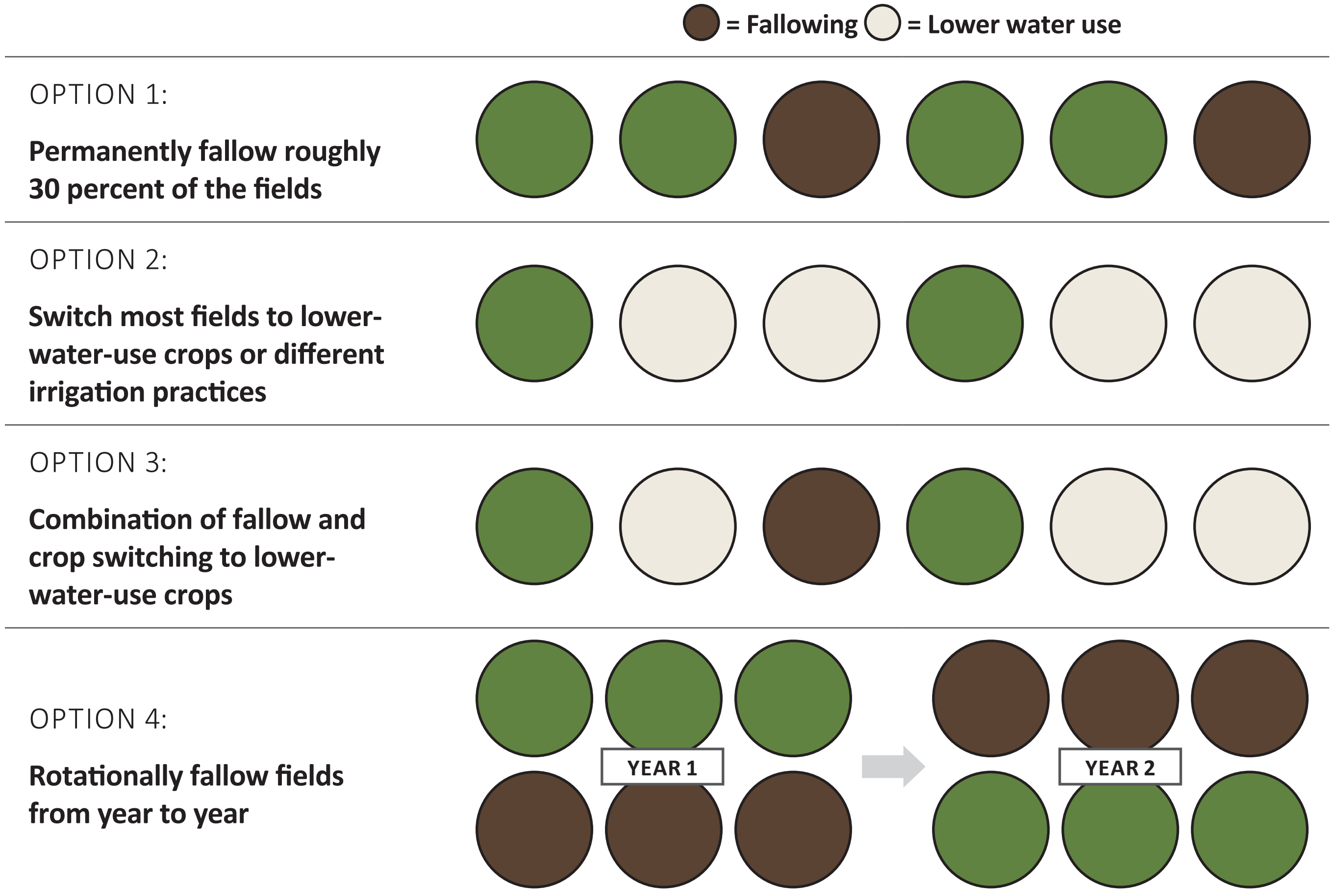


Figure 15. Illustration of strategies that have been used and will continue to be utilized to reduce water use, including permanently fallowing acreage, switching to crop types that use less water, or rotationally fallowing some fields.

Center Pivot Irrigation and La Garita Mountains (photo by Sinjin Eberle)

Basinwide, future agricultural water needs will be met through a diverse array of innovative projects and partnerships. The operation of groundwater management subdistricts will involve implementing multiple subdistrict programs including, but not limited to:

- Conservation Reserve Enhancement Program (CREP), which is currently limited to Subdistrict 1
- Forbearance agreements
- Conservation Reserve Program (CRP)
- Well purchase programs
- Well permit acquisition (i.e., fallowing programs)

Other strategies include:

- Acquiring groundwater conservation easements
- Completing irrigation infrastructure retrofits for increased efficiency
- Improving existing and creating new storage capacity

As noted previously, improving existing and creating new storage capacity in the basin will be critically important. For example, the recovery of storage lost due to sedimentation and/or unsafe dams would provide additional flexibility in reservoir release schedules. New storage projects, such as a potential new off-channel reservoir in Conejos County, would help extend the irrigation season and work toward reducing the extent and duration of dry-up on the Rio San Antonio and Conejos River while also creating a new recreational fishery. This new storage opportunity was identified in a recent feasibility study commissioned by the Conejos Water Conservancy District. A conceptual rendering of the potential reservoir site is shown on Figure 16.

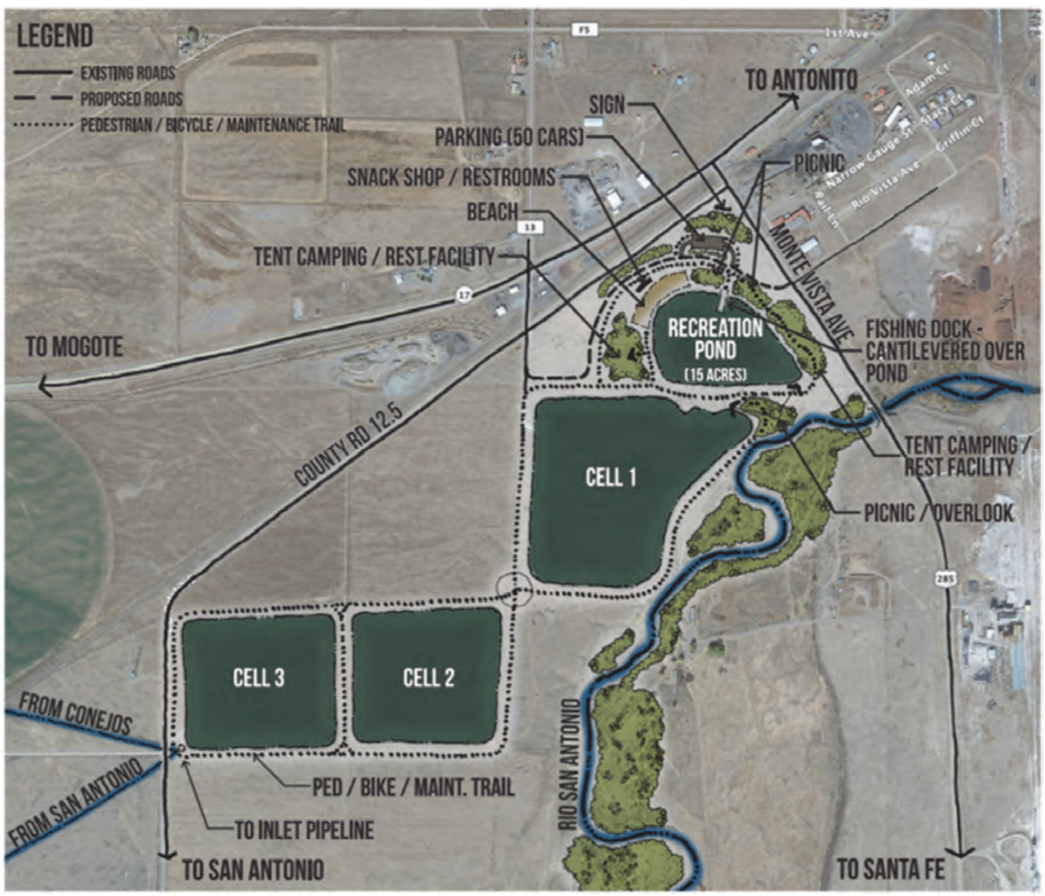


Figure 16. Conceptual rendering of potential reservoir near Antonito, Colorado (image courtesy of Conejos Water Conservancy District)

Collectively, a variety of innovative strategies will be used in the basin to improve and recover aquifer levels, help meet the incremental agricultural water supply gap, meet Rio Grande Compact flows, and maintain a thriving agricultural economy.

3 STRATEGIES FOR ENVIRONMENT AND RECREATION

The Rio Grande BRT envisions a future in which the watershed health and function is maintained and enhanced. The BRT and its partners will continue working together to improve watershed and stream health through a variety of strategies and actions, including:

- Implementing projects identified in stream and watershed plans, including:
  - Wetland and wet meadow conservation and restoration to support watershed health.
  - River and riparian restoration projects.
- Conducting studies that improve the understanding of forest health and water yield and taking action to improve health and resiliency.

Several stream management plans, watershed assessments, and studies have been completed since 2015 that guide the management of stream, wetland, and riparian areas in the basin. These and other assessments currently underway are shown on Figure 17.

In addition to the assessments outlined in Figure 17, several other studies and plans have recently been completed, including the **2019 SLV Wetland Assessment** and the **Rio Grande and Conejos Rivers Boatable Days Flow Evaluation** studies, completed as part of the **Rio Grande and Conejos Rivers stream management plans**. State and federal agencies also completed land and resource management plans, including the **2020 Rio Grande National Forest Plan**, the **San Luis Valley National Wildlife Refuge Complex Habitat Management Plan**, and the **Bureau of Land Management's PonchaVilla Zone Assessment**.

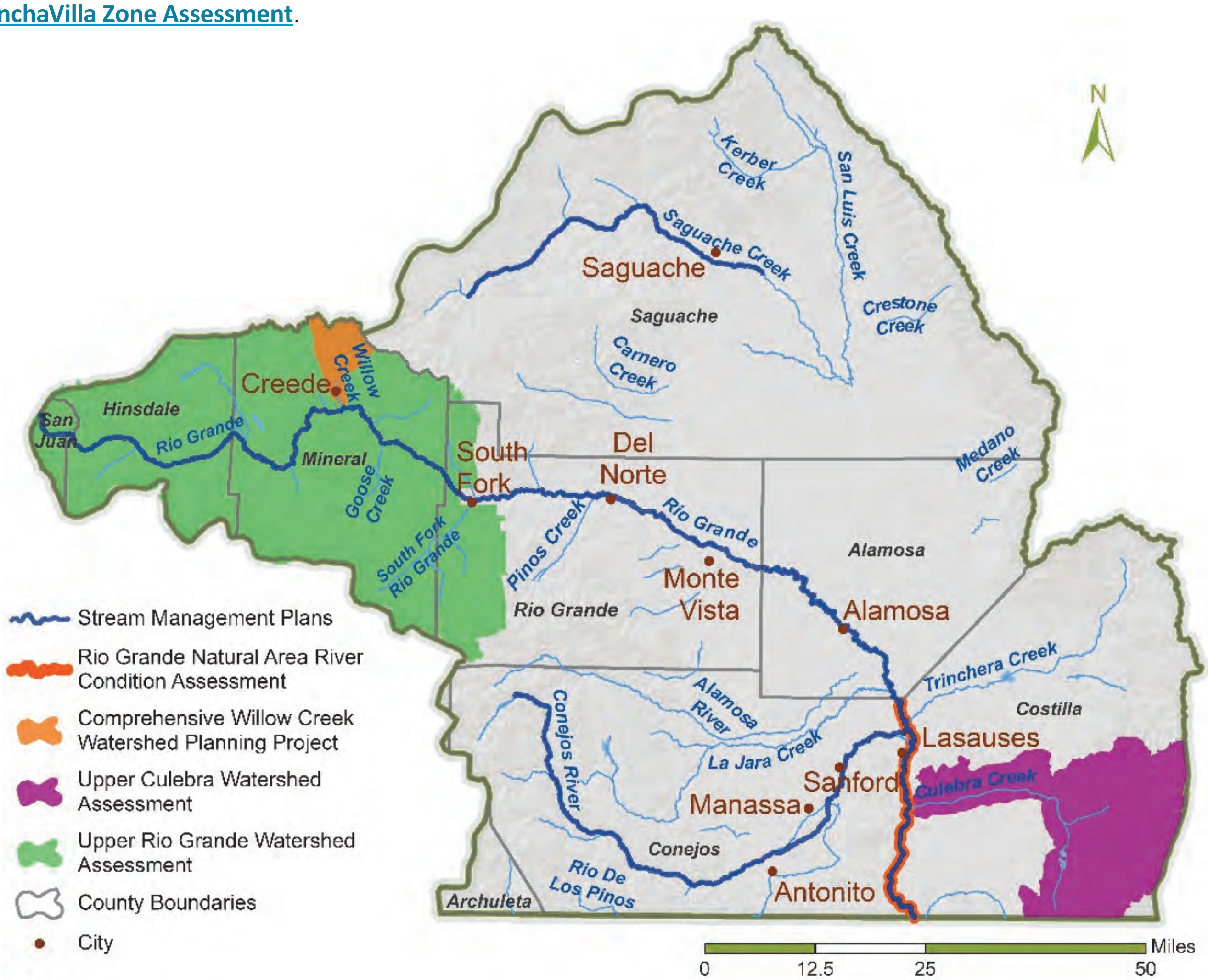


Figure 17. Stream management plans, watershed assessments, and studies completed since 2015 or currently underway

A variety of stakeholders will continue implementing projects and action items identified in the assessments and studies shown on Figure 17 and outlined in Section 3. For example, members of the SMP stakeholder group are working to implement several river restoration projects, diversion infrastructure retrofits, and streamflow targets prioritized in the Rio Grande, Conejos River, and Saguache Creek SMPs. Recommendations from the Upper Rio Grande Watershed Assessment are being implemented in the Rio Grande National Forest, such as stream restoration and improved recreational opportunities. Additionally, the Upper Culebra Watershed Assessment and Comprehensive Willow Creek Watershed Planning Project are currently being completed and will result in recommendations for a variety of watershed improvement projects. Basin stakeholders recognize the need to continually update management plans and other studies.

Upper Culebra Watershed Assessment

The stakeholder-driven Upper Culebra Watershed Assessment (UCWA) seeks to understand the current condition and set a path toward improved watershed health. The project is led by the Costilla County Conservancy District in partnership with a diverse group of state and federal agencies, local nonprofits, landowners, and community stakeholders. There are many environmental challenges facing the Upper Culebra Watershed, including extended drought, forest fire potential, extensive beetle kill, water quality impairments, endangered species, degraded habitat, and other anthropogenic impacts. While stakeholders recognize the vital need to implement projects to address these concerns, the current condition of the Upper Culebra Watershed is largely undocumented. The UCWA will assess the ecological condition of the watershed by collecting, compiling, and analyzing data, and by characterizing riparian habitat, geomorphology, geology, adjacent uplands, water infrastructure, aquatic habitat, flow regimes, grazing, forest health, and water quality through the collection of new data and the analysis of existing data. This project will result in a comprehensive assessment of the Upper Culebra Watershed that partners can use to prioritize projects, secure funding, and implement collaborative, multi-benefit projects that improve the watershed's health and resiliency. The data will be included in the final Upper Culebra Watershed Assessment Report. The UCWA will summarize the causes of current and potential degradation and prioritize projects for implementation to improve watershed health for ecological and sustainability benefits. The assessment is anticipated to be completed in January 2022.

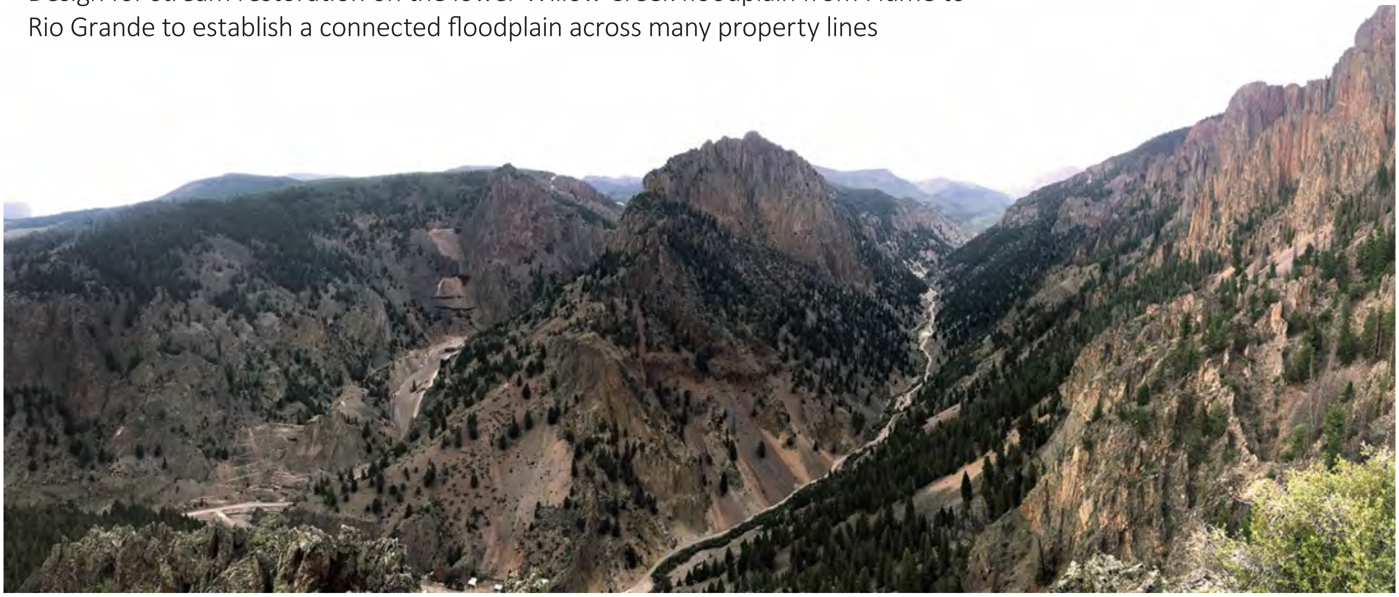
Culebra Creek headwaters (photo by Greg Taillacq)

Comprehensive Willow Creek Watershed Planning Project

The comprehensive Willow Creek Watershed Plan unites the varied needs of Willow Creek into one plan that can be efficiently executed with collaborative stakeholder involvement, including local community members and government, regional water partners, and state and federal entities. Providing consistency in one plan will ensure future implementation actions mesh with specific geographical properties, such as channel characteristics/stability, vegetation, habitat, recreational opportunities, fish passage, legacy mining impacts, and water supply infrastructure. Aligning goals and objectives across the watershed will ensure effectiveness of future efforts with downstream neighbors on the Rio Grande.

The Comprehensive Willow Creek Watershed Plan will result in:

- The Willow Creek Watershed Plan
- The Willow Creek Water and Soil Quality Databank, collating 20+ years of data into a single databank to better enable a water treatment solution for Willow Creek
- Ongoing water quality sampling
- Conceptual design for stream stability and flood mitigation in North Creede reach
- Design for stream restoration on the lower Willow Creek floodplain from Flume to Rio Grande to establish a connected floodplain across many property lines



East and West Willow Creeks (photo by Kathryn Valicenti)

These outcomes will specifically enhance data sharing and project design among partners and across reaches, restore and protect land and water within the watershed, and mitigate flood hazards - all while ensuring long-term water quantity and quality.

The protection of aquatic, riparian, and wetland habitats will continue to support a growing recreational tourism economy. In addition to the recreational value of healthy watersheds, the Rio Grande BRT recognizes the need to bolster recreation by:

- Supporting recreational enhancement projects, including boat ramps and other river access.
- Improving boating safety by reducing hazards, including hazardous bridges and instream diversion dams.
- Providing wildlife viewing and environmental educational opportunities.

4 STRATEGIES FOR MEETING MUNICIPAL AND INDUSTRIAL NEEDS

As discussed in section 5, municipal and industrial water uses in the basin are relatively low in comparison to agricultural use. Strategies to meet potential future increases in industrial water use are focused on successfully securing well augmentation for industrial uses such as aquaculture, agricultural product processing, and energy development, including solar power generation.

Strategies to support future municipal water use are focused on complying with the State Engineer's Well Rules and Regulations and upgrading distribution and wastewater treatment infrastructure. All cities and towns using groundwater wells must comply with the State Engineer's Well Rules and Regulations by joining a Subdistrict or securing an augmentation plan. Although municipal water demand may increase in the future, cities and towns are and will continue to maintain compliance with Well Rules and Regulations. The majority of the basin's municipalities need water distribution and/or wastewater infrastructure improvements (see Volume 2, Table 4). Improvement needs include replacing water collection and distribution infrastructure, especially water mains, to improve efficiency and water quality; upgrading wastewater treatment plants to increase efficiency and water quality; and improving stormwater management infrastructure. To support thriving communities, the basin's future municipal water needs will be met through continued compliance with Well Rules and Regulations and by upgrading municipal water infrastructure.

Installation of new water distribution infrastructure for the City of Alamosa (photo courtesy of City of Alamosa).

5 STRATEGIES FOR MEETING POTENTIAL FUTURE GAPS IF PROJECTS ARE NOT SUFFICIENT

It is anticipated that potential future M&I supply gaps will be met through water-efficient practices and the acquisition of water supplies; however, currently identified projects will not be sufficient to meet potential agricultural water supply gaps. A combination of future actions and strategies will be necessary to meet the future agricultural water supply gap. The following actions will likely be required:

- Substantial reduction in well pumping
- Reduction of irrigated land, including the use of voluntary fallowing program
- Use of irrigation efficiency technologies

WATER ADMINISTRATION

Future management of water administration, both surface and groundwater, is critical to the viability of the basin's sustainable water resources. Although there was not a strategic vision dedicated to water administration, the category intrinsically lives within all five strategic visions listed in this section and is crucial to the success of meeting basin needs.

Fly Fishing Conejos River (photo by Daniel Boyes).

Section 7. Future Basin Projects

The Rio Grande BRT, along with other stakeholders, identified projects that will further progress toward achieving basin goals and meeting future water needs. The list of projects is managed in a database that was initially developed prior to the 2015 BIP and was updated in 2020 during the BIP update. The purpose of the Project Database is to keep a record of the projects considered by the Rio Grande BRT through the BIP process, both in the past and into the future. Table 7 provides a snapshot summary of the Rio Grande BRT's Project Database at the conclusion of the current BIP update process.

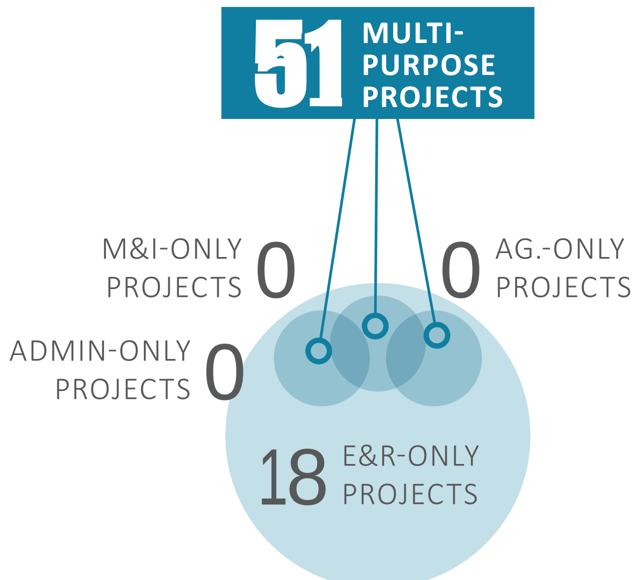
Total estimated cost for project implementation is $164.5 million

(For projects that have identified a project cost)

Table 7. Snapshot Summary of Rio Grande Basin Projects

Total Projects	75
New projects added in 2020	72
Projects completed since 2015 BIP	45
Projects being implemented	8
Projects identified as meeting M&I needs	29
Projects identified as meeting Ag needs	39
Projects identified as meeting E&R needs	61
Tier 1 projects	28
Tier 2 projects	19
Tier 3 projects	26
Tier 4 projects	28
TOTAL COST OF ALL PROJECTS	**$164,500,000**
PERCENTAGE OF PROJECTS WITH AN ESTIMATED COST	**100%**

Projects that are concepts, planned, or are being implemented were the basis for the above data summary (with the exception of data specifically describing projects completed or being implemented).



Project Tiering and Level of Readiness

A new feature of the Project Database for the BIP update is the assignment of "tiers" to projects (see description of tiers in the graphic). The project tiering exercise is a tool roundtables can use to do a preliminary characterization of their projects and associated project readiness. It facilitates a "first-pass" process and helps standardize data gathering to allow for project updates and movement through the tiers as they advance toward funding. Project tiering was initially developed as a tool for basin-level WSRF grant approval discussions, where the data fields describing alignment with BIPs, local planning, and criticality are likely to be considered. Note that some of these categories are subjective and were considered differently across basins. Tiering has no bearing on whether a project can be funded. Project proponents can apply for CWCB funding whether or not their project is in the database, and inclusion of a project in the database does not guarantee funding. For the CWCB in the long term, it will be useful for identifying immediate and long-term project costs and associated funding needs. Data fields describing level of readiness, alignment with the Colorado Water Plan, and the amount of available project data will also be considered.

TIER 1	**Supported and Ready** *Ready to launch and has full data set*
TIER 2	**Supported and Pursued** *Almost ready to move forward and has a significant amount of data*
TIER 3	**Supported and Developing** *Project is developing but still needs to be fleshed out*
TIER 4	**Considering** *Project not yet moving forward but should be kept on the list*

See Projects List Appendix in Volume 2 for additional detail on projects.

Section 8. Education and Outreach

The Rio Grande BRT recognizes the importance of, and is committed to, providing outreach and education and supporting participation that furthers the shared messages of the Rio Grande Basin's education partners, the Rio Grande BRT, Interbasin Compact Committee, and CWCB as they relate to the preservation and sustainability of water resources.

The vision of the Rio Grande BRT is to reach target audiences such as local community members, recreational visitors, and urban audiences outside the basin to communicate the BRT's values regarding the importance of agriculture, water management, collaboration among partner agencies, and natural resources stewardship. Through these key target audiences, the Rio Grande BRT anticipates informing numerous Coloradans about the Rio Grande Basin's water projects, which also align with the Colorado Water Plan's goals for increasing awareness of, and connection with water projects, management, and use.

The Rio Grande BRT and its partners will implement the following efforts:

- Conduct basinwide education and outreach efforts that are responsive, inclusive, and collaborative and that can be effectively communicated using a variety of dissemination methods.
- Maintain an Education Action Plan (EAP) that provides strategies on sharing information regarding all types of water uses, administration, challenges, and opportunities. The EAP will be consistent with the objectives and priorities identified in the BIP update.
- Reference and utilize statewide educational resources, such as the Statewide Water Education Action Plan (SWEAP), when applicable, to effectively engage and inform Coloradans within and outside the basin on water-related topics.
- Encourage and support basin stakeholders to continue improving their educational skill sets.

The Rio Grande BRT and its partners will conduct education and outreach activities using:

- Consistent messaging with water management entities, elected officials, state and federal agencies, community members and stakeholders, K-12 and higher education, local media, and agricultural, municipal, industrial, environmental, and recreational users.
- A variety of outlets, including, but not limited to:
  - Print and digital media: Newspaper articles, podcasts, radio interviews, videos, newsletters, and websites.
  - In-person educational opportunities: Water education courses, camps, symposiums, tours, workshops and trainings, and public and in-class presentations.
- A multi-pronged approach to reach community members in varying age and economic groups. Working with higher education, specifically the Salazar Rio Grande del Norte Center, makes it possible to leverage the facilities, faculty, and staff of Adams State University.

Colorado Parks and Wildlife staff discuss fish sampling methods with students at the Youth Conservation Camp held by the Rio Grande Watershed Conservation and Education Initiative (photo by Heather Dutton)

Rio Grande Basin tour (photo by Heather Dutton)

Appendix A. Rio Grande Basin Current and 2050 Planning Scenario Water Supply and Gap Revised Results

Analysis for Basin Implementation Plans

Technical Memorandum

Prepared for:

Colorado Water Conservation Board

Project Title:

Rio Grande Basin
Current and 2050 Planning Scenario
Water Supply and Gap Revised Results

Date: June 14, 2021

Prepared by: Wilson Water Group
Reviewed by: Brown & Caldwell

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Section 1: Introduction

This technical memorandum summarizes changes to modeling inputs and results from the 2019 Technical Update that were conducted during the Basin Implementation Plan update process. The original model approach and results, as well as other water supply related analyses, were documented in Volume 2 of the Technical Update in a memo entitled "Current and 2050 Planning Scenario Water Supply and Gap Results".

The approach and results were presented to stakeholders throughout the State and to the Basin Roundtables, and feedback was obtained regarding areas where the approaches to developing the agricultural, municipal, and industrial demands or the modeling could be improved or refined. This technical document summarizes the revisions to inputs and/or results that affect the Rio Grande Basins.

The following are general notes regarding this effort:

- The revisions were based on stakeholder input and may not include every aspect of the Technical Update. For example, one basin may only have revised M&I demands whereas another basin may only have revisions to modeling operations.
- Revisions to West Slope basins may affect the transbasin import supply gap estimated for basins that receive imports. Revised import supply gaps are also included in the sections below if applicable.
- This document provides a summary of the revisions. Spreadsheets and modeling datasets will be available on the Colorado Water Plan website for further information on revisions.
- The revised information herein supersedes any previously developed information. Documentation and reports relying on the information from September 2019 will reflect a note to this effect, but the documentation will not be updated.
- The revised information will be used in the Basin Implementation Plan Volume 1 and 2 reports and the Update to the Colorado Water Plan.

1.1 DELIVERABLES

The revised model results are provided both within this document and in separate Excel spreadsheets for each basin. The General Contractor Team for the Technical Update has developed several spreadsheets of more localized results at the Water District level for basins that have requested this detail. These spreadsheets have also been updated and provided to the Local Experts in each of those basins. Additionally, revised streamflow results were loaded into the Flow Tool and made available to the Local Experts. Lastly, the model input and output files were delivered to the General Contractor and will be made available via the Colorado Water Plan website. The spreadsheets, modeling datasets, the revised Flow Tool, and this documentation serve as the deliverables for this effort.

1.2 DISCLAIMER

The technical data and information generated are intended to help inform decision making and planning regarding water resources at a statewide or basin-wide planning level. The information made available is not intended to replace projections or analyses prepared by local entities for specific project or planning purposes. The information or datasets provided are from a snapshot in time and cannot reflect actual or exact conditions in any given basin or the state at any given time. While the Technical Update and Basin

Implementation Plan strives to reflect the Colorado Water Conservation Board's (CWCB) best estimates of future water supply and demands under various scenarios, the reliability of these estimates is affected by the availability and reliability of data and the current capabilities of data evaluation. Moreover, the Technical Update and Basin Implementation Plan cannot incorporate the varied and complex legal and policy considerations that may be relevant and applicable to any particular basin or project; therefore, nothing in the Technical Update, Basin Implementation Plan, the associated Flow Tool or Costing Tool is intended for use in any administrative, judicial or other proceeding to evince or otherwise reflect the State of Colorado's or the CWCB's legal interpretations of state or federal law.

Furthermore, nothing in the Technical Update, Basin Implementation Plan, or any subsequent reports generated from these datasets is intended to, nor should be construed so as to, interpret, diminish, or modify the rights, authorities, or obligations of the State of Colorado or the CWCB under state law, federal law, administrative rule, regulation, guideline or other administrative provision.

Section 2: Rio Grande Basin Revised Results

The following sections reflect the revisions implemented in the Rio Grande Basin and the resulting agricultural and M&I demands, water supply, and gaps modeled results. As discussed above, refer to the original 2019 Technical Update documentation for more information on the demands and gaps in each basin.

2.1 RIO GRANDE BASIN MUNICIPAL REVISIONS

Only the municipal demand in the Rio Grande basin was revised, based on water usage information provided by the City of Alamosa and the Town of Crestone. The revision resulted in a decrease to the annual basin-wide demand ranging from 287 to 456 acre-feet under Current/Baseline conditions and across the Planning Scenarios. No revisions were made to agricultural demands or water supplies.

At the request of the Rio Grande Basin Roundtable, in January 2021, ELEMENT updated the Rio Grande Basin municipal baseline and projected water demands that were initially prepared for the Colorado Water Plan Technical Update analyses completed in 2019 (Technical Update; 2019 Analysis). The updated analysis incorporates the addition of outreach data for the Town of Crestone and the addition of Water Efficiency Plan (WEP) data for the City of Alamosa. The addition of these data sources required the modification of other analysis inputs that had previously been used to represent demands for populations served by these municipalities. Upon review, we determined that the new data is of higher quality than the data included in the original analysis. The updates affected the following baseline and projected demands:

- Alamosa County, and
- Saguache County

The following sections provide additional detail regarding the analysis and the results, which should supersede the initial results provided with the Technical Update.

2.1.1 CITY OF ALAMOSA WATER EFFICIENCY PLAN UPDATE

In September of 2020, an updated WEP for the City of Alamosa was provided to ELEMENT. At the time of the 2019 analysis, the City of Alamosa had not completed a WEP and its demand was represented by the Alamosa

County demand data from the Rio Grande Basin Implementation Plan (BIP). The WEP demand data is of higher quality than the BIP data and using the data selection hierarchy established for the 2019 analysis, the Alamosa County BIP data previously used to represent all of Alamosa County was removed from the January 2021 revisions and the City of Alamosa WEP was added. The City of Alamosa WEP accounts for 66% of the total population in Alamosa County, so the WEP demand data was used to represent all of Alamosa County. Table 1 below shows a comparison of the Alamosa County demand data from the 2019 analysis and the January 2021 updated analysis that incorporates the City of Alamosa WEP data. Water demand values are in acre-feet per year (AFY) and gallons per capita per day (gpcd).

Table 1: Alamosa County Baseline Demand Comparison

Analysis	2015 Population Per SWSI Update	Total County Systemwide Demand (AFY)	Total County Demand incl. NRW (gpcd)	Indoor Residential Baseline Demand (AFY)	Outdoor Residential Baseline Demand (AFY)	Indoor Non-Residential Baseline Demand (AFY)	Outdoor Non-Residential Baseline Demand (AFY)	Non-Revenue Baseline Demand (AFY)
2019 Analysis	15,968	3,592	201	1,118	740	693	617	424
Jan 2021 Update	15,968	3,285	184	1,023	677	634	565	388
Difference	0	(307)	(17)	(95)	(63)	(59)	(52)	(36)

2.1.2 TOWN OF CRESTONE DATA

In September of 2020, outreach demand data for the Town of Crestone from 2014 through 2019 was provided to ELEMENT. At the time of the Technical Update, there was no water provider-level information for the Town of Crestone. All of Saguache County was represented by BIP demand data. The analysis was updated using the new data to represent the population served by the Town of Crestone and the remaining Saguache County population remains represented by the BIP data. This approach was used because the population served by the Town of Crestone does not meet the methodology threshold required to use that data to represent all of Saguache County. The Town of Crestone average demand for 2014 – 2019 was added to the provider outreach demand dataset and was used to calculate a revised Saguache County baseline demand. Because the Town of Crestone is relatively small compared to the total Saguache County population, these revisions had minimal impact on Saguache County’s baseline demand. Table 2 below shows a comparison of the Saguache County demand data from the 2019 analysis and the updated analysis incorporating the Town of Crestone outreach data.

Table 2: Saguache County Baseline Demand Comparison

Analysis	2015 Population Per SWSI Update	Total County Systemwide Demand (AFY)	Total County Demand incl. NRW (gpcd)	Indoor Residential Baseline Demand (AFY)	Outdoor Residential Baseline Demand (AFY)	Indoor Non-Residential Baseline Demand (AFY)	Outdoor Non-Residential Baseline Demand (AFY)	Non-Revenue Baseline Demand (AFY)
2019 Analysis	6,219	1,168	168	364	240	225	201	138
Jan 2021 Update	6,219	1,168	168	364	241	225	201	138
Difference	0	0.4	0.4	0.2	0.1	0.1	0.1	0.1

2.1.3 UPDATED BASELINE

The Rio Grande Basin does not have sufficient data to support a county-level demand distribution. While the WEP demand data and the outreach data were of higher quality than the BIP data, the WEP still did not provide detail for all of the demand categories used in the 2019 analysis and the Town of Crestone population is not significant enough to rely upon for the entire basin. Based on the Technical Update methodology, the statewide demand distribution from the 2019 analysis was applied to all counties in the Rio Grande Basin. This approach was not changed with the January 2021 update. For any county population that is not directly represented by water provider-reported demand data, the municipal demand methodology developed during the Technical Update defined logic to “fill” the missing information. This includes filling of per capita demands. This update for the Rio Grande Basin does not allow any counties aside from Alamosa and Saguache to be revised. Table 3 below shows the impacts on the Rio Grande Basin baseline demands based on the January 2021 updates described above. Note that the systemwide demand for the Rio Grande Basin has decreased by about 300 AFY, mostly influenced by the addition of the City of Alamosa WEP data.

Table 3: Rio Grande Basin Baseline Demand Comparison

		Baseline (2015) AFY					
Analysis	Population	Residential Indoor	Non-Residential Indoor	Residential Outdoor	Non-Residential Outdoor	Non-Revenue	Systemwide
2019 Analysis	45,975	3,312	2,052	2,191	1,828	1,256	10,639
Jan 2021 Update	45,975	3,217	2,128	1,993	1,775	1,220	10,333
Difference	0	(95)	76	(198)	(53)	(36)	(306)

Below is a comparison of the 2019 analysis and updated figures and tables from the Colorado Water Plan Technical Update Volume 1, Section 4.7: Rio Grande Results of the Colorado Water Plan Technical Update final documentation.

The comparison Figure 1 below shows that the data source distribution contributing to the Rio Grande Basin’s baseline demands changed substantially with this January 2021 update. The percent showing as “Estimated” has increased because when the Alamosa WEP was selected to fill the entirety of Alamosa County for the 2021 update, rather than using the BIP data in the 2019 analysis, demands for the portion of the population located outside of the City of Alamosa’s service area are now considered to be estimated. Previously, these demands outside the City’s service area were represented by BIP data. Even with an increase in estimated demands, the data being used to represent the Basin’s baseline demand is of higher quality and maintains consistency with the Technical Update data source prioritization methodology.

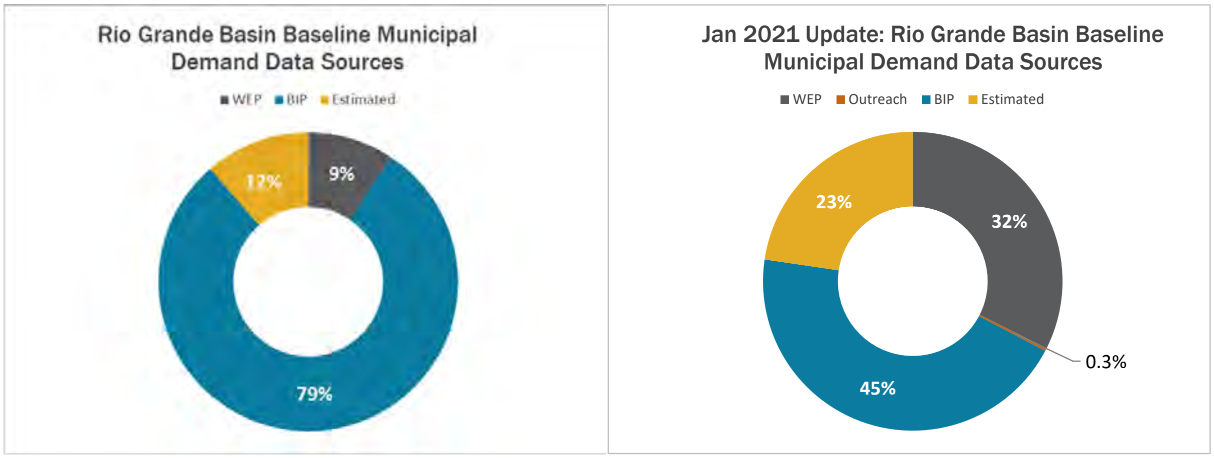
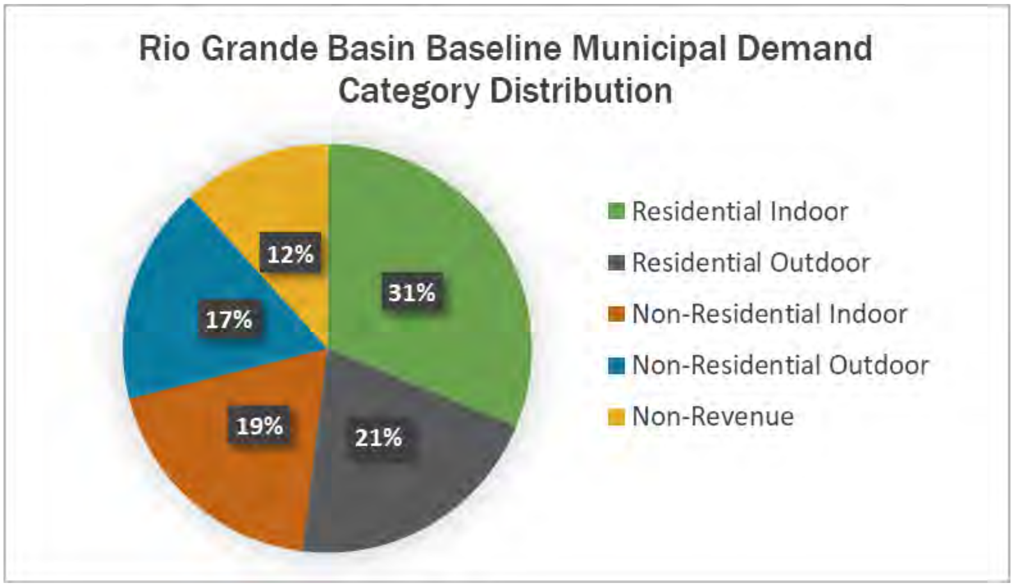


Figure 1: 2019 Analysis vs. 2021 Update: Sources of Water Demand Data in the Rio Grande Basin

The comparison Figure 2 below shows the updated basin-level demand distribution. Because the Rio Grande Basin uses the statewide demand distribution, this is unchanged for this update.



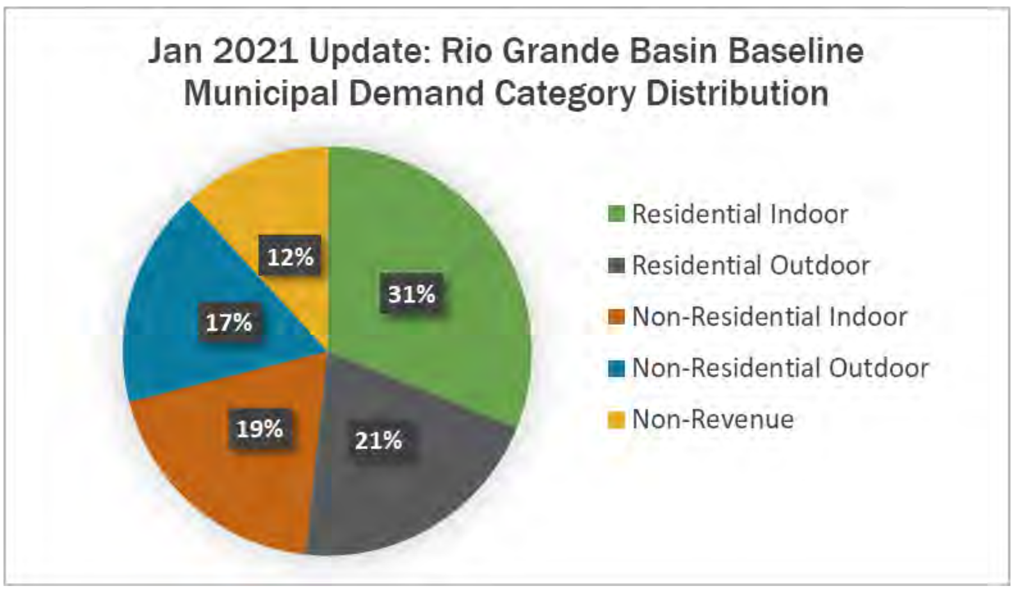
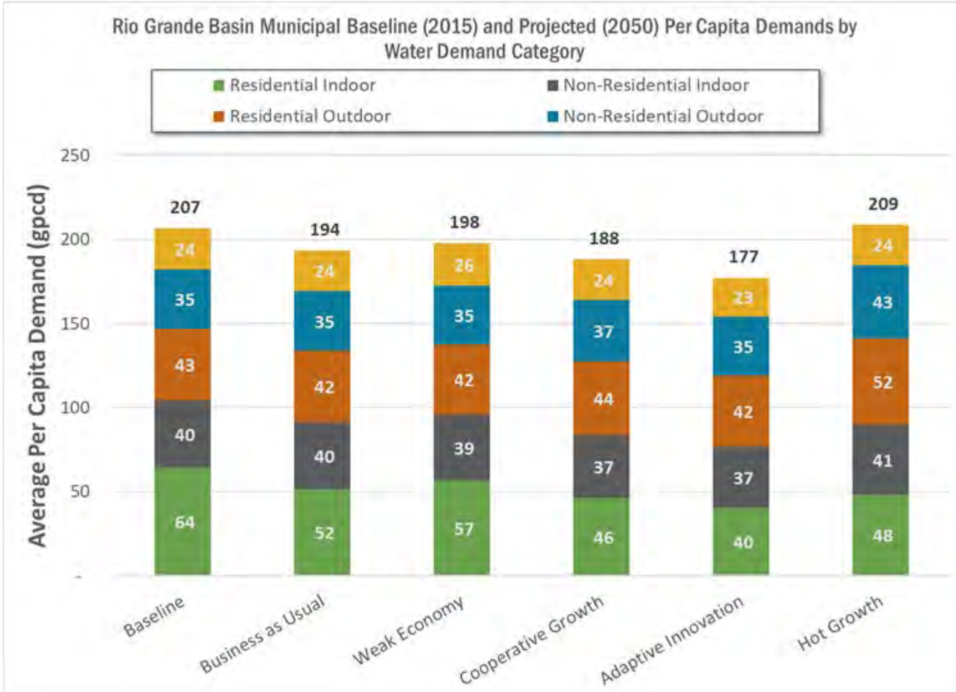


Figure 2: 2019 Analysis vs. 2021 Update: Categories of Water Usage in the Rio Grande Basin

The comparison Figure 3 below shows the changes in per capita water demands for each projection scenario. The basin-scale per capita demands have decreased slightly in each scenario, influenced mostly by the addition of the City of Alamosa WEP.



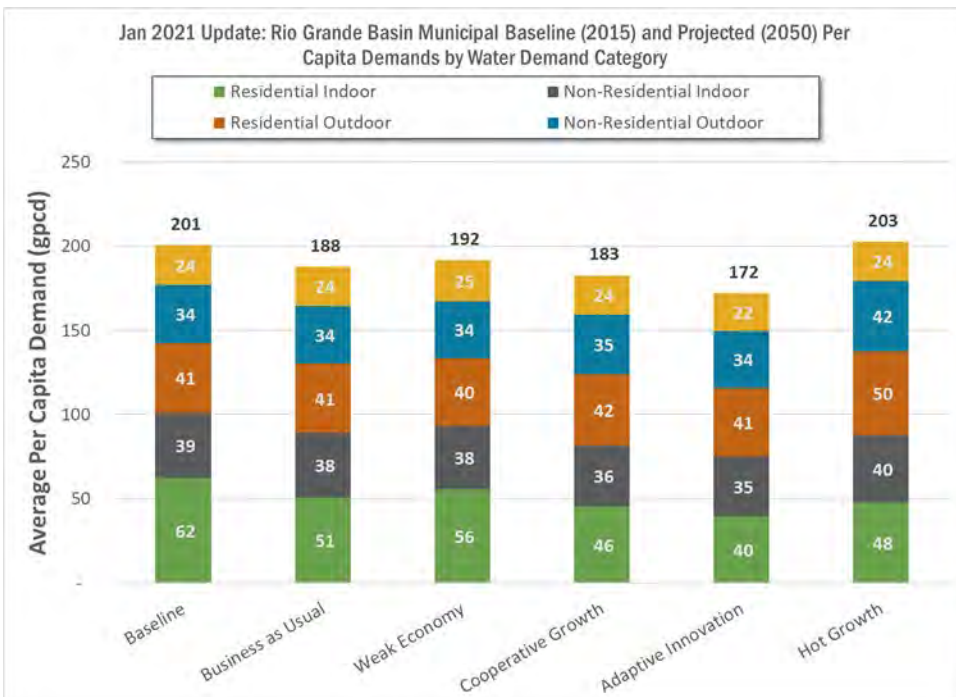


Figure 3: 2019 Analysis vs. 2021 Update: Rio Grande Basin Municipal Baseline and Projected Per Capita Demands by Water Demand Category

The following tables show the total annual volumetric demands by county for the 2019 analysis and the January 2021 update. Note that only Alamosa and Saguache counties changed with this update.

Table 4: 2019 Analysis

County	Baseline (2015)	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Alamosa	3,592	4,822	3,749	4,411	5,030	6,382
Conejos	2,525	2,567	2,050	2,371	2,672	3,353
Costilla	627	676	523	624	713	894
Mineral	126	162	125	148	170	215
Rio Grande	2,601	2,507	1,980	2,324	2,633	3,288
Saguache	1,168	1,213	943	1,122	1,279	1,601

Table 5: January 2021 Update

County	Baseline (2015)	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Alamosa	3,285	4,471	3,462	4,088	4,669	5,924
Conejos	2,525	2,567	2,050	2,371	2,672	3,353
Costilla	627	676	523	624	713	894
Mineral	126	162	125	148	170	215
Rio Grande	2,601	2,507	1,980	2,324	2,633	3,288
Saguache	1,168	1,214	944	1,122	1,279	1,602

Table 6: Calculated Difference by County

County	Baseline (2015)	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Alamosa	(307)	(351)	(287)	(323)	(361)	(458)
Conejos	0	0	0	0	0	0
Costilla	0	0	0	0	0	0
Mineral	0	0	0	0	0	0
Rio Grande	0	0	0	0	0	0
Saguache	0	1	1	0	0	1

The comparison Table 7 below shows the changes in annual demand for each projection scenario based on the January 2021 updates.

Table 7: 2019 Analysis vs. 2021 Update: Rio Grande Basin Municipal Baseline and Projected Demands (AFY)

	Baseline (2015)	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
2019 Analysis (no rounding)	10,639	11,947	9,370	11,000	12,496	15,732
Jan 2021 Update	10,333	11,596	9,083	10,677	12,136	15,276
Difference	(306)	(351)	(287)	(323)	(360)	(456)

The comparison Figure 4 below show the change in annual volumetric demands by scenario for the 2019 analysis and the January 2021 update.

Figure 4: 2019 Analysis vs. 2021 Update: Rio Grande Basin Municipal Baseline and Projected Population and Municipal Demands

2.2 RIO GRANDE BASIN REVISED WATER SUPPLY AND GAP RESULTS

The following tables reflect the revised demand, water supply, and gap results based on the revised M&I demands in the basin. The revised data did not result in any changes to the agricultural demand or gap, however, did result in a slight decrease to M&I demand and gap.

As discussed in the 2019 Technical Update, the Rio Grande Basin benefits from the delivery of a small amount of imported transbasin supplies from the Southwest basin. Revisions to the Southwest Basin's transbasin exports did not impact the transbasin import supply gap associated with these deliveries; the information presented in the 2019 Technical Update for this gap remains unchanged.

Table 8: Rio Grande Basin Agricultural Water Supply and Gap Summary

	Agricultural Results	Baseline	Business as Usual	Weak Economy	Coop. Growth	Adaptive Innovation	Hot Growth
Average	Average Annual Demand (ac-ft)	1,825,178	1,717,781	1,735,702	1,656,255	1,471,434	1,638,935
	Average Annual Demand Increase from Baseline (ac-ft)	-	-	-	-	-	-
	Average Annual Gap (ac-ft)	683,881	655,775	661,464	737,365	741,866	826,430
	Average Annual Gap Increase from Baseline (ac-ft)	-	-	-	53,484	57,986	142,549
	Average Annual Percent Gap	37%	38%	38%	45%	50%	50%
	Average Annual CU Gap (ac-ft)	348,288	333,392	336,305	374,561	376,927	419,840
Critically Dry Maximum	Demand In Maximum Gap Year (ac-ft)	2,058,802	1,935,437	1,956,199	1,814,118	1,605,689	1,789,675
	Increase from Baseline Demand (ac-ft)	-	-	-	-	-	-
	Gap In Maximum Gap Year (ac-ft)	1,059,702	1,017,391	1,026,351	1,112,661	1,110,956	1,238,485
	Increase from Baseline Gap (ac-ft)	-	-	-	52,959	51,254	178,783
	Percent Gap In Maximum Gap Year	51%	53%	52%	61%	69%	69%

Table 9: Rio Grande Basin M&I Water Supply and Gap Summary

	M&I Results	Baseline	Business as Usual	Weak Economy	Coop. Growth	Adaptive Innovation	Hot Growth
Average	Average Annual Demand (ac-ft)	17,417	20,742	17,365	19,818	21,337	25,330
	Average Annual Demand Increase from Baseline (ac-ft)	-	3,325	-	2,401	3,920	7,913
	Average Annual Gap (ac-ft)	-	3,325	-	2,401	3,920	7,913
	Average Annual Gap Increase from Baseline (ac-ft)	-	3,325	-	2,401	3,920	7,913
	Average Annual Percent Gap	0%	16%	0%	12%	18%	31%

	M&I Results	Baseline	Business as Usual	Weak Economy	Coop. Growth	Adaptive Innovation	Hot Growth
Critically Dry Maximum	Demand In Maximum Gap Year (ac-ft)	17,417	20,742	17,365	19,818	21,337	25,330
	Increase from Baseline Demand (ac-ft)	-	3,325	-	2,401	3,920	7,913
	Gap In Maximum Gap Year (ac-ft)	-	3,325	-	2,401	3,920	7,913
	Increase from Baseline Gap (ac-ft)	-	3,325	-	2,401	3,920	7,913
	Percent Gap In Maximum Gap Year	0%	16%	0%	12%	18%	31%

Table 10: Rio Grande Basin Water Supply and Gap Summary

	Agricultural and M&I Results	Baseline	Business as Usual	Weak Economy	Coop. Growth	Adaptive Innovation	Hot Growth
Average	Average Annual Demand (ac-ft)	1,842,594	1,738,523	1,753,068	1,676,073	1,492,771	1,664,265
	Average Annual Gap (ac-ft)	683,881	659,100	661,464	739,766	745,787	834,343
	Average Annual Percent Gap	37%	38%	38%	44%	50%	50%
Critically Dry Max	Demand In Maximum Gap Year (ac-ft)	2,076,219	1,956,179	1,973,564	1,833,936	1,627,026	1,815,005
	Gap In Maximum Gap Year (ac-ft)	1,059,702	1,020,716	1,026,351	1,115,062	1,114,877	1,246,398
	Percent Gap In Maximum Gap Year	51%	52%	52%	61%	69%	69%