# RIO GRANDE BASIN IMPLEMENTATION PLAN


**APRIL 2015**

**Rio Grande Basin Roundtable**

DiNatale WATER CONSULTANTS

# RIO GRANDE BASIN IMPLEMENTATION PLAN

## REVISED DRAFT

Rio Grande Natural Area.
Photo: Heather Dutton

# ACKNOWLEDGEMENTS

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Mike Gibson, RGBRT Chairperson
Rick Basagoitia
Ron Brink
Nathan Coombs
Rio de la Vista
Heather Dutton
Eugene Jacquez
Nicole Langley
Judy Lopez
Cindy Medina
Emma Regier
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Charlie Spielman
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**Front Cover Photos, from top:** Confluence of the Rio Grande and Conejos River on the Cross Arrow Ranch; photo: John Fielder. Rio Grande cutthroat trout; illustration © JR Tomelleri. Farmer irrigating via acequia system; photo: The Acequia Institute. Map of the Rio Grande Basin wrapping front and back: Jeremy Carlson

# CONTENTS

# LIST OF TABLES



Diversion dam on the Rio Grande above Monte Vista. Photo © Adriel Heisey / www.adrielheisey.com

# LIST OF FIGURES

Rio Grande below Ute Ridge. Photo © Adriel Heisey / www.adrielheisey.com

# ACRONYMS, ABBREVIATIONS, AND WORDS WITH MULTIPLE SPELLINGS

| | |
|---|---|
| **AF** | Acre-feet |
| **AFY** | Acre-feet/year |
| **Ag** | Agriculture (subcommittee abbreviation) |
| **ARWRF** | Alamosa River Watershed Restoration Foundation |
| **ATM** | Alternative transfer method |
| **AWDI** | American Water Development Inc. |
| **BLM** | Bureau of Land Management |
| **BOR** | Bureau of Reclamation |
| **BRT** | Basin Roundtable |
| **CDPHE** | Colorado Department of Public Health and Environment |
| **CFS** | Cubic feet per second |
| **CNHP** | Colorado Natural Heritage Program |
| **CPW** | Colorado Division of Parks and Wildlife |
| **CREP** | Conservation Reserve Enhancement Program |
| **CRGRF** | Colorado Rio Grande Restoration Foundation |
| **CSFS** | Colorado State Forest Service |
| **CSU** | Colorado State University |
| **CU** | Consumptive use |
| **CWCB** | Colorado Water Conservation Board |
| **CWCD** | Conejos Water Conservancy District |
| **CWT** | Per hundred pounds of weight |
| **DNR** | Department of Natural Resources |
| **DWR** | Division of Water Resources |
| **Env & Rec** | Environmental and Recreational (subcommittee abbreviation) |
| **EPA** | Environmental Protection Agency |
| **ESA** | Endangered Species Act |
| **G&MOs** | Goals and measurable outcomes |
| **GOCO** | Great Outdoors Colorado |
| **GPCD** | Gallons per capita per day |
| **HB** | House Bill |
| **HCP** | Habitat Conservation Plan |
| **IBCC** | Interbasin Compact Committee |
| **ISF** | Instream flow |
| **IWJV** | Intermountain West Joint Venture |
| **IWR** | Irrigation water requirement |
| **Los Sauces** | Also spelled La Sauses, Lasauses, and La Sauces |
| **McIntire** | Also spelled McIntyre and MacIntire |
| **M&I** | Municipal and Industrial (subcommittee abbreviation) |
| **NAWCA** | North American Wetlands Conservation Act |
| **NCNA** | Nonconsumptive needs assessment |
| **NEPA** | National Environmental Policy Act |
| **NRCS** | Natural Resource Conservation Service |
| **PFW** | Partners for Fish and Wildlife |
| **RG** | Rio Grande |
| **RGB** | Rio Grande Basin |
| **RGBIP** | Rio Grande Basin Implementation Plan |
| **RGBRT** | Rio Grande Basin Roundtable |
| **RGCT** | Rio Grande cutthroat trout |
| **RGDSS** | Rio Grande Decision Support System |
| **RGHRP** | Rio Grande Headwaters Restoration Project |
| **RGNA** | Rio Grande Natural Area |
| **RGR** | Rio Grande Reservoir |

| | |
|---|---|
| **RGWACD** | Rio Grande Watershed Association of Conservation Districts |
| **RGWCD** | Rio Grande Water Conservation District |
| **RGWCEI** | Rio Grande Watershed Conservation and Education Initiative |
| **RiGHT** | Rio Grande Headwaters Land Trust |
| **RWEACT** | Rio Grande Watershed Emergency Action Coordination Team |
| **SB** | Senate Bill |
| **SLV** | San Luis Valley |
| **SLVEC** | San Luis Valley Ecosystem Council |
| **SLVID** | San Luis Valley Irrigation District |
| **SLVIWO** | San Luis Valley irrigation well owner |
| **SLVWCD** | San Luis Valley Water Conservancy District |
| **SSI** | Self-supplied Industrial |
| **SWE** | Snow water equivalent |
| **SWSI** | Statewide Water Supply Initiative |
| **TMD** | Transmountain diversion |
| **TNC** | The Nature Conservancy |
| **TU** | Trout Unlimited |
| **USDA** | U.S. Department of Agriculture |
| **USFS** | U.S. Forest Service |
| **USFWS** | U.S. Fish and Wildlife Service |
| **USGS** | U.S. Geological Survey |
| **WAdm** | Water Administration (subcommittee abbreviation) |
| **WCRC** | Willow Creek Reclamation Committee |
| **WSRA** | Water Supply Reserve Account |

Spring on the conserved Gilmore Ranch, with Mount Blanca beyond. Photo: Rio de la Vista

Center pivots in the San Luis Valley.
Photograph by Dan Downing

# 1 INTRODUCTION

## 1.1 : STATE WATER PLAN PROCESS

The Rio Grande Basin Implementation Plan (referred to in this document as the Plan, and sometimes also as the Rio Grande Basin Water Plan) was developed in response to Governor John Hickenlooper's 2013 Executive Order, which launched a Colorado initiative to identify strategies to address the State's growing water demands. The Rio Grande Basin Roundtable (RGBRT) is one of nine basin roundtables established by the Colorado Water for the 21st Century Act.

Cattails growing in Rio Grande corridor wetland.. Photo: Rio de la Vista

The Colorado Water Conservation Board (CWCB) provided guidance to basin roundtables, stating that:

"The purpose of the Basin Implementation Plans is for each basin [roundtable] to identify projects and methods to meet basin specific municipal, industrial, agricultural, environmental, and recreational needs. The Basin Implementation Plans will inform and help drive Colorado's Water Plan."

The Rio Grande Basin Implementation Plan is focused on achieving a balance of competing water needs through cooperative management of water resources. The Plan identifies the critical water issues facing all who live, work, and recreate in the Rio Grande Basin (the Basin) and proposes ways to address those issues, thereby advancing the statewide mission to ensure:

1. A productive economy that supports vibrant and sustainable cities, viable and productive agriculture, and a robust skiing, recreation, and tourism industry
2. Efficient and effective water infrastructure promoting smart land use

3. A strong environment that includes healthy watersheds, rivers and streams, and wildlife

The Basin has a long history of collaborative efforts and successes, focused on addressing the challenges that face the community. The Basin has experienced:

- Prolonged and systemic drought
- Significant decline of the groundwater aquifers that sustain agriculture, towns, and critical ecosystems
- Landscape-scale wildfires
- Forest succession due to diseases and insect outbreaks
- Climate change
- Dust on snow
- Lack of a diverse economy
- Degraded and at-risk wildlife habitats
- Aquatic-dependent and terrestrial wildlife being considered for or listed as a "threatened" or "endangered" species under the Endangered Species Act (ESA)
- Rio Grande Compact obligations to downstream states
- Costly and time-consuming permitting of water projects
- Aging irrigation and municipal water infrastructure

**Working within the Rio Grande Basin's water-related challenges will require cooperation of the entire community.**

This Plan is intended as a framework to guide future decision making and to address water challenges with a balanced, collaborative, and solutions-oriented approach.

Senior water rights irrigate the conserved Gilmore Ranch, along the Rio Grande west of Alamosa. Photo: Rio de la Vista

Water Division 3 meeting in the Rio Grande Basin. Photo: Erich Schlegel

## 1.2 : BASIN ROUNDTABLE AND BASIN IMPLEMENTATION PLAN PROCESS

The RGBRT serves as a forum to discuss water-related issues and as an organization through which local entities and water users seek funding for projects. To date, projects approved by the RGBRT have secured approximately $9.4 million from the CWCB's Water Supply Reserve Account (WSRA) statewide account and $2 million from the WSRA Basin account. These grants have funded 45 projects in the Basin, ranging from studies to infrastructure improvement and river restoration, among others. The funding provided by CWCB through the WSRA has been integral in assisting the Basin to address water needs.

RGBRT members called for a plan that provides a concise history of the development of the Basin, existing and future water needs, future priorities, and an initial identification of projects and methods to address these priorities and needs. The Plan is to identify agricultural, municipal, industrial, environmental, recreational, and water administration needs and outline multi-use projects to address the Basin's needs.

The RGBRT appointed a Steering Committee to oversee the development of the Plan and review content submitted by the RGBRT consultants and subcommittees. The members of the Steering Committee are named in the table below:

## 1.2.1 : BASIN IMPLEMENTATION PLAN STEERING COMMITTEE

| Steering Committee Name | Organization |
|---|---|
| Mike Gibson* | Chairperson, San Luis Valley Water Conservancy District |
| Rick Basagoitia* | Colorado Parks and Wildlife |
| Ron Brink* | Rancher/farmer |
| Nathan Coombs* | Conejos Water Conservancy District |
| Rio de la Vista* | Rio Grande Headwaters Land Trust and Environmental representative |
| Heather Dutton* | Rio Grande Headwaters Restoration Project and Recreation representative |
| Eugene Jacquez* | Costilla County Water User/Costilla County representative |
| Nicole Langley | Transforma Research & Design |
| Judy Lopez* | Rio Grande Watershed Conservation and Education Initiative and Education representative |
| Cindy Medina* | Alamosa Riverkeepers |
| Emma Regier | Rio Grande Headwaters Restoration Project |
| Travis Smith* | San Luis Valley Irrigation District, CWCB Board member, Inter-Basin Compact Committee member |
| Charlie Spielman* | Industrial Water Users representative |
| Kevin Terry* | Trout Unlimited and Non-voting Environmental and Recreation representative |
| Steve Vandiver* | Rio Grande Water Conservation District, Inter-Basin Compact Committee member |

* Member of the Rio Grande Basin Roundtable

Steering Committee meeting to go over the Rio Grande Basin Plan. Photo: Heather Dutton

Homesite along Rio Grande in Antelope Park. Photo © Adriel Heisey / www.adrielheisey.com

## 1.2.2 : BASIN PLAN SUBCOMMITTEES

The RGBRT and Steering Committee formed five subcommittees — Agricultural, Environmental and Recreational, Municipal and Industrial, Water Administration, and Public Outreach — to reach out to and give a voice to the various interests in the Basin, and to carefully weigh all perspectives as the Plan was developed. Through an extensive education and outreach campaign, the RGBRT engaged the entire community to promote understanding of and receive feedback on the Plan's objectives.

The subcommittees developed the substantive content of the Plan related to their specific areas of expertise. The subcommittees included members of the RGBRT as well as key stakeholders in the Basin. The members of the five subcommittees are named in the tables below:

**Agricultural Subcommittee**

| Name | Organization |
|---|---|
| Ron Brink* | Chairperson, rancher/farmer |
| Peter Clark* | Farmer, Rio Grande County well users |
| Nathan Coombs* | Conejos Water Conservancy District |
| Ralph Curtis | Retired Rio Grande Water Conservation District Manager |
| Mario Curto* | Well user |
| Jim Ehrlich* | Colorado Potato Administrative Committee |
| Lawrence Gallegos* | Conejos County Clerk |
| Greg Higel* | Rio Grande Water Users, Rio Grande Water Conservation District, Rio Grande Headwaters Restoration Project, and rancher |
| Keith Holland* | Santa Maria Reservoir Company |
| Eugene Jacquez* | Rio Culebra Watershed and Rio Culebra Agricultural Coop |
| Judy Lopez* | Rio Grande Watershed Conservation and Education Initiative |
| Ed Nielsen* | Rancher/realtor |
| Karla Shriver* | Rio Grande County Commissioner, San Luis Valley Great Outdoors Coalition Chair, Rio Grande Headwaters Restoration Project, San Luis Valley Water Conservancy District, and farmer |

* Member of the Rio Grande Basin Roundtable

**Environmental and Recreation Subcommittee**

| Name | Organization |
|---|---|
| Rio de la Vista* | Chairperson, Rio Grande Headwaters Land Trust |
| Cary Aloia | Wetlands Dynamics LLC |
| Rick Basagoitia* | Colorado Parks and Wildlife |
| Christine Canaly | San Luis Valley Ecosystem Council |
| Peter Clark* | Farmer, Rio Grande County well users |
| Heather Dutton* | Rio Grande Headwaters Restoration Project |
| Ben Doon | Costilla County |
| Christine Gallegos | Sangre de Cristo National Heritage Area |
| Courtney Hurst | Rio Grande Headwaters Land Trust |
| Ruth Lewis | Wetlands Focus Group Chair / NRCS |
| Jill Lucero | Bureau of Land Management |
| Sue Swift Miller | Bureau of Land Management |
| Jenny Nehring | Wetland Dynamics LLC |
| Joseph Old Elk | U.S. Forest Service |
| Emma Regier | Rio Grande Headwaters Restoration Project |
| Karla Shriver* | Rio Grande County Commissioner, San Luis Valley Great Outdoors Coalition Chair, Rio Grande Headwaters Restoration Project, San Luis Valley Water Conservancy District, and farmer |
| Kevin Terry* | Trout Unlimited |
| Paul Tigan | Bureau of Land Management |

* Member of the Rio Grande Basin Roundtable

| Municipal and Industrial Subcommittee | |
|---|---|
| **Name** | **Organization** |
| Charlie Spielman* | Chairperson, Industrial Water Users and Retired Geologist |
| Marty Asplin | Town of Del Norte |
| Nathan Coombs* | Conejos Water Conservancy District |
| Allen Davey | Davis Engineering |
| Gene Farish* | Farish Law |
| Bob Kirkham | GeoLogical Solutions |
| Nicole V. Langley | Transforma Research & Design |
| Jason Lorenz | Agro Engineering |
| Forrest Neuerburg | Town of Monte Vista |
| Dale Wiescamp* | Rio Grande County Representative and Wiescamp Realty LLC |

* Member of the Rio Grande Basin Roundtable

| Water Administration Subcommittee | |
|---|---|
| **Name** | **Organization** |
| Steve Vandiver* | Chairperson, Rio Grande Water Conservation District |
| Tony Aloia | Colorado Parks and Wildlife |
| Nathan Coombs* | Conejos Water Conservancy District |
| Craig Cotten | Colorado Division of Water Resources, Division 3 |
| Greg Higel* | Rio Grande Water Users, Rio Grande Water Conservation District, Rio Grande Headwaters Restoration Project, and rancher |
| Travis Smith* | San Luis Valley Irrigation District, CWCB Board member, and Interbasin Compact Committee member |

* Member of the Rio Grande Basin Roundtable

| Public Outreach Subcommittee | |
|---|---|
| **Name** | **Organization** |
| Judy Lopez* | Chairperson, Rio Grande Watershed Conservation and Education Initiative |
| Ron Brink* | Rancher/farmer |
| Rick Basagoitia* | Colorado Parks and Wildlife |
| Heather Dutton* | Rio Grande Headwaters Restoration Project |
| Christine Gallegos | Sangre de Cristo National Heritage Area |
| Joe Gallegos | Sangre de Cristo Acequia Association |
| Ruth Heide | Valley Courier |
| Eugene Jacquez* | Rio Culebra Watershed & Rio Culebra Agricultural Coop |
| Cindy Medina* | Alamosa Riverkeepers |
| Emma Regier | Rio Grande Headwaters Restoration Project |
| Travis Smith* | San Luis Valley Irrigation District, CWCB Board Member, and Interbasin Compact Committee member |
| Kevin Terry* | Trout Unlimited |

* Member of the Rio Grande Basin Roundtable

## 1.3 : ORGANIZATION OF THE BASIN IMPLEMENTATION PLAN

This Plan is organized in the following manner:

**Section 1: Introduction.** The introduction describes Colorado's Water Plan process and the role of the RGBRT. It lists members of the RGBRT together with the Rio Grande Basin Implementation Plan's steering committee and subcommittees. This section also describes the organization of this Plan.

**Section 2: Basin Overview.** A general description of the Basin, including geography, land ownership, history of the San Luis Valley, and Basin economy is included in Section 2. This section is intended as a reference guide, with background and supporting information to the Plan. It describes:

- Surface and groundwater resources
- History of water development, including the reservoirs, canals, and well development
- Timeline of the history of water development
- Water rights administration, including the Rio Grande Compact and surface and groundwater administration
- Existing environmental and recreational attributes

**Section 3: Goals.** The guidelines for this Plan, as reflected in the RGBRT's goals, are outlined in Section 3. The goals portray the Basin priorities identified by the RGBRT membership and the public.

**Section 4: Basin Water Needs.** The Basin's agricultural, municipal and industrial, environmental and recreational, and water administration needs, as identified by the Plan's subcommittees, are described in Section 4.

**Section 5: Constraints and Opportunities.** Section 5 identifies the constraints that limit the ability of the Basin to meet the needs identified in Section 4. This section also discusses opportunities to address the constraints.

**Section 6: Projects and Methods.** Projects and methods identified as ways to strategically implement projects that meet the identified goals are summarized in Section 6.

**Section 7: Public Outreach.** Section 7 details the extensive public outreach effort that was conducted in preparing the Plan.

**Section 8: Path Forward.** Section 8 describes the next steps in the implementation of the Plan.

San Luis Valley river.
Photo: Julie Messick

Ranches and hayfields along the Rio Grande above Del Norte. Photo © Adriel Heisey / www.adrielheisey.com

# 2 BASIN OVERVIEW

## 2.1 : BASIN BACKGROUND

The upper Rio Grande Basin in south central Colorado encompasses roughly 7.2% of the state's land (approximately 7,500 square miles). Its borders are defined by the Colorado–New Mexico state line on the south, the La Garita range on the north, the San Juan Mountains and Continental Divide on the west, and the Sangre de Cristo and the Culebra mountains on the east. Snowmelt runoff and summer storms are the main contributors of water supply to the headwaters in the surrounding mountains. Streams and rivers deliver water from the mountains to the San Luis Valley (the Valley). With an average elevation of 7,500 feet, the Valley floor receives an average of less than eight inches of precipitation per year.

Flowering potato plant. Photo: Julie Messick

Basin-wide, there is twice as much public land as there is private land, with the majority of the streams' headwaters in the Rio Grande National Forest (RGNF). In contrast, the majority of the land on the Valley floor is privately owned. In addition to other crops, the Valley has the second-largest production of potatoes in the United States. Areas in the Valley that are not irrigated are mostly classified as shrubland (24%) and grassland (31%). The San Juan, La Garita, and Sangre de Cristo mountain ranges are largely forested.

The existence of the Valley was known to European explorers since the Spanish settled what is now New Mexico in the 1590s, but it was largely ignored due to its isolation and relatively inhospitable environment. At that time, it was a land frequented by various nomadic Indian groups and was of little obvious benefit to settlers. Among the first explorers into the Valley was Diego de Vargas, who entered the region as a show of force, following his defeat of the Pueblo Indians at Santa Fe in 1692. In the early 1800s, fur

**FIGURE 1.**

Map of Rio Grande Basin geography.

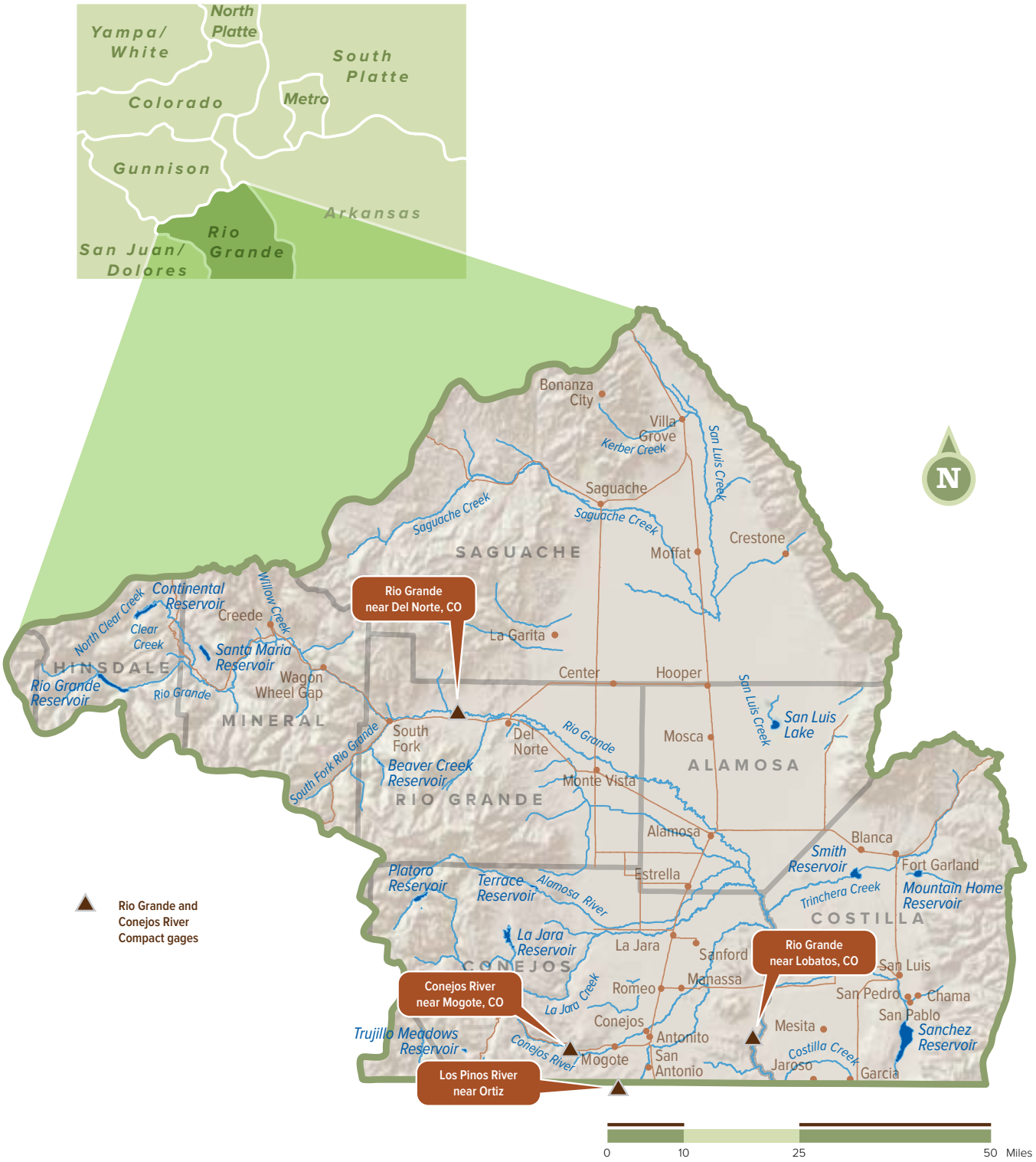


**FIGURE 2.**

Location and ownership of public lands in the Rio Grande Basin.

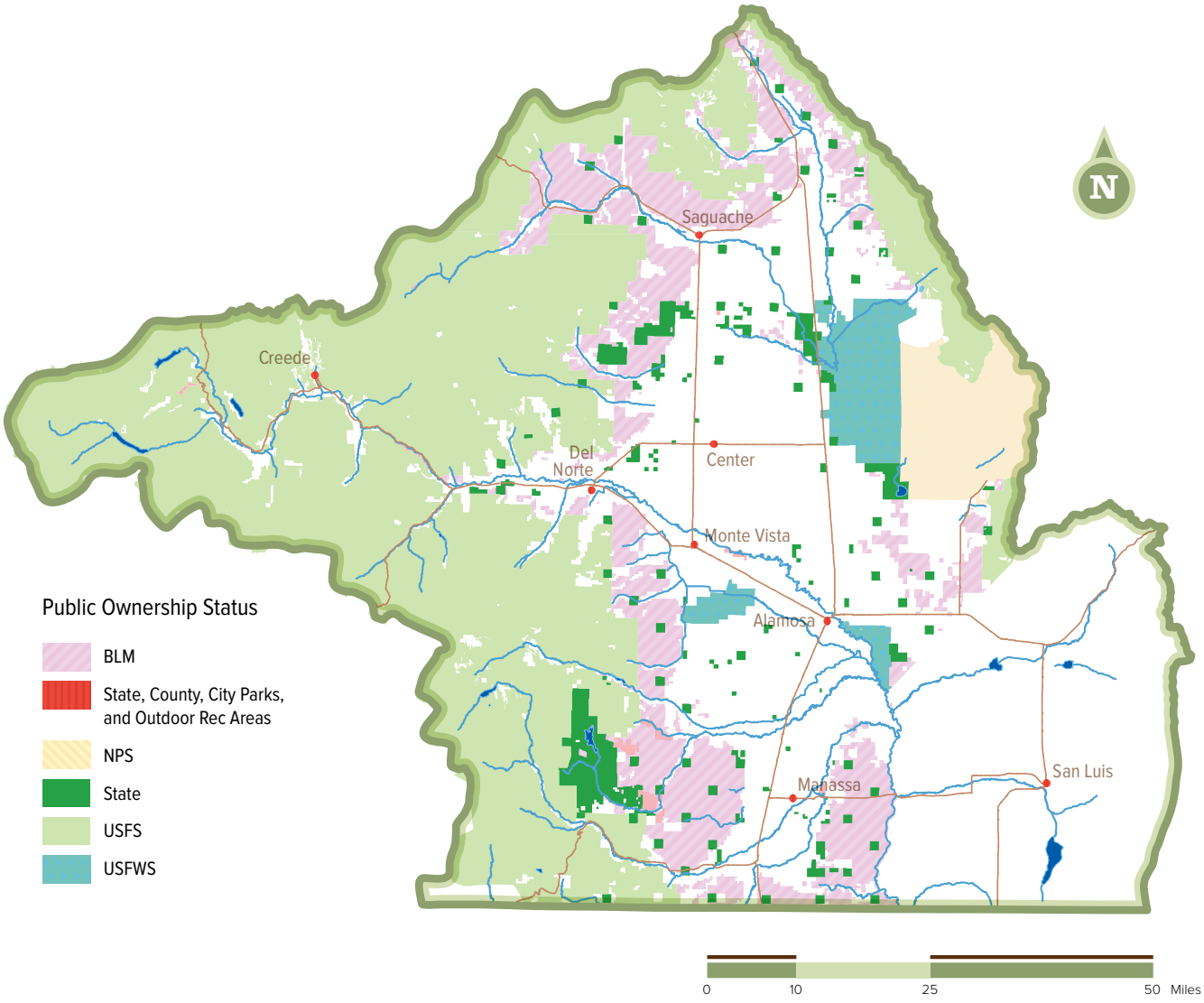


**TABLE 1.**

Public and private land ownership in the Rio Grande Basin.

| Entity | On Fig 2. | Total Area (acres) | Percent of Public Lands | Percent of Total Basin land |
|---|---|---|---|---|
| Private | | 2,085,634 | - | 43% |
| Bureau of Land Management | BLM | 499,998 | 18% | 10% |
| Colorado Parks and Wildlife | | 9,707 | 0.4% | 0.2% |
| National Park Service (NPS) | NPS | 136,765 | 5% | 3% |
| Rio Grande National Forest | USFS | 1,830,552 | 67% | 38% |
| State of Colorado | State | 138,729 | 5% | 3% |
| State, County, City; Park and Outdoor Recreation Areas | | 13,731 | 1% | 0.3% |
| US Fish and Wildlife Service | USFWS | 112,241 | 4% | 2% |
| **Total Public Lands** | | **2,741,722** | - | **57%** |

Source: Public lands layer from U.S. Fish and Wildlife Service. (The original data set consisted of a merge of 56 Colorado 1:100,000-scale land-ownership maps that were digitized at the USFWS. The hardcopy maps/source materials were provided to the USFWS by the BLM Colorado State Office.)

trappers began passing through the Valley on their way west to the San Juan Mountains. In 1803, the Louisiana Purchase gave the United States control over vast areas of the West, including parts of Colorado, but not the Rio Grande Basin. In late 1806, under an order from President Thomas Jefferson to explore the Rocky Mountains near Spanish territory, Lieutenant Zebulon Pike and his men entered the Valley, where they set up camp for the winter. In February of 1807, Pike and his men were arrested by the Spaniards for trespassing and taken to Mexico. They were released and returned to the United States in 1810.

Pike was the last recorded explorer in the Valley until 1848. After the Rio Grande Basin became part of the United States territory, John C. Fremont came in search of a rail route through the Rockies. Fremont was followed in 1853 by John Gunnison, who also in search of a rail route. In the 1870s, explorer and surveyor Ferdinand V. Hayden came to Colorado to map the unexplored regions of the territory. His journey took him through the Valley (Simonds n.d.).

By the 1850s, Hispanic settlers from what is now New Mexico had migrated into the Valley to establish small plazas within land grants issued by the New Mexican governor in Santa Fe. These pioneers gave birth to the permanent settling of Colorado, which started in San Luis, Colorado's oldest town (established in 1851).

Nearly 160 years after founding the first permanent settlements in the Valley, today's Hispanic residents retain many of the cultural traits of their forbearers. In three Basin counties, one in three households speak a language other than English, while that figure is one in two in Costilla County. The systems of

acequias, or community water systems founded by Hispanic settlers, remain in operation throughout the southern portion of the Basin.

Settlers and immigrants from around the world came to the Basin following the Homestead Act of 1862 and establishment of the railroad. Many put down roots on ranches and farms, setting the stage for the Basin's way of life today. Mormon settlers found a home in the Basin toward the end of the 1870s; their initial settlements at Manassa and Sanford near the Conejos River remain agriculture-based communities. Japanese-Americans from California were drawn to the Basin in the 1920s to grow lettuce, spinach, cauliflower, and carrots, mainly in Conejos and Costilla counties.

The Sangre de Cristo National Heritage Area, designated by the federal Omnibus Public Land Management Act of 2009, encompasses more than 3,000 square miles spanning across Conejos, Costilla, and Alamosa counties. The area contains impressive historic, cultural, and natural treasures. Visitors to this heritage area have the opportunity to experience history in San Luis and impressive natural splendor at the Great Sand Dunes National Park and Preserve. The area includes over 20 cultural properties listed in the National Register of Historic Places (U.S. Department of the Interior, National Park Service n.d.).

## 2.2 : ECONOMY

Agriculture is the primary economic driver in the Basin, with roughly 523,000 acres of irrigated land. Agricultural products sold total approximately $325 million per year; crops account for approximately $285 million of that total, the largest being alfalfa and grass hay, barley, potatoes, and spring wheat. Livestock contributes approximately $40 million to the total (San Luis Valley Development Resource Group 2013), though the numbers of mature cattle have been declining since 2001. Agriculture is also the largest source of base jobs in the Valley, accounting for 18% of the Valley's workforce (State of Colorado, Department of Local Affairs, Planning and Management 2012).

Potato harvest in the San Luis Valley. Photo: Julie Messick

Hay is grown in all of the counties that support agriculture (Alamosa, Conejos, Costilla, Rio Grande, and Saguache), with Conejos County being the largest producer. The average price of hay in the Valley increased by 77% from 2010 to 2012, according to USDA statistics. This large increase in price was driven by drought

conditions in the Southwest, the demand by dairies in New Mexico, and demand in other Western states, including Texas. Prices and production of potatoes in the San Luis Valley showed much less variability between 2010 and 2012; in the Valley as a whole, production of potatoes decreased from 21.5 million CWT (per hundred pounds of weight) to 20 million CWT between 2010 and 2012, but gross income increased from $178 million to $190 million over the same time period.

A comparison summary of the total tons produced, acres harvested, total revenue, and gross revenue per ton and acre is shown in Table 2. Of note is the gross revenue per acre-foot (AF) of water consumed. The gross revenue for alfalfa hay in 2010 was $428 per acre and $175 per AF of water consumption. In contrast, potatoes had gross revenue of $3,217 per acre and $2,681 per AF of water consumption. Even with the unusually high hay prices in 2012, as a result of the Western U.S. drought, gross revenue for alfalfa per AF of water consumption was $359 compared to $2,932 per AF of water consumed for potatoes. Potatoes grown in the Valley generate five to ten times the gross revenue per AF of water consumed compared to that of alfalfa. However, potatoes are not a suitable crop in all areas and soil types of the Valley.

Regarding inhabitants, the Basin's population overall is projected to increase at about 0.9% per year between 2014 and 2050. In the years between 2010 and 2013, though, population in the Rio Grande, Conejos, and Costilla counties is estimated to have decreased slightly.

The Basin's thriving tourism industry, much of which is water-dependent, accounts for 11% of employment in the area. The Basin's 2 million acres of

**TABLE 2.** Production, revenue and water use by major crop grown in the San Luis Valley.

| | Alfalfa Hay | | Grass Hay | | Potatoes | | Barley | |
|---|---|---|---|---|---|---|---|---|
| | **2010** | **2012** | **2010** | **2012** | **2010** | **2012** | **2010** | **2012** |
| Total Tons Produced | 553,000 | 619,000 | 167,000 | 202,000 | 1,076,400 | 999,000 | 214,380 | 178,230 |
| Acres Harvested | 150,000 | 145,000 | 115,000 | 105,000 | 55,200 | 54,000 | 49,100 | 43,100 |
| Total Revenue | $64,220,000 | $127,530,000 | $19,400,000 | $41,870,000 | $177,580,000 | $190,000,000 | $27,080,000 | $39,920,000 |
| Gross Revenue/Ton | $116 | $206 | $116 | $207 | $165 | $190 | $126 | $224 |
| Gross Revenue/Acre | $428 | $880 | $169 | $399 | $3,217 | $3,519 | $552 | $926 |
| Consumptive Use (CU) of Water (AF) | 367,500 | 355,250 | 251,083 | 229,250 | 66,240 | 64,800 | 71,195 | 62,495 |
| Gross Revenue/ AF of CU | $175 | $359 | $77 | $183 | $2,681 | $2,932 | $380 | $639 |

**Sources:** U.S. Department of Agriculture, National Agricultural Statistics Service n.d. (for production, revenue, and water use)
State of Colorado, Department of Natural Resources, Water Conservation Board, and Division of Water Resources 2011 (consumptive use comes from average IWR/acre from the 2011 RGDSS StateCU files)

public land — which includes the RGNF, Great Sand Dunes National Park and Preserve, several wilderness areas, wildlife areas and refuges, and the Wolf Creek Ski Area — annually attract hundreds of thousands of visitors to the region. Popular recreational activities include angling, hunting, wildlife and bird watching, winter sports, camping, rafting, paddling, and boating activities — all of which depend on adequate and healthy water resources.

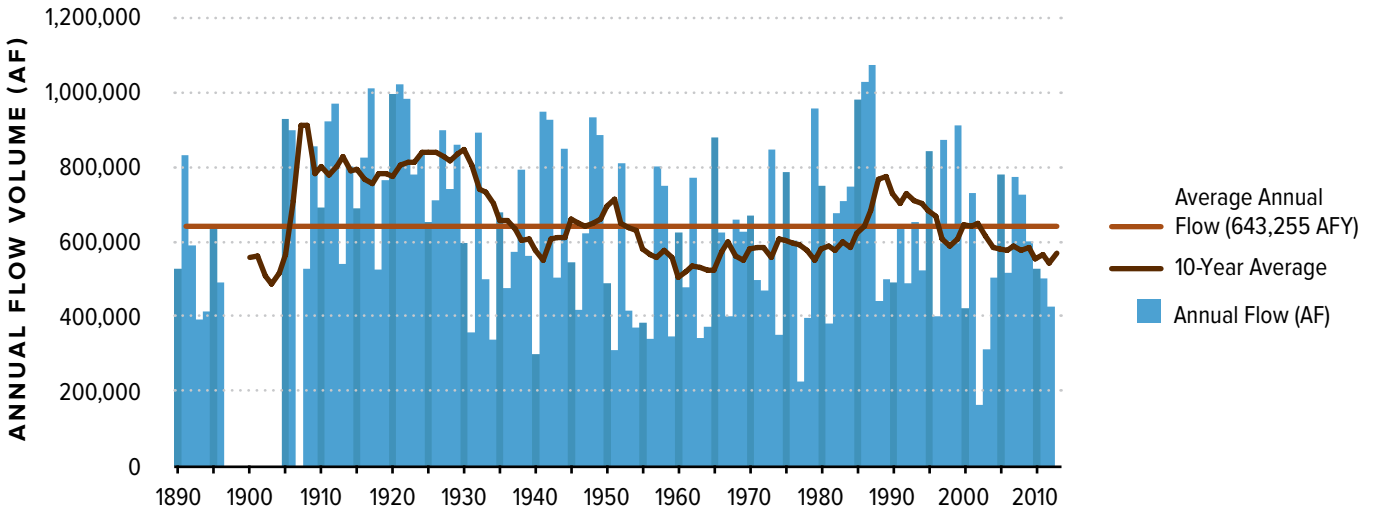
Fishing on the Rio Grande.
Photo: Rio de la Vista

## 2.3 : SURFACE WATER HYDROLOGY AND GROUNDWATER RESOURCES

The Basin experiences highly variable seasonal and year-to-year fluctuations in streamflow. Streams and rivers are fed primarily by snowmelt runoff. To a lesser extent, summer monsoons contribute to regional streamflow. Snowmelt generally begins in late March, with a peak in late May or June. Summer thunderstorms typically last only hours, but can cause dramatic spikes in streamflow rates. A relatively small amount of snowmelt runoff is captured in reservoirs located throughout the Basin, to be released later in the season when the water is needed by irrigators. For the most part, water users' surface water diversions for irrigation are dictated by the river flows.

Annual flows of the Rio Grande, which are measured at the Del Norte stream gage, range historically from a high of 1.1 million AF in 1987 to a low of 164,000 AF in 2002, as shown in Figure 3. Flows in the Conejos River system, which are totaled at three stream gages, Conejos near Mogote, Los Pinos, and

**FIGURE 3.** Annual streamflow at the Rio Grande near Del Norte gage from 1890–2012.

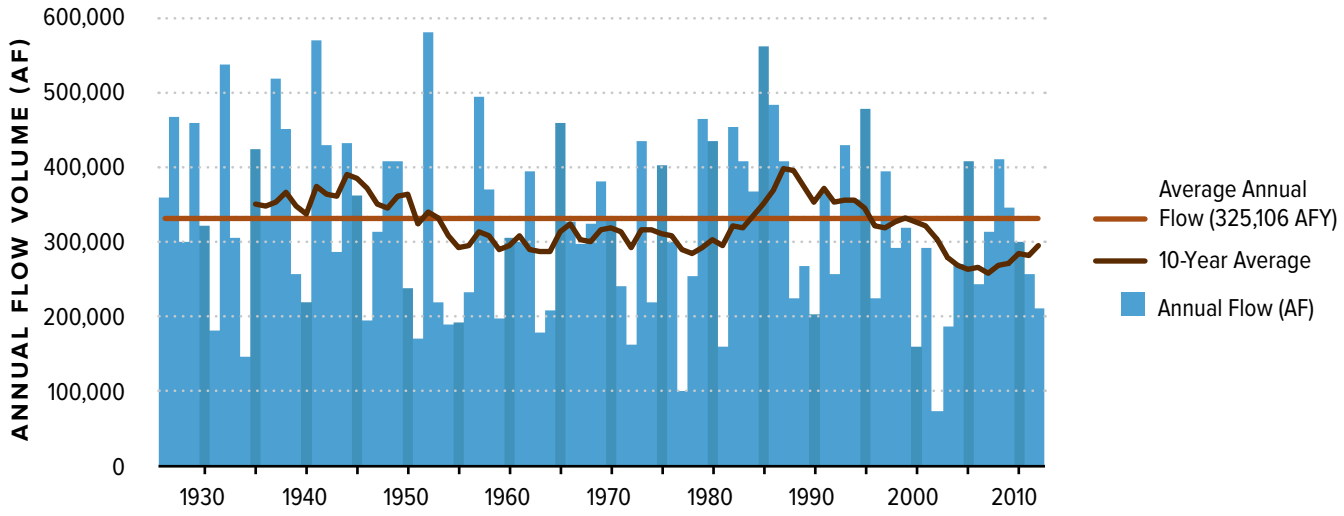



Source: U.S. Geological Survey, National Water Information System, USGS 08220000 Rio Grande Near Del Norte, Colo. n.d.

**FIGURE 4.**

Annual streamflow at the Conejos River index gages from 1926–2012.

(Conejos River near Mogote, Los Pinos River near Ortiz, and San Antonio River at Ortiz)




Source: U.S. Geological Survey, National Water Information System, USGS 08246500 Conejos River near Mogote, Colo.; USGS 08248000 Los Pinos River Near Ortiz, Colo.; USGS 08247500 San Antonio River at Ortiz, Colo. n.d.

San Antonio (the Conejos index gages), also vary greatly, as shown in Figure 4. Between 1926 and 2012, the largest flow of the combined Conejos index gages was 583,000 AF in 1952, and the smallest flow was 73,000 AF in 2002, almost an eight-fold difference. Over the last 75 years, the 10-year running average peaked in 1987 for both the Rio Grande main stem and Conejos River, followed by a steady 25-year decline that has continued until present day.

In addition to diversions from rivers and streams, water users draw on two stacked aquifers, known as the "unconfined" and "confined" aquifers. The uppermost aquifer, the unconfined, ranges in thickness from 30–100 feet throughout the Valley and is recharged by precipitation, streams, canal leakage, and return flows from irrigation.

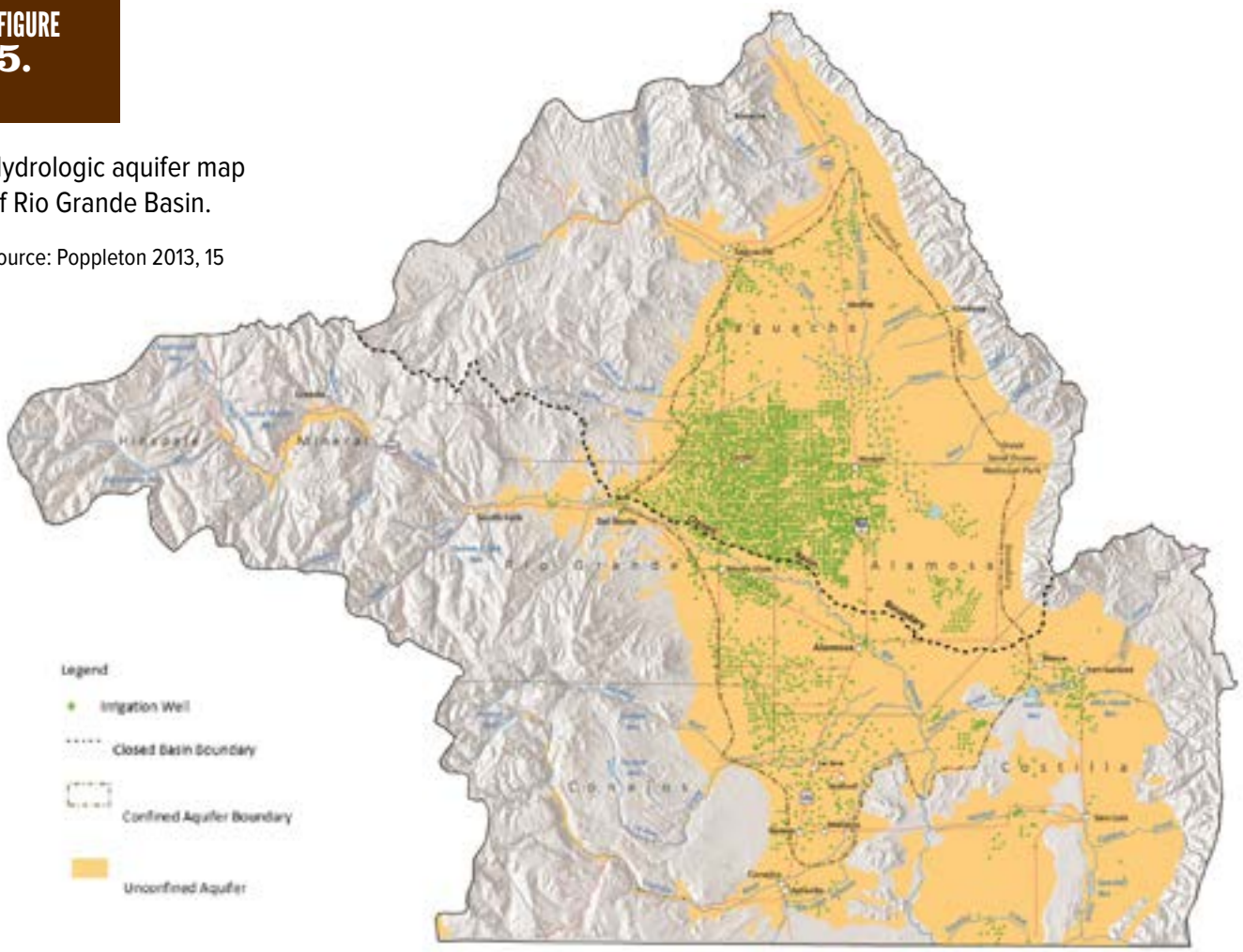
The larger, deeper confined aquifer is separated from the unconfined aquifer by a series of blue clay and basalt layers, and is under artesian pressure. The confined aquifer extends several thousand feet below the surface and is primarily recharged by flows at the rim of the Valley, in areas without basalt or blue clay barriers.

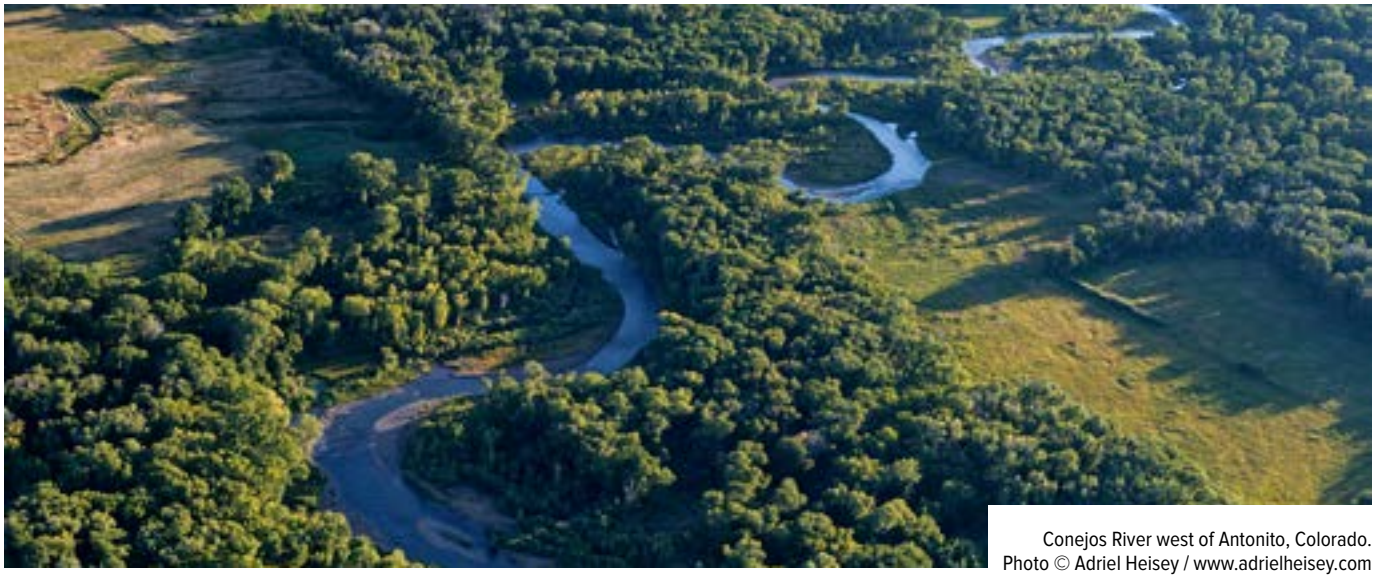
The general location of the unconfined and confined aquifers is shown in Figure 5. A schematic showing the dynamics of the unconfined and confined aquifers is shown in Figure 6. This figure depicts the general water balance of the aquifers. One additional source of recharge to the unconfined aquifer that is not shown in Figure 6 is return flows from irrigation.

**FIGURE 5.**

Hydrologic aquifer map of Rio Grande Basin.

Source: Poppleton 2013, 15

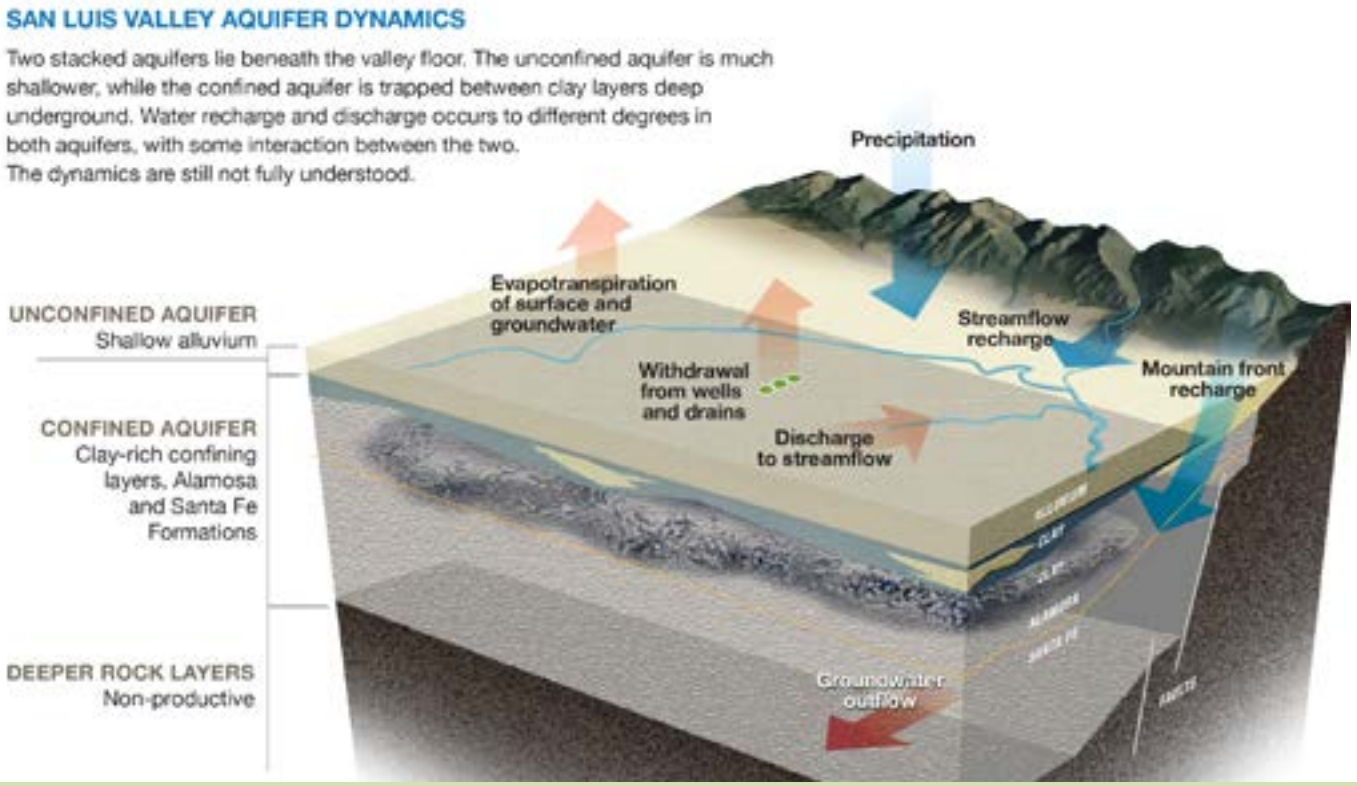


Conejos River west of Antonito, Colorado.
Photo © Adriel Heisey / www.adrielheisey.com

**FIGURE 6.**

Aquifer recharge of the confined and unconfined aquifers along a mountain front of the San Luis Valley.

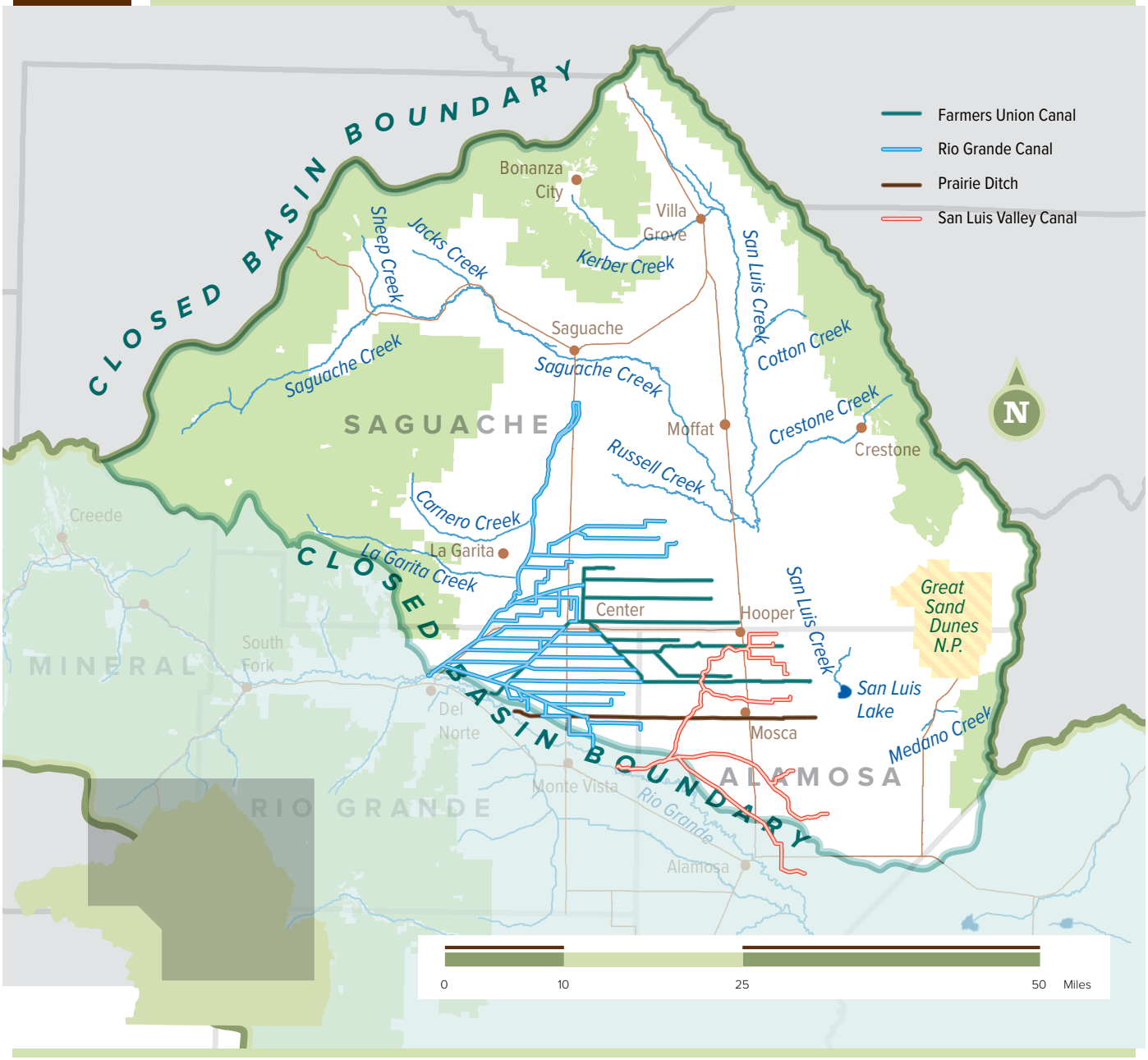



Source: Smith 2013, 25

Geese on the Rio Grande in Antelope Park.
Photo © Adriel Heisey / www.adrielheisey.com

**FIGURE 7.**

Map of Closed Basin area and associated canals.




The northern one-third of the basin is a "Closed Basin" (Figure 7) that does not have a natural outlet to the Rio Grande. A hydraulic divide that parallels the Rio Grande from Del Norte to Alamosa one to three miles north of the river provides a buffer between groundwater that is tributary to the Rio Grande and groundwater in the Closed Basin. The extent of the hydraulic divide is the subject of much study and is of great importance with respect to groundwater administration.

## 2.4 : HISTORY OF WATER DEVELOPMENT

The Basin has a rich history of water development, with many of the oldest adjudicated water rights in Colorado. The Basin's water development history ranges from the surface water development via canals, ditches, and reservoirs to groundwater development of the unconfined and confined aquifers.

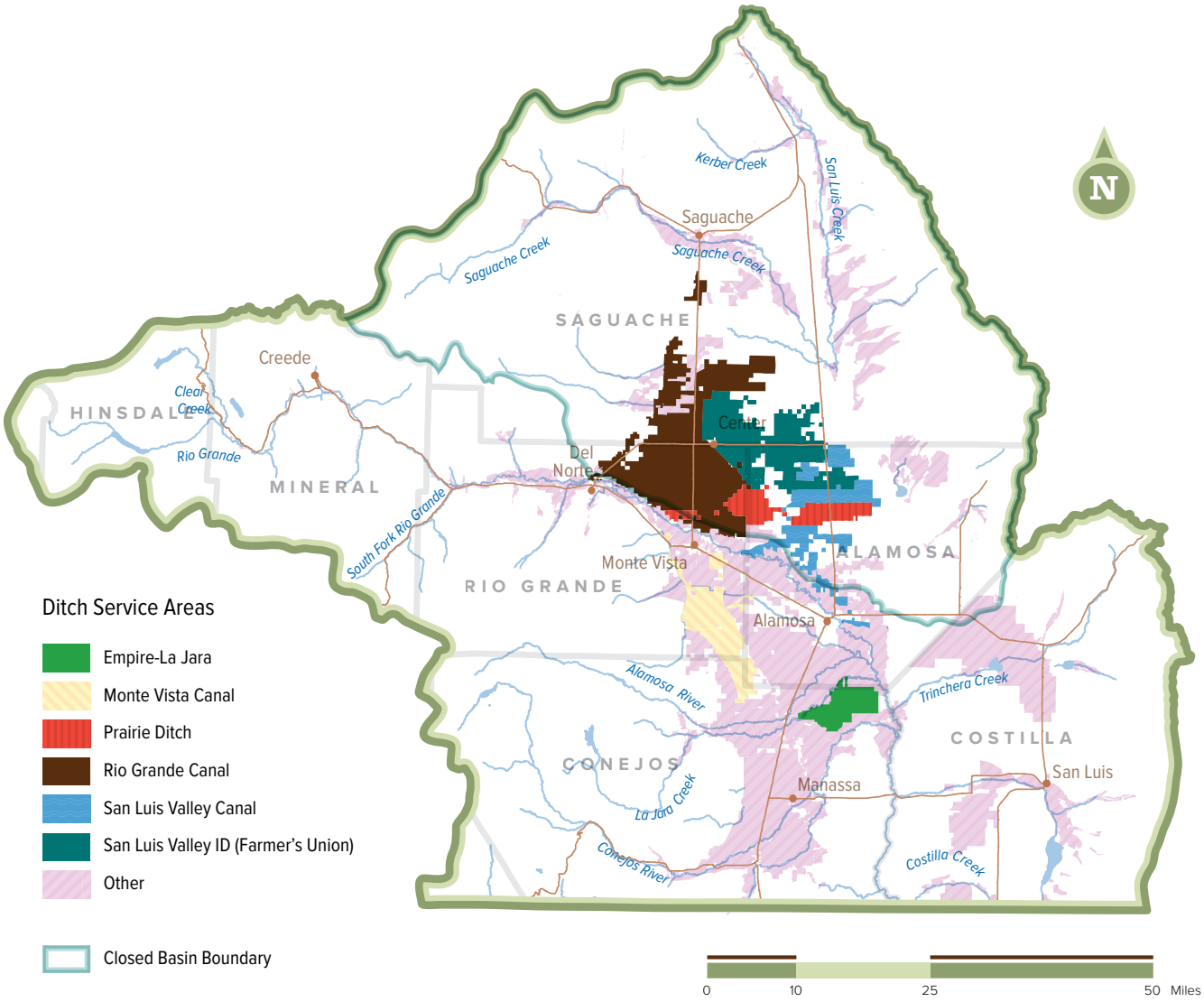
### 2.4.1 : CANALS AND DITCHES

Hispanics from New Mexico settled along the Conejos and Culebra rivers in the 1850s and almost immediately began to develop community water systems known as acequias. Colorado's first surface water right, appropriated in the Basin in 1852, is the People's Ditch near San Luis, which diverts water from Culebra Creek. In 1855, the first diversion from the Conejos River occurred via the Guadalupe Ditch. The first diversion from the Rio Grande main stem occurred in 1866 at the Silva Ditch. By 1870, nearly 50,000 acres in the Basin were irrigated by canals and ditches.

A new wave of settlement and water development occurred in the 1870s. The Denver and Rio Grande Railroad was extended to the Valley in 1879. Over the next 15 years, the number of acres under irrigation rose to nearly 400,000, due to a canal building boom and the construction of nearly 2,000 artesian wells (San Luis Valley Advisory Committee 2013). By 1900, the Basin's streams were over-appropriated, meaning there were more water rights claims than actual available water to satisfy these claims. This led to a recognition of the need to construct reservoirs to capture winter and high flows during runoff. Intense irrigation development continued until there were nearly 700,000 irrigated acres by the 1930s. Today the canals and ditches provide water for farms and ranches, along with wetlands, wildlife areas, and municipal and industrial uses. The areas that can be served by the canals and ditches are shown in Figure 8.

Senior water rights irrigate the conserved Gilmore Ranch, along the Rio Grande west of Alamosa.. Photo: Rio de la Vista

**FIGURE 8.** Map of service areas of canals and ditches in the San Luis Valley.



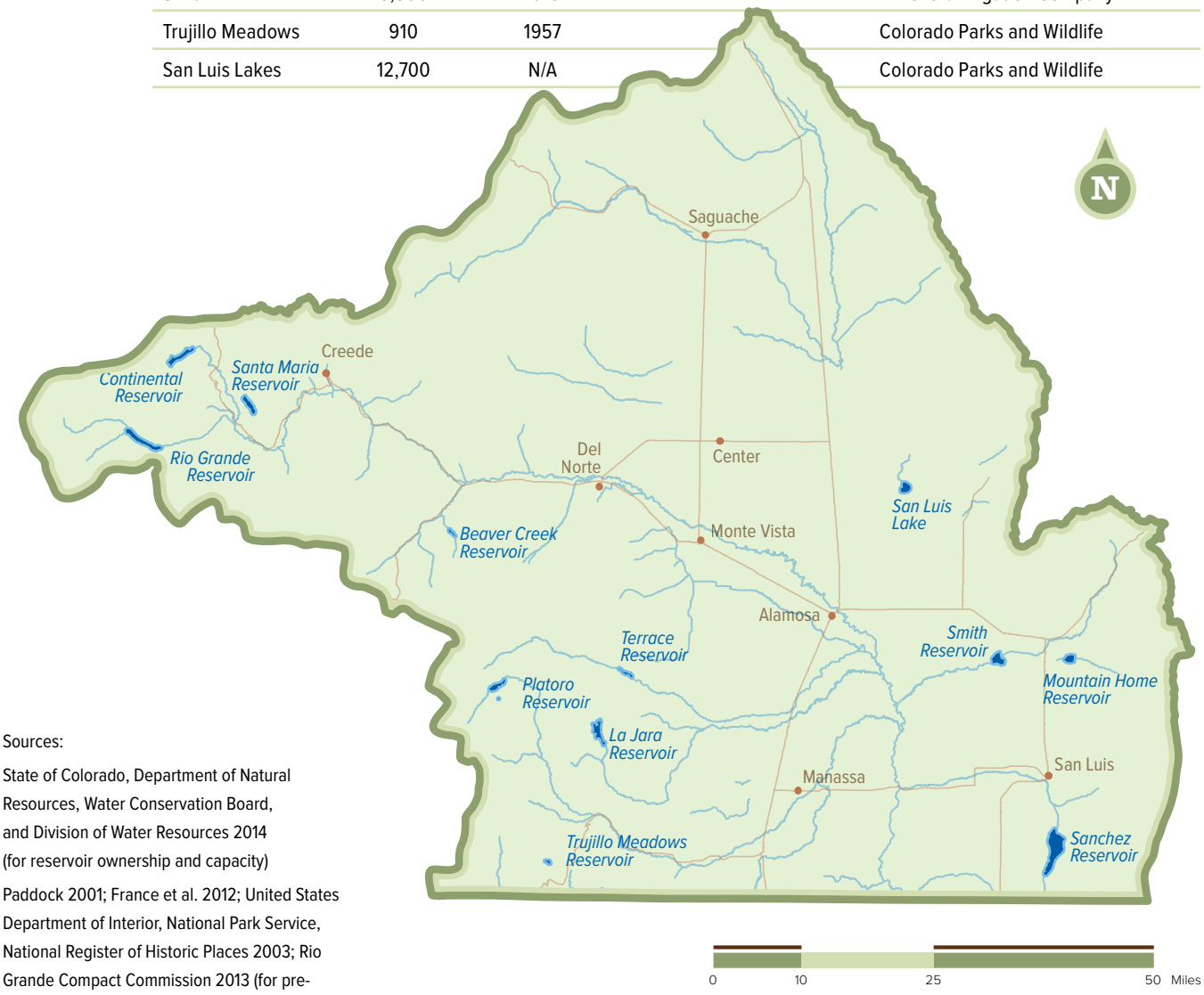

## 2.4.2 : RESERVOIRS

Basin water users suffered a major setback in the development of water supplies for irrigation in 1896, when the U.S. Secretary of the Interior imposed an embargo on the use of federal rights-of-way for development of water diversion, conveyance, and reservoir facilities on the Rio Grande in Colorado and New Mexico. The embargo, which was prompted by efforts to negotiate a water-use treaty with Mexico, saw certain terms relaxed in 1907 and fully lifted in 1925. The relaxing of the embargo in 1907 allowed the completion of several reservoirs in the Basin in Colorado. Several other reservoirs were completed after the embargo was lifted in 1925. These reservoirs include Sanchez, Rio Grande, Santa Maria, Continental, Mountain Home, Terrace, La Jara, and other smaller structures.

**FIGURE 9.**

Major Rio Grande Reservoirs.

| Reservoir Name | Capacity (AF) | Year Built | Pre–Compact Reservoir | Ownership |
|---|---|---|---|---|
| Continental | 22,680 | 1928 | X | Santa Maria Reservoir Company |
| Santa Maria | 43,800 | 1913 | X | Santa Maria Reservoir Company |
| Rio Grande | 52,000 | 1912 | X | San Luis Valley Irrigation District |
| Beaver Park | 4,758 | 1914 | X | Colorado Parks and Wildlife |
| La Jara | 14,060 | 1910 | X | Colorado Parks and Wildlife |
| Mountain Home | 17,370 | 1908 | X | Trinchera Irrigation Company |
| Platoro | 59,570 | 1951 | | Bureau of Reclamation/CWCD |
| Sanchez | 103,100 | 1911 | X | Sanchez Ditch and Reservoir Company |
| Terrace | 15,180 | 1912 | X | Terrace Reservoir Company |
| Smith | 5,800 | 1913 | | Trinchera Irrigation Company |
| Trujillo Meadows | 910 | 1957 | | Colorado Parks and Wildlife |
| San Luis Lakes | 12,700 | N/A | | Colorado Parks and Wildlife |




Sources:

State of Colorado, Department of Natural Resources, Water Conservation Board, and Division of Water Resources 2014 (for reservoir ownership and capacity)

Paddock 2001; France et al. 2012; United States Department of Interior, National Park Service, National Register of Historic Places 2003; Rio Grande Compact Commission 2013 (for pre-Compact reservoir designation and year built)

## 2.4.3 : GROUNDWATER DEVELOPMENT

Groundwater development in the Valley began with the discovery of the confined aquifer in 1887. By 1891, there were an estimated 2,000 flowing wells in the Valley; by 1904, there were 3,234 flowing wells; and by 1916, there were approximately 5,000 flowing wells in the Valley. That number increased to 6,074 flowing wells by 1936 and to an estimated 7,500 flowing wells by 1958.

Artesian well on Dutton Ranch, near Alamosa. Source: Allen Davey

Significant development of the groundwater from the unconfined aquifer for irrigation did not begin until the 1930s. While the first irrigation well in the unconfined aquifer was constructed in 1903, there was little or no further development of the unconfined aquifer for irrigation purposes for the next 25 years. The number of wells withdrawing water from the unconfined aquifer increased from 176 in 1936 to approximately 1,300 wells in 1952 and is several times that number today.

Well construction in both the confined and the unconfined aquifers continued until 1972, when the State Engineer imposed a moratorium on the issuance of well permits for new appropriations of groundwater from the confined aquifer and from the unconfined aquifer outside of the Closed Basin. In 1981, the State Engineer imposed a moratorium on the issuance of well permits for new appropriations from the unconfined aquifer in the Closed Basin, effectively ending new appropriations of groundwater in the Valley. In 2003, the State Engineer issued a policy that declined the issuance of permits to deepen existing wells, to drill supplemental wells, or to drill alternate points of diversion for wells, without the applicant first obtaining a judicial confirmation of the absence of material injury to third parties. The purpose of this policy was to prevent enlarged use of groundwater rights.

### 2.4.3.1 CONJUNCTIVE USE OF SURFACE WATER AND GROUNDWATER

Prior to the advent of high-capacity pumps and sprinkler systems, the predominate methods of irrigation were surface application through "flood" irrigating and subirrigating. These methods of irrigation caused the groundwater to build up to within one to three feet of the surface, and water was then allowed to run slowly through small ditches spaced about 16 feet apart. Water from these ditches seeped outward, supplying moisture to the plants. However, this method resulted in over-diversion during the spring snow melt runoff, in unduly high water tables, and in excessive evaporation and transpiration losses.

In the Closed Basin, the effect of this practice essentially was to create an "artificial" aquifer. With continued large diversions from the Rio Grande via irrigation canals and ditches to the porous and shallow soils in the Closed Basin, the underground basin filled rapidly; the water table rose from depths ranging from 40 feet on the east and 100 feet on the west to a position practically at the surface on the east, bordering the sump, and to a level within 10 to 15 feet of the surface on the west. As a result, much, but not all, of the

water in the unconfined aquifer of the Closed Basin resulted from diversions from the Rio Grande.

The practice of subirrigation, however, was not without its drawbacks or its critics. A serious condition soon complicated the situation. It was brought about by the rise in groundwater levels to such an extent that lands in the lower parts of the Valley were becoming seeped, forcing abandonment of acreages along the eastern side of the Closed Basin, with concomitant substitution of lands farther west. This gradual process of abandonment at the east and extension westward continued until it reached the extreme west side of the Valley, while the broad stretches of once-occupied lands to the east were left to revert to their natural state, badly damaged by alkali.

Because the aquifers are not fully maintained by natural recharge, continuation of pumping is dependent upon artificial recharge.

Crop water demands typically continue after the peak surface water flows and diversions have ceased. The use of the unconfined aquifer as a storage reservoir through the practice of subirrigation helped solve the water supply timing problem that otherwise could only be addressed with the Valley's limited reservoir storage. Because the practice of subirrigation maintained an underground water reservoir, water was available to the crops for an extended period.

A combination of factors worked to render subirrigation unfeasible. An extended period of low-water years, the imposition of curtailments on diversions from the Rio Grande to comply with the Rio Grande Compact (see Section 2.5.1), and the development of pumps to extract huge quantities of groundwater were all factors contributing to a lowering of the groundwater table in the Closed Basin area, in turn eliminating the use of subirrigation.

The increased use of wells drilled into the underground aquifers became an important part of the economy of the Closed Basin, and the advent of center pivot sprinklers once again changed the irrigation practices in the Basin. While the earliest use of center pivot sprinkler systems occurred in the Closed Basin area north of the Rio Grande, they are now used throughout the Valley. Sprinkler irrigation is most efficient with wells, has increased the yield of crops, and reduces losses. Because the aquifers are not fully maintained by natural recharge, continuation of pumping is dependent upon artificial recharge. Just as they have in the past, landowners have imported water into the Closed Basin from the Rio Grande and used it to recharge the underground aquifers, in effect using these aquifers as storage facilities.

In addition, some farmers use both surface water and groundwater in their sprinkler systems. It is not uncommon to deliver surface water to center pivot sprinklers and use groundwater to supplement the surface water supply in times of shortage. These practices of conjunctive use of surface water and groundwater are common in much of the Valley, with groundwater recharge being practiced most extensively in the Closed Basin area north of the Rio Grande.

#### 2.4.3.2 CLOSED BASIN PROJECT

During the time of the use of subirrigation practices, drains were constructed to carry excess groundwater away from the irrigated lands, returning some water to the Rio Grande. Much of the excess water in the Closed Basin flowed to the sump area on the east side of the Closed Basin and was lost to evaporation and transpiration by native vegetation. Thus, for many years, water users in the Valley discussed the construction of a large open drain to lower water levels in the sump area and return the water to the Rio Grande. This water would have been considered new water that would allow increased consumption of Rio Grande flows in Colorado under both the 1929 Temporary Compact and the Rio Grande Compact (the Compact). As a consequence, Article III of the Compact provides that if water is imported into the Rio Grande from the Closed Basin, Colorado will receive no credit for the water unless it meets specific total dissolved solids limitations.

The Closed Basin Project (the Project) is a federal reclamation project that was authorized by the U.S. Congress in 1972 and constructed by the Bureau of Reclamation. The project is designed to salvage shallow groundwater from the sump area of the Closed Basin and to deliver that water to the Rio Grande. The project was sponsored by and is currently administered by the Rio Grande Water Conservation District (RGWCD). The decree approving the Project authorized diversion of up to 117,000 acre-feet annually for Project priorities and the other authorized uses. The Project consists of 110 wells in the unconfined aquifer, which pump water into a ditch for conveyance to the Rio Grande to help meet Colorado's obligations under the Compact. The Project discharges water into the Rio Grande above its confluence with Trinchera Creek. Water has been available from the Project since 1988. The annual yield from the Project has not met the initial expectations; in recent years, it has produced approximately 14,000 acre-feet, or approximately 13% of the initial projected yield.

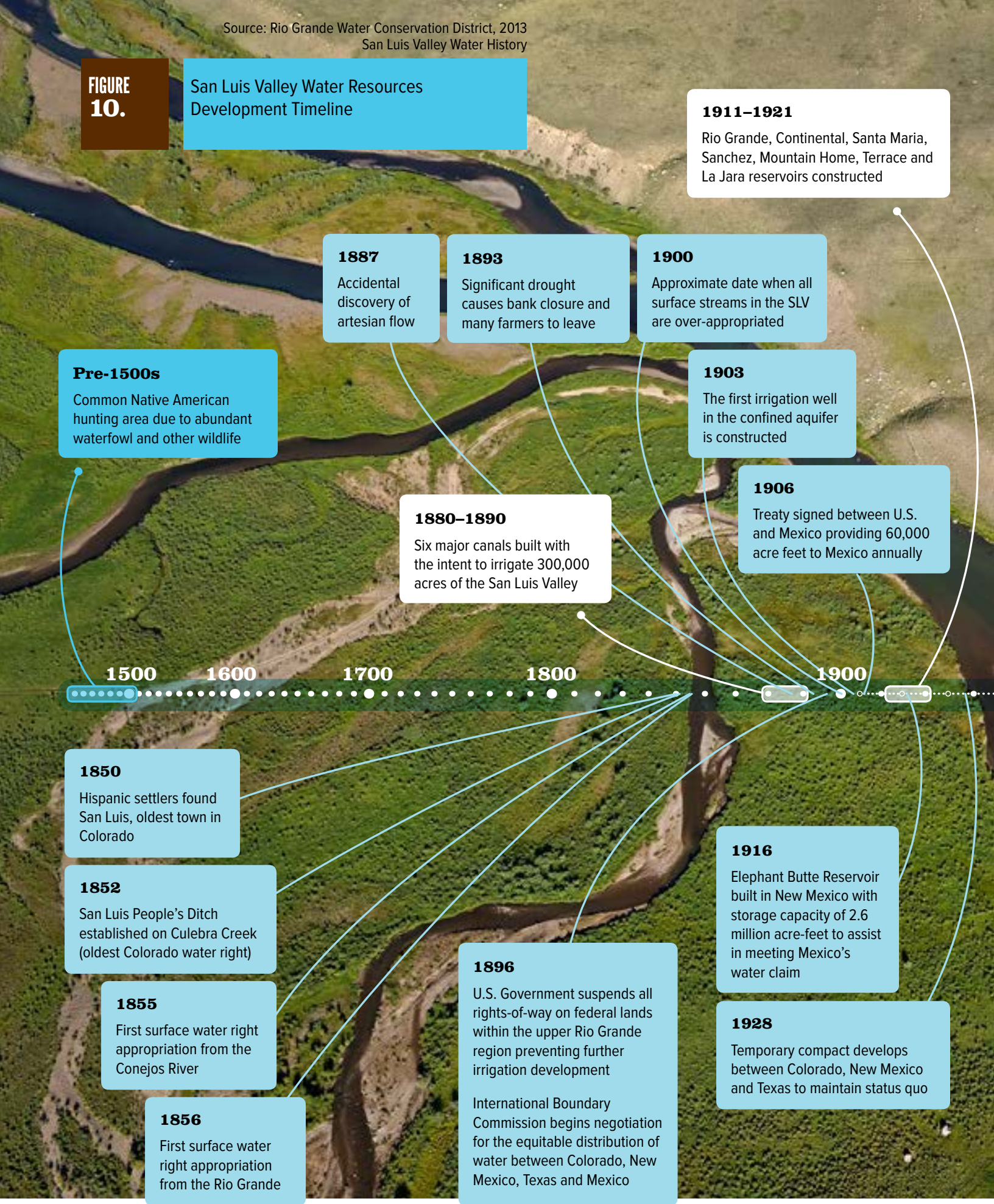
The allocation of the yield of the Closed Basin Project is a central part of current water supply administration in the Valley. Through agreement between multiple water users, the production from the Closed Basin Project was allocated 60% to the Rio Grande and 40% to the Conejos River. This agreement is intended to address, in part, the problem of stream depletions caused by existing well production in the Valley. The allocation of the water between the two rivers mirrors the way in which the Rio Grande Compact allocates separate delivery obligations between the rivers. The allocation agreement has the effect of reducing the burden of curtailment of surface water rights to meet the obligations of the Compact and, hence, a potential reduction of total irrigated acreage.

## 2.4.4 : TIMELINE OF WATER DEVELOPMENT

The following timeline of water development (Figure 10) shows major events in the Basin. This timeline was developed using significant inputs from RGWCD publications.

Source: Rio Grande Water Conservation District, 2013
San Luis Valley Water History

**FIGURE 10.** San Luis Valley Water Resources Development Timeline




**Pre-1500s**
Common Native American hunting area due to abundant waterfowl and other wildlife

**1850**
Hispanic settlers found San Luis, oldest town in Colorado

**1852**
San Luis People's Ditch established on Culebra Creek (oldest Colorado water right)

**1855**
First surface water right appropriation from the Conejos River

**1856**
First surface water right appropriation from the Rio Grande

**1880–1890**
Six major canals built with the intent to irrigate 300,000 acres of the San Luis Valley

**1887**
Accidental discovery of artesian flow

**1893**
Significant drought causes bank closure and many farmers to leave

**1896**
U.S. Government suspends all rights-of-way on federal lands within the upper Rio Grande region preventing further irrigation development

International Boundary Commission begins negotiation for the equitable distribution of water between Colorado, New Mexico, Texas and Mexico

**1900**
Approximate date when all surface streams in the SLV are over-appropriated

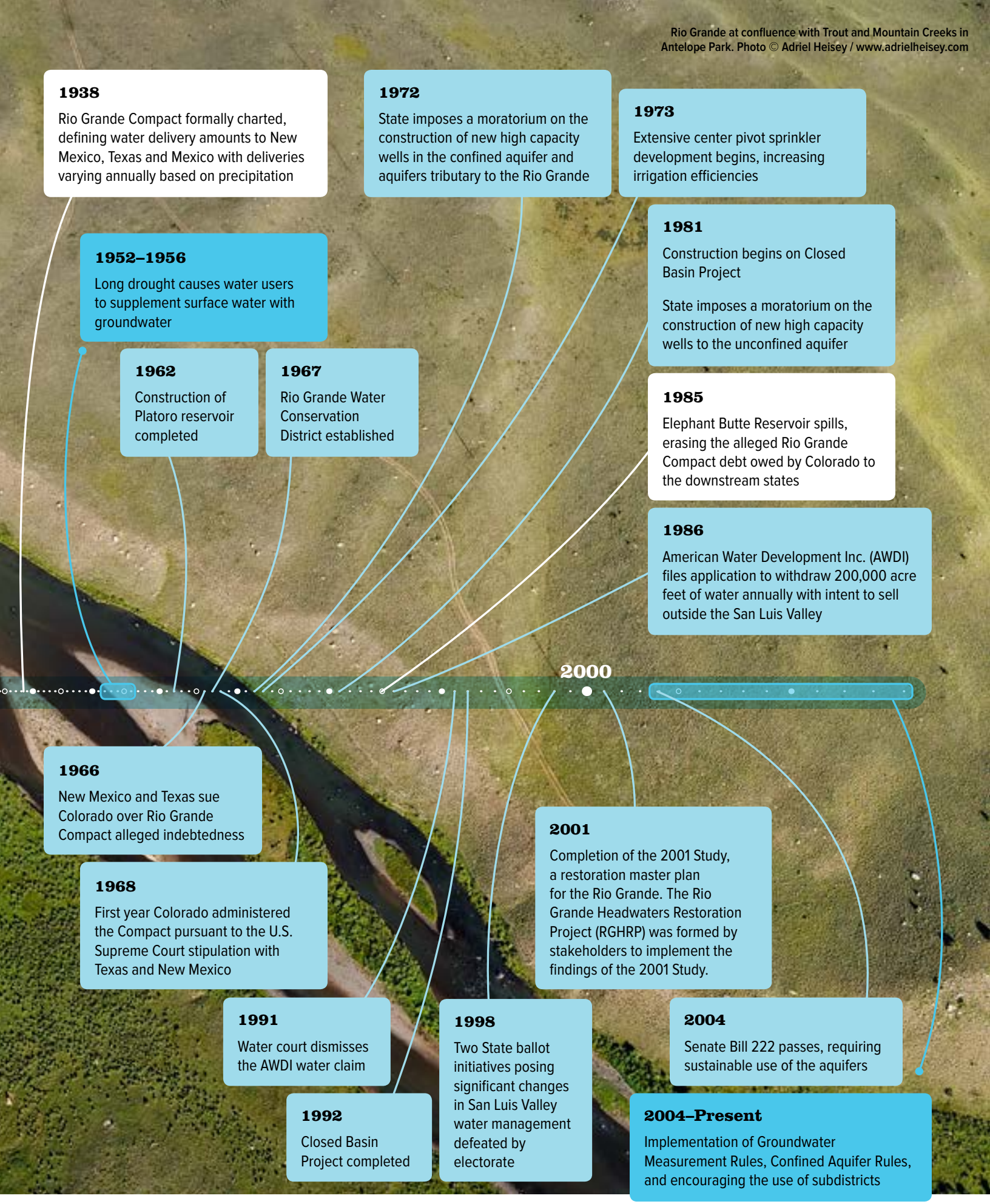
**1903**
The first irrigation well in the confined aquifer is constructed

**1906**
Treaty signed between U.S. and Mexico providing 60,000 acre feet to Mexico annually

**1911–1921**
Rio Grande, Continental, Santa Maria, Sanchez, Mountain Home, Terrace and La Jara reservoirs constructed

**1916**
Elephant Butte Reservoir built in New Mexico with storage capacity of 2.6 million acre-feet to assist in meeting Mexico's water claim

**1928**
Temporary compact develops between Colorado, New Mexico and Texas to maintain status quo



Rio Grande at confluence with Trout and Mountain Creeks in Antelope Park. Photo © Adriel Heisey / www.adrielheisey.com

**1938**

Rio Grande Compact formally charted, defining water delivery amounts to New Mexico, Texas and Mexico with deliveries varying annually based on precipitation

**1952–1956**

Long drought causes water users to supplement surface water with groundwater

**1962**

Construction of Platoro reservoir completed

**1967**

Rio Grande Water Conservation District established

**1966**

New Mexico and Texas sue Colorado over Rio Grande Compact alleged indebtedness

**1968**

First year Colorado administered the Compact pursuant to the U.S. Supreme Court stipulation with Texas and New Mexico

**1972**

State imposes a moratorium on the construction of new high capacity wells in the confined aquifer and aquifers tributary to the Rio Grande

**1973**

Extensive center pivot sprinkler development begins, increasing irrigation efficiencies

**1981**

Construction begins on Closed Basin Project

State imposes a moratorium on the construction of new high capacity wells to the unconfined aquifer

**1985**

Elephant Butte Reservoir spills, erasing the alleged Rio Grande Compact debt owed by Colorado to the downstream states

**1986**

American Water Development Inc. (AWDI) files application to withdraw 200,000 acre feet of water annually with intent to sell outside the San Luis Valley

**2000**

**2001**

Completion of the 2001 Study, a restoration master plan for the Rio Grande. The Rio Grande Headwaters Restoration Project (RGHRP) was formed by stakeholders to implement the findings of the 2001 Study.

**1991**

Water court dismisses the AWDI water claim

**1992**

Closed Basin Project completed

**1998**

Two State ballot initiatives posing significant changes in San Luis Valley water management defeated by electorate

**2004**

Senate Bill 222 passes, requiring sustainable use of the aquifers

**2004–Present**

Implementation of Groundwater Measurement Rules, Confined Aquifer Rules, and encouraging the use of subdistricts

# 2.5 : WATER ADMINISTRATION

## 2.5.1 : RIO GRANDE COMPACT

Interstate compacts and international treaties that affect water use in the Basin include the Rio Grande Compact of 1938 (the Compact), the Rio Grande, Colorado, and Tijuana rivers treaty of 1945 between the U.S. and Mexico, and the Amended Costilla Creek Compact of 1963.

The Compact establishes Colorado's obligation of deliveries of water at the New Mexico state line for use by New Mexico, Texas, and Mexico. The schedules of delivery for the Rio Grande and Conejos River are based upon the relationship between inflows at upstream gaging stations and the outflow at downstream gaging stations that existed during the Compact study period (1928–1937). For any given quantity of inflow at the upstream Compact gaging station, a corresponding amount of outflow is scheduled for delivery at the downstream gaging station. The relationship between inflow and outflow is not linear — the greater the inflow, the greater the percentage of the inflow scheduled for delivery at the state line. The practical effect of the Article III schedules of delivery is to limit the consumptive use of water in Colorado. New consumptive uses of water in Colorado were to come from water held over in storage in post-1929 reservoirs that would otherwise have spilled from Project storage or new water added to the Rio Grande, e.g., the Closed Basin Project. The Rio Grande Compact Commission was established to administer the terms of the agreement. The Commission consists of one representative from each state and a nonvoting federal representative.

Surface water on the Rio Grande and Conejos River is administered to keep Colorado in compliance with its Compact delivery obligations. Generally speaking, no surface water diversions are allowed during the nonirrigation season, November 1 to March 31, but pre-Compact reservoirs are allowed to store. During the irrigation season, the Division 3 Engineer for the Colorado Division of Water Resources (DWR) makes an estimate of the annual index flows at the upstream gaging stations, using forecasts from the Natural Resources Conservation Service (NRCS) and the National Weather Service (NWS), and an estimate of the amount water to be delivered by the Rio Grande and Conejos River. That estimate is updated every 10 days. With this information, the Division Engineer calculates the percentage curtailment: the amount of inflow at the upstream Compact gaging station that should be delivered to the

Measuring flow. Photo: Rio de la Vista

downstream gage. The curtailment percentage is then applied to and deducted from the amount of inflow available for diversion from the rivers, and that quantity is passed through the system for delivery to the downstream gaging station. This is done on a daily basis throughout the irrigation season to ensure Colorado remains in compliance with its Compact obligations.

An illustration of the average monthly curtailment and water available for Colorado users during the irrigation season is shown in Figure 11. However, actual curtailment varies based on the hydrologic conditions of each year and generally fluctuates throughout the irrigation season due to discrepancies between the projected index and the actual index flow.

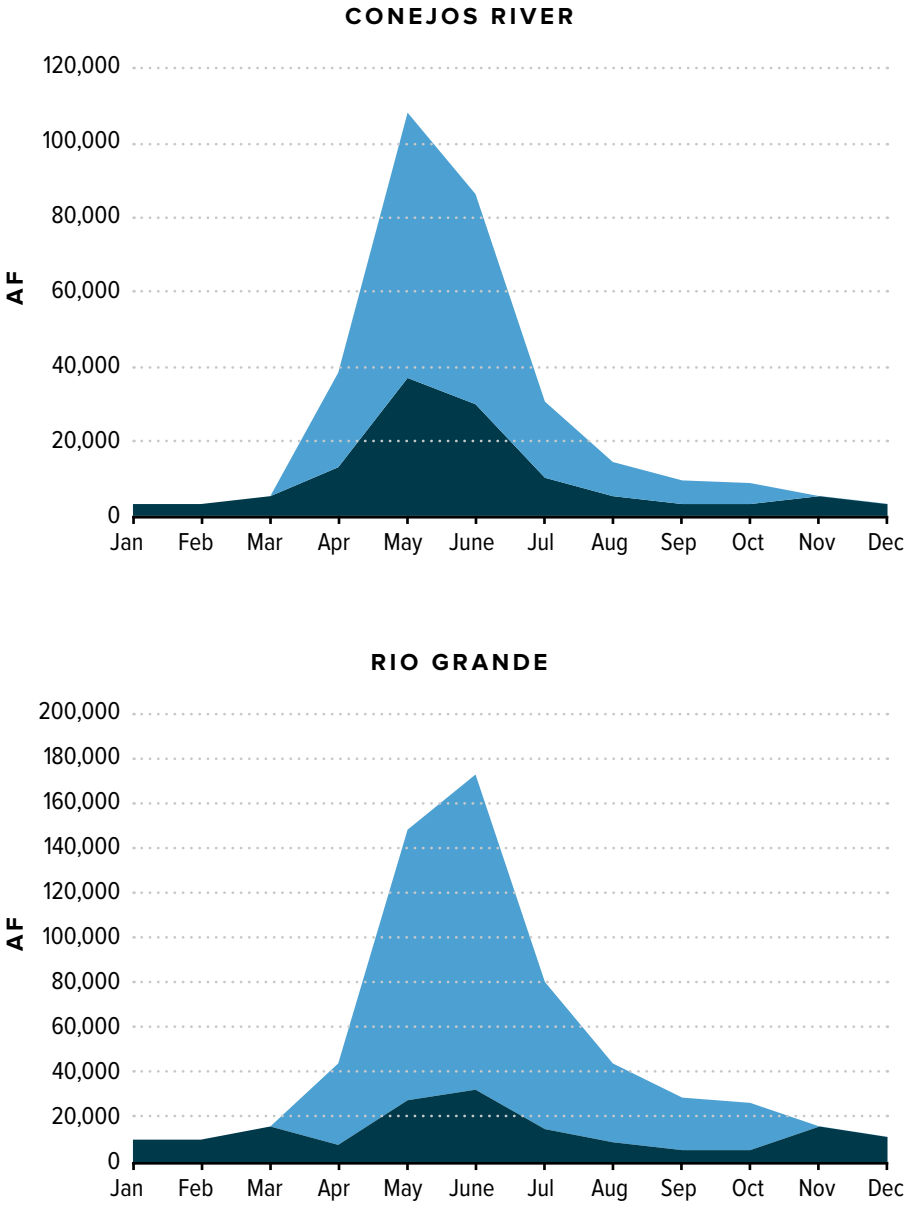



**FIGURE 11.**

Monthly average index flows, Colorado's use, and curtailment for Conejos River and Rio Grande.

1926–2013. Assumes constant curtailment by percentage of index flows during irrigation season and 100% curtailment November through March.

Sources for calculation of monthly average index flows: State of Colorado, Department of Natural Resources, Division of Water Resources 2014; U.S. Geological Survey, National Water Information System, USGS 08249000 Conejos River Near Lasauses, Colo. n.d.

Source for calculation of Colorado's use and constant curtailment values: Vandiver 1999

## 2.5.2 : SURFACE WATER ADMINISTRATION

The Colorado Division of Water Resources Division 3 Engineer administers water within the Basin. Within Division 3, water commissioners are responsible for the day-to-day administration of water rights. Water commissioners for District 20 (Rio Grande main stem) and District 22 (Conejos River) must also administer the Compact curtailment as computed daily by the Division 3 Engineer's staff. Water Districts 25, 26, and 27 drain into the Closed Basin and have no natural surface water outlet to the Rio Grande. Therefore, water rights within these districts are independent of water rights on the Rio Grande.

Surface water is administered in accordance with the system of prior appropriation and the Compact. Recognizing that meeting the terms of the Compact is the greatest need, DWR allows remaining water that is available for consumption after curtailment to be utilized in accordance with the priorities of the water rights. As such, many junior water rights receive water only during wet years. If sufficient water to meet the Compact obligations has been delivered to the state line during the irrigation season, DWR may set curtailment to zero. When curtailment is zero, water users are legally able to divert the entire flow of the river, which has historically resulted in dry-up points along some rivers and streams. During recent years when zero curtailment has occurred, water users and agencies have worked together to reduce dry-up, which is a key goal of the RGBRT.

Rio Grande, Continental, Santa Maria, and Beaver Park reservoirs are the major pre-Compact reservoirs located upstream of the Del Norte gage on the Rio Grande. A pre-Compact reservoir stores under its water rights, when those water rights are in priority, or by exchange. The provisions of the Compact do not alter a pre-Compact reservoir's ability to store water, making these facilities especially valuable infrastructure for the Basin. Storage within post-Compact reservoirs is limited by the provisions of Articles VI and VII of the Compact. These provisions eliminate the ability to store water

Platoro Reservoir in the Conejos Basin. Photo: Richard Stenzel

Rio Grande Reservoir in the fall. Photo: Heather Dutton.

in post-Compact reservoirs when Rio Grande Project (downstream Compact reservoirs) storage totals less than 400,000 acre-feet. In times of abundant supply in the Basin, these Articles may not impair the ability to store native water in post-Compact reservoirs in Colorado, but those reservoirs must also be in priority as to other vested water rights on their stream system within Colorado.

These reservoirs have relatively junior priorities compared with the surface water rights in the Valley and are rarely in priority to store water during the irrigation season except in high-flow years. Thus, the reservoirs store water primarily in the winter months, with storage normally beginning on November 1 and continuing until the onset of the irrigation season the following spring, typically March 31.

Several ditch systems within the Valley have decrees approved by the Colorado Water Court that allow them to store in-priority, native water temporarily in Rio Grande, Continental, Santa Maria, and Platoro reservoirs. The term "direct flow storage" is commonly used to describe this practice of electing reservoir storage instead of headgate diversions under certain decreed conditions. This allows for more efficient use of the water at later times during the year, by better aligning crop demands with water supply.

## 2.5.3 : GROUNDWATER ADMINISTRATION

Current groundwater administration has its roots in activities that occurred in the 1960s and have developed up to today. One of the principal investigators of the hydrologic systems of the Valley in the late 1960s and early 1970s was USGS geologist Philip A. Emery. Emery authored a number of the studies that formed the basis of the understanding of the hydrology of the Valley through the mid-1980s. At one point, Mr. Emery made what he later described as a "back-of-the-envelope" calculation of the amount of water in storage in the confined aquifer system of the Valley; he estimated the total volume of the aquifer, multiplied the volume by an assumed specific yield, and concluded the confined aquifer held as much as 2 billion acre-feet of groundwater. This attracted a number of speculative water development schemes to the Valley.

In 1986, American Water Development (AWDI) sought to develop as much as 200,000 acre-feet annually from the confined aquifer for export out of the Valley. After five years of litigation and a lengthy trial, the case ended badly for AWDI. Cabeza de Vaca and its financial backer, Farallon Capital Management, then bought AWDI's property and began an extensive engineering investigation to try to succeed where AWDI had failed; this new venture was called Stockman's Water. At this juncture, water users from the Valley went to the Colorado General Assembly to seek an alternative to continued litigation to resolve the questions of future use of the confined aquifer.

These efforts resulted in the 1998 adoption of HB 89-1011, which addressed concerns regarding groundwater use in the Valley and, in particular, new uses of the confined aquifer. The Bill recognized that, at that time, there was insufficient comprehensive data of the relationship between the surface streams and the confined aquifer system to permit a full understanding of the effect of the groundwater withdrawals upon the local natural stream and aquifer systems. The Bill required the Colorado State Engineer

Trinchera Ranch and Blanca Massif. Photo: John Fielder

to promulgated Rules and Regulations governing new withdrawals of groundwater affecting the confined aquifer system, allowing withdrawals only upon an approved plan for augmentation. In addition, withdrawals are to occur only in a manner that will protect Colorado's ability to meet Compact obligations and prevent injury to senior appropriators. As such, the Bill requires augmentation plans to "recognize that unappropriated water is not made available and injury is not prevented as the result of the reduction of water consumption by nonirrigated native vegetation."

As a requirement of HB 98-1011, the State Engineer and the Colorado Water Conservation Board performed a specific study of the aquifer systems, the Rio Grande Decision Support System (RGDSS) Study. This study involved collection and evaluation of existing data, supplementation of the existing data with new studies, development of several models, and the organization of the data and models into an accessible format. The RGDSS Study was carried out in phases from 1998 and is one of the most comprehensive studies of the Valley's geology and hydrology.

As part of the strategy developed by the RGWCD to protect the Valley's aquifers from exploitation, the Basin supported the formation of a national park through the Great Sand Dunes Park and Preserve Act of 2000. The Act expanded the boundary of the former Great Sand Dunes National Monument to better protect the above-ground ecology and the connected groundwater hydrology associated with the dunes. Much of the political interest in the boundary expansion was motivated by an overwhelming local desire to protect water resources of the area. In 2008, the State of Colorado granted a water right to the Great Sand Dunes National Park and Preserve for the groundwater beneath its boundaries, which was required by the U.S. Congress in the Act. This was the first nonconsumptive water right issued by the State of Colorado. The water right precludes any withdrawal of water from the aquifers that would cause injury to the Park's environments, which are dependent on the groundwater.

#### 2.5.3.1 DROUGHT OF 2000–2005 AND SENATE BILL 04-222

The period 2000–2003 was the second-driest consecutive four-year period of recorded streamflow on the Rio Grande, exceeded only by the drought of 1953–1956. The year 2002 was the driest year of record on the Rio Grande, falling below the lowest level of the schedule of anticipated deliveries of the Compact. With decreased streamflow came increased reliance on groundwater and resulting groundwater-level declines and depletions to streamflows. The drought of 2002, combined with a reduction in the Closed Basin Project's yield, renewed the concern of Valley water users over well depletions to both the aquifer systems and the surface streams. The decline in yield of the Closed Basin Project together with the drought showed that the 60/40 agreement (60% to the Rio Grande and 40% to the Conejos River) was not a complete solution to groundwater problems in the Valley and that other measures would be required to address groundwater overdraft and protect senior water rights from injury caused by groundwater pumping. At this

time, the estimated reduction since 1976 in the storage capacity of a portion of the unconfined aquifer was close to 1,000,000 acre-feet. Water users in the Valley began discussing ways to protect surface and groundwater supplies in a manner that was less destructive than the examples of groundwater regulation seen in the Arkansas and South Platte basins. This concern resulted in local water users promoting the idea of the Groundwater Management Subdistricts. In 2004, at the urging of water users from the Valley, the Colorado General Assembly enacted SB 04-222 that addresses the application of rules and regulations governing the use of underground water in Division 3.

The Colorado Division of Water Resources Well Rules and Regulations are intended to prevent injury, provide for sustainable groundwater supplies, and prevent interference with meeting Colorado's obligation under the Rio Grande Compact.

As the State adopted rules governing the use of groundwater, in recognition of the unique geologic and hydrologic conditions, along with the prevailing conjunctive use practices, the State Engineer was given wide discretion to permit the continued use of groundwater consistent with preventing material injury to senior surface water rights. In regulating an aquifer or system of aquifers, the State Engineer was to apply the following principles:

- Use of the confined and unconfined aquifers shall be regulated so as to maintain a sustainable water supply in each aquifer system, with due regard for the daily, seasonal, and long-term demand for groundwater.
- Fluctuations in the artesian pressure in the confined aquifer system have occurred and will continue to occur in response to climatic conditions, water supply, and water demands. Such pressure fluctuations shall be allowed with the ranges that occurred during the period of 1978 through 2000. Artesian pressures shall be allowed to increase in periods of greater water supply and shall be allowed to decline in periods of lower water supply in much the same manner and within the same ranges of fluctuation as occurred during the period of 1978 through 2000, while maintaining average levels similar to those that occurred in 1978 through 2000.
- Groundwater use shall not unreasonably interfere with the State's ability to fulfill its obligations under the Compact with due regard for the right to accrue credits and debits under the Compact.
- Water is added to the stream system to assist in meeting the Compact delivery schedules or to replace depletions to streamflows resulting from the use of groundwater.
- The State Engineer is not to curtail pumping from wells in Division 3 that are included in a Groundwater Management Subdistrict with a judicially approved management plan.

#### 2.5.3.2 GROUNDWATER MANAGEMENT SUBDISTRICTS

To date, one Groundwater Management Subdistrict has been formed, Subdistrict No. 1; through court action, its original management plan was changed such that the Amended Plan of Water Management has been approved by Colorado's Water Court. The Subdistrict No. 1 is located in the heavily irrigated area north of the Rio Grande within the Closed Basin. Subdistrict No. 1 contains some 174,000 acres of irrigated land and

approximately 3,000 irrigation wells, approximately 300 of which withdraw water from the confined aquifer system and the balance of which withdraw water from the unconfined aquifer.

In May 2006, the RGWCD filed a Petition for Establishment of a Special Improvement District No. 1 of the RGWCD. On July 19, 2006, the Alamosa County District Court approved the petition to form this subdistrict. The principal goals of the Amended Plan are to (1) replace injurious stream depletions caused by wells in the Subdistrict, (2) recover groundwater levels in the unconfined aquifer of the Closed Basin such that within 20 years groundwater levels have recovered to within 200,000 to 400,000 acre-feet below the January 1, 1976 storage level, (3) maintain a sustainable irrigation water supply in the unconfined aquifer, and (4) avoid interference with Colorado's obligations under the Compact. The Amended Plan proposes to reduce irrigated land within Subdistrict No. 1 by 40,000 acres.

Other subdistricts are actively being formed across the Valley floor. The DWR has developed preliminary estimates of the locations and water use needs that are anticipated to approximately align with the future subdistrict borders. In addition, the development of independent augmentation plans remains an option for well users.

#### 2.5.3.3 PROPOSED GROUNDWATER REGULATIONS FOR EXISTING USES OF GROUNDWATER

As required by SB 04-222, the State Engineer has begun the process of preparing Well Rules and Regulations for existing uses of groundwater in Division 3. The rules are to prevent injury to water right holders, provide for sustainable groundwater supplies, and prevent interference with the Compact. In addition to his own professional knowledge and experience, the State Engineer has relied upon the data and conclusions of the RGDSS Study in preparing the proposed Well Rules and Regulations.

Medano Creek at Great Sand Dunes National Park and Preserve. Photo: Heather Dutton

The promulgation of these rules has been delayed by the need to update and recalibrate the RGDSS groundwater model to include, among other things, measured well-pumping data being obtained pursuant to the Division 3 groundwater measurement rules. The updating and recalibration effort is expected to be completed by mid-2015, when the Well Rules and Regulations are expected to be promulgated.

The proposed Well Rules and Regulations will require well owners to meet one of the following options:

- Join a Groundwater Management Subdistrict
- Have a Plan of Augmentation for their well
- Shut off and cease use of their well

For more information on Water Administration of the Rio Grande Compact, surface water, groundwater, and other areas in the Basin, see Appendix 2: Basin Overview, Section 2.5: Water Administration.

## 2.6 : ENVIRONMENTAL AND RECREATIONAL RESOURCES

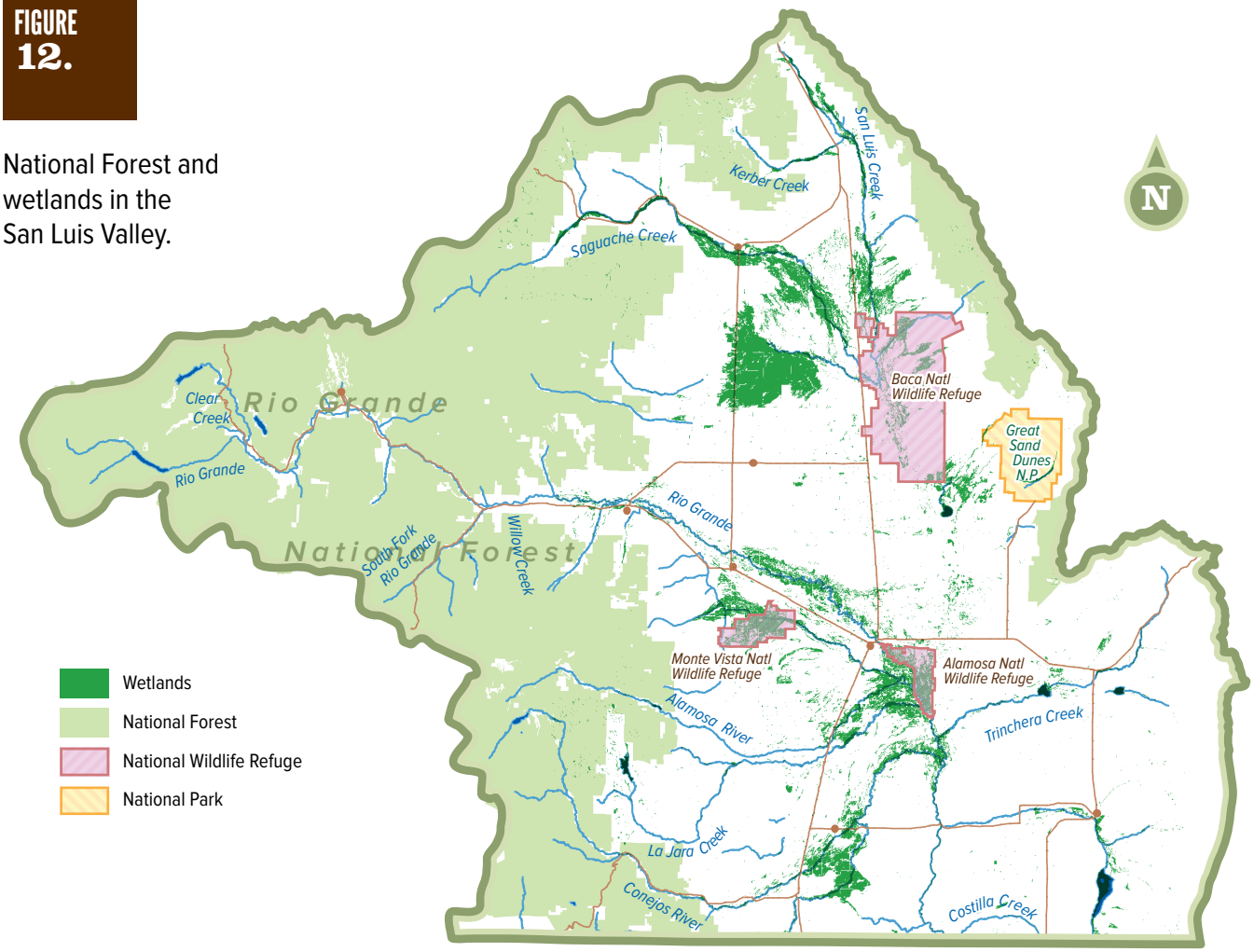
### 2.6.1 : KEY ENVIRONMENTAL ATTRIBUTES

In addition to the substantial public lands of the RGNF and the BLM, the Basin is home to the Great Sand Dunes National Park and Preserve, the Alamosa, Monte Vista, and Baca national wildlife refuges, many state wildlife areas, and other state lands. The Valley's extensive wetlands and riparian habitats support at least 13 threatened and endangered species and over 160 species of birds, ranging from the iconic greater sandhill crane to the endangered southwestern willow flycatcher. While working farms and ranches support a rural way of life and produce food and fiber, many private lands also provide critical wildlife habitat. Healthy watersheds and the Valley's underground aquifers are crucial to sustaining biodiversity and habitat, wetland and riparian ecosystems, and diverse recreational opportunities that are inherently important to sustaining a vibrant and resilient local economy.

Rio Grande near South Fork, Colorado. Photo: Richard Stenzel.

FIGURE 12.

National Forest and wetlands in the San Luis Valley.




## 2.6.2 : WATERSHED HEALTH

The RGNF is home to the headwaters of the Rio Grande and Conejos River high in the San Juan Mountains. The RGNF encompasses 1.84 million acres, 38% of the Basin's land area. Currently, the ecosystems within the RGNF are being affected by a variety of factors, including infestations of spruce bark beetles and tent caterpillars, wildfire, and climate change. The effects of these disturbances on the health of the watershed are a cause of serious concern, as the health of the upland forests directly impacts the health of the Rio Grande, Conejos River, and their tributaries in upper reaches. For more information on the recent changes to the RGNF and watershed health, see Appendix 2: Basin Overview, Section 2.6.2: Watershed Health.

## 2.6.3 : RIPARIAN AREAS

The Basin's rivers and streams provide the backbone for the communities, economies, and ecosystems of the Valley. Many of the farms and ranches situated along riparian corridors and ditches rely on surface irrigation and often provide seasonal wildlife habitat by flooding meadows and hay fields. Groundwater irrigators rely on the waterways to provide recharge to the aquifers through streamflows and diversions into recharge zones.

The Basin contains thousands of miles of riparian areas — lands located directly adjacent to a river, stream, or lake — which serve important functions as transition areas between aquatic and terrestrial ecosystems. Naturally functioning riparian areas significantly affect and improve the health of surrounding lands and the entire ecosystem of the Basin. They perform integral hydrologic and chemical functions that act as filters for pollutants, erosion control, flood control, and recharge aquifers (Mitsch and Gosselink 1993; Niemuth et al. 2004). Many of the riparian areas in the Valley have been degraded over time and no longer optimally perform these important ecosystem functions.

Efforts to restore impaired riparian areas have resulted in improved water quality, enhanced fish and wildlife habitat, improved groundwater recharge, flood mitigation and sediment transport, protection of private property, and socioeconomic values associated with agriculture, tourism, and recreation. The RGBRT has a long track record of supporting river restoration projects through the Rio Grande Headwaters Restoration Project. Historic mining impacts are being addressed with the support of the RGBRT on the Alamosa River, Willow Creek, and Kerber Creek. More information about riparian areas, including descriptions of the key riparian areas — the Rio Grande, Willow Creek, Conejos River, Alamosa River, Saguache Creek, Kerber Creek, and Rio Culebra — can be found in Appendix 2: Basin Overview, Section 2.6.3: Riparian Areas.

A frosty Rio Grande.
Photo: Heather Dutton

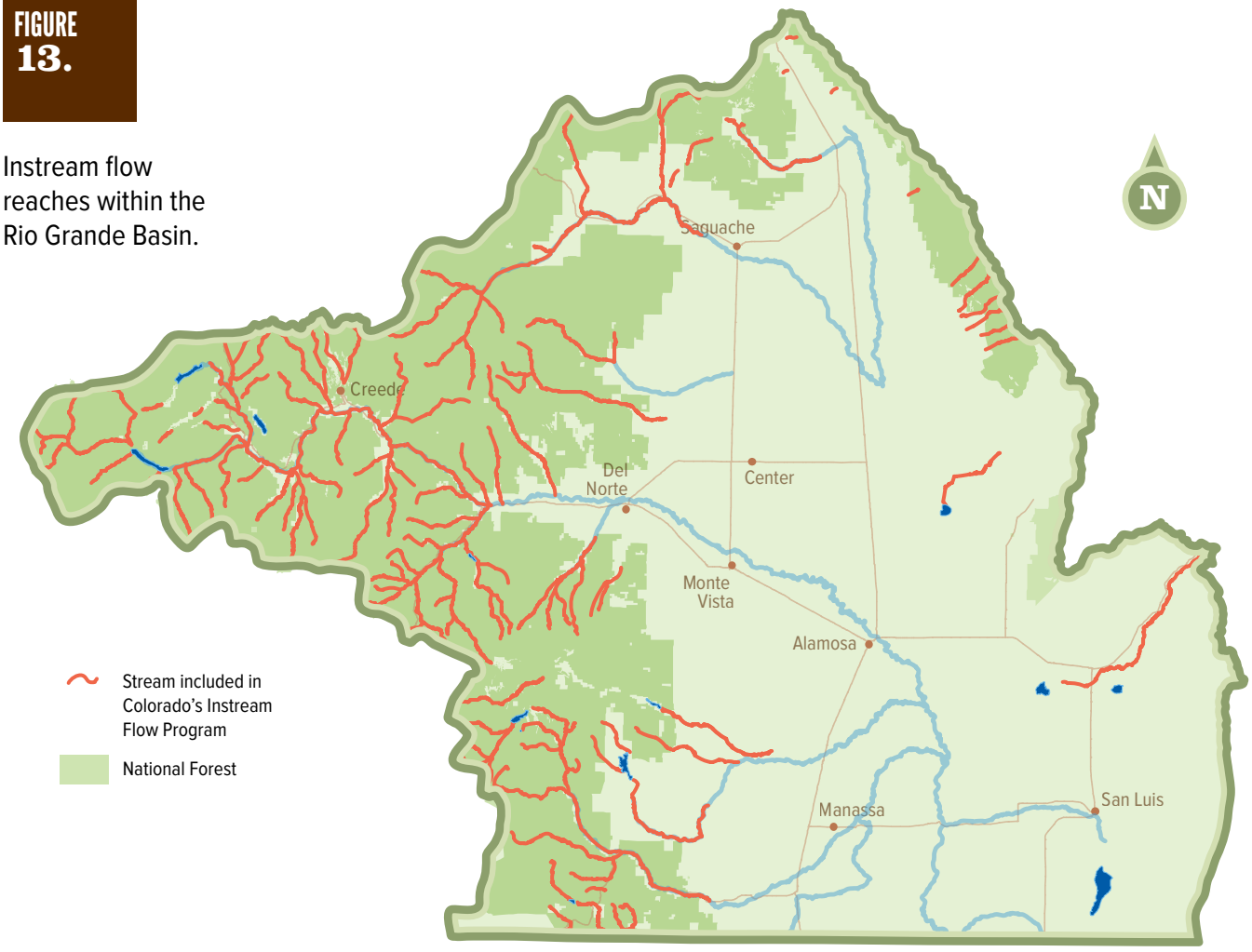
## 2.6.4 : INSTREAM FLOW PROTECTIONS

Recognizing the value of environmental habitats and recreational activities as well as the importance of maintaining natural flows for agriculture, the RGBRT regards instream flows as multi-purpose attributes. Instream flows are nonconsumptive water rights that are held exclusively by the CWCB for minimum flows between specific points in-channel through a reach of stream or in natural lakes to maintain water levels. Instream flow rights are administered within the State's priority system to protect against injury to senior water users at any point within the reach and to legally

preserve, protect, or improve the natural environment to a reasonable degree. Currently, there are almost 1,000 miles of instream flow protections in the Basin. These occur mainly in the headwater streams and rivers, including the Rio Grande, Conejos, and Alamosa rivers. This is largely due to the successful negotiation of a settlement achieved in 2000 that recognizes Federal Reserved Water Rights for the U.S. Forest Service on every major stream within the RGNF in the Basin. Additionally, in 2008, Colorado's Water Court recognized a unique groundwater right for the Great Sand Dunes National Park and Preserve (U.S. Department of Justice 2013). The groundwater right requires sustained aquifer levels around the Park in order to protect its unique hydrology. Rivers and streams with instream flow designations are shown in Figure 13.

**FIGURE 13.**

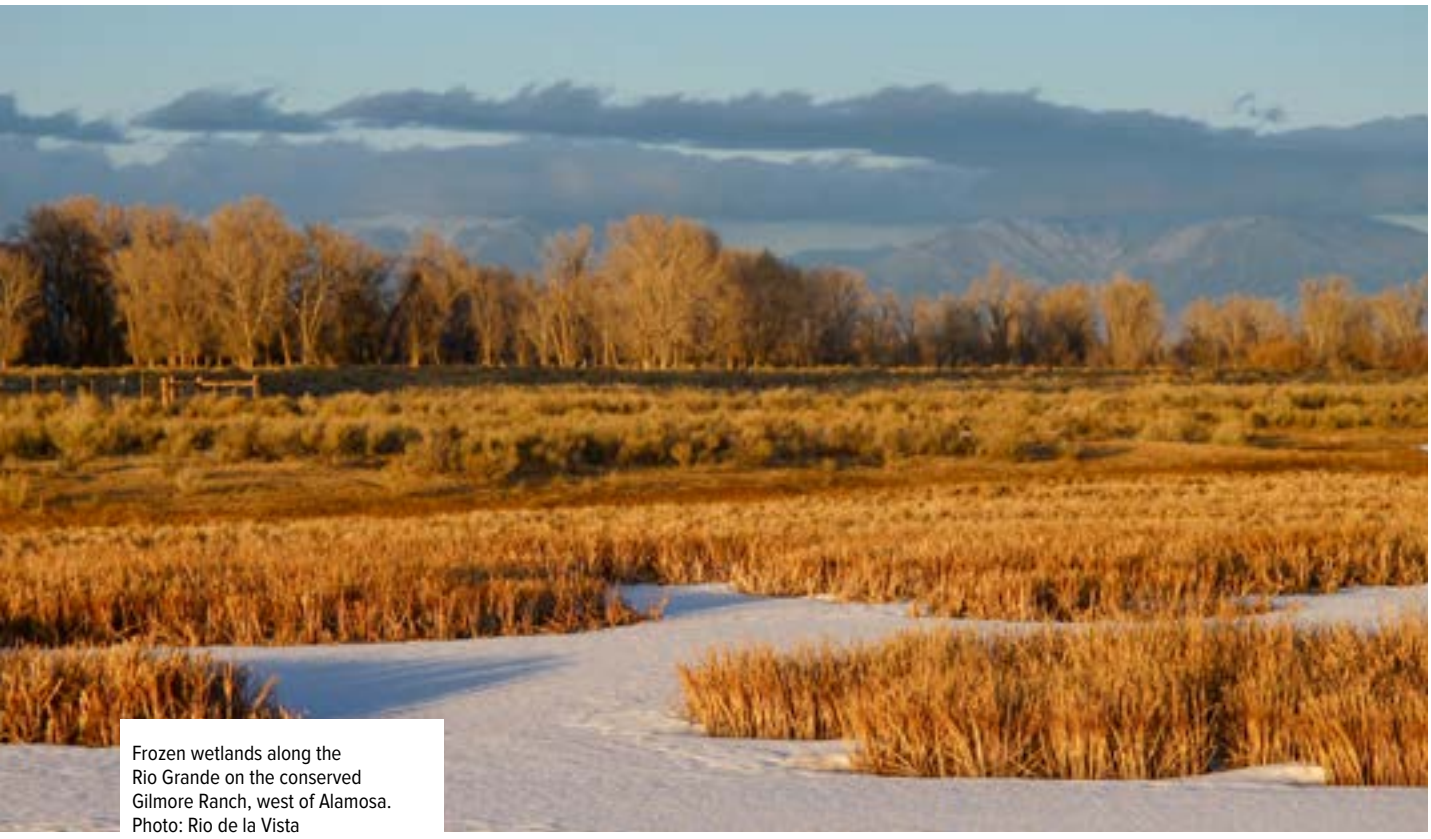
Instream flow reaches within the Rio Grande Basin.



## 2.6.5 : WETLANDS

Naturally functioning wetlands provide many ecosystem services, which significantly affect and improve the health of surrounding lands and the entire ecosystem of the Basin. Similar to riparian areas, wetlands perform integral hydrologic and chemical functions that act as filters for pollutants, erosion control, flood control, and recharge aquifers (Mitsch and Gosselink 1993; Niemuth et al. 2004).

The Basin has several types of wetlands, the most abundant being freshwater emergent, which comprises 90% of the total wetland acreage. While many of these wetlands are seasonal and connected to agriculture, there are large complexes of perennial wetlands on the Valley floor that are largely owned and managed by the Colorado Parks and Wildlife, U.S. Fish and Wildlife Service, and Bureau of Land Management. These wetlands provide outstanding habitat for migrating birds, wetland vegetation, and other dependent species. The major, agency-owned wetland complexes in the Basin, along with their management objectives and other important details, are discussed in Appendix 2: Basin Overview, Section 2.6.5: Wetlands.



Frozen wetlands along the Rio Grande on the conserved Gilmore Ranch, west of Alamosa. Photo: Rio de la Vista

## 2.6.6 : KEY SPECIES

The diversity and abundance of wetlands and riparian areas located throughout the Valley makes it a vital area for wetland-dependent birds in Colorado. The wetlands and riparian zones along the Rio Grande, Conejos River, and their many smaller tributaries are important to over 75% of the area's wildlife species, including 13 state and federal threatened, endangered, and species of special concern, as well as over 160 species of birds.

The Basin's wetlands provide important habitat for a wide range of migrating, nesting, and wintering bird species, including the Rocky Mountain flock of greater sandhill crane and the endangered southwestern willow flycatcher. Birds, along with a variety of wildlife that includes fish and amphibians, such as boreal toads, also depend upon these resources annually. Three fish species are at risk in the Basin: the Rio Grande cutthroat trout, Rio Grande chub, and Rio Grande sucker. In October 2014, the Rio Grande cutthroat trout was determined to be "not warranted" for listing under the Endangered Species Act by the USFWS. However, all three species have seen a reduction in populations due to predation and competition from non-native fish species. Fish habitat in the Basin is threatened by river and stream modification from activities such as recreation, road construction, other land use activities, and historic mining.

Numerous river and stream corridors are included in designated areas of important seasonal habitat and/or winter range habitat for elk, deer, and moose. The specific species discussed in the Plan represent the key species that serve as indicators of healthy habitats and populations of other species, given their similarities in relation to resource needs; however, this list is not intended to be exhaustive of all species of concern. Additional discussion of the needs of key species can be found in **Section 4.3.4: Habitat Needs for Sensitive Species (Threatened, Endangered, Candidate, and Indicator Species)**.

**The wetlands and riparian zones along the Rio Grande, Conejos River, and their many smaller tributaries are important to over 75% of the area's wildlife species, including 13 state and federal threatened, endangered, and species of special concern, as well as over 160 species of birds.**

From left: Great Horned Owl, photo: Rio de la Vista; greater sandhill cranes, photo: Rio de la Vista; Elk stags, photo: Erich Schlegel

Visitors enjoy Medano Creek flowing through the Great Sand Dunes National Park. Photo: Rio de la Vista

## 2.6.7 : RECREATION

The Basin's thriving tourism industry, much of which is water dependent, accounts for 11% of employment in the area. The Basin is largely ringed by the RGNF and large areas of BLM lands. In addition, it is home to the Great Sand Dunes National Park and Preserve, the Alamosa, Monte Vista, and Baca national wildlife refuges, many state wildlife areas, and other state lands. The Basin's two million acres of public land and associated wilderness areas, wildlife areas and refuges, and Wolf Creek ski area, annually attract hundreds of thousands of visitors to the region. Popular recreational activities include angling, hunting, wildlife and bird watching, winter sports, camping, rafting, paddling, and boating activities. All depend on adequate and healthy water resources.

### 2.6.7.1 WATERFOWL HUNTING

The Valley floor is well known for early-season waterfowl hunting opportunities that are enjoyed by residents from all over the state. It is recognized that quality, public-land waterfowl hunting opportunities are extremely limited in Colorado, and the Basin has over half a dozen state wildlife areas that provide such opportunities.

### 2.6.7.2 ANGLING

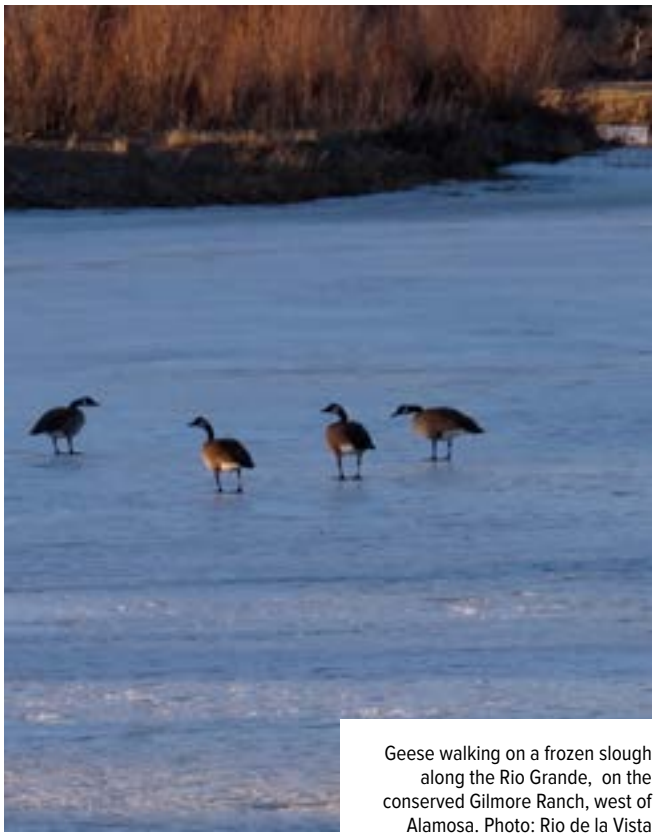
The Basin has excellent fishing opportunities, from many high-altitude streams and lakes to the Gold Medal Waters of the Rio Grande and superb fishing on the upper Conejos River. Colorado Parks and Wildlife offers extensive information about fishing opportunities, including an interactive fishing atlas map, at http://ndismaps.nrel.colostate.edu/fishingatlas/.

Rio Grande cutthroat trout. Photo: Kevin Terry

### 2.6.7.3 BOATING IN THE RIO GRANDE BASIN

Boating (in kayaks, duckies, dories, canoes, rafts, etc.) largely occurs on the upper reaches of the Rio Grande, beginning in the RGNF from below Rio Grande Reservoir and extending to below South Fork. Above South Fork, the river flows through public and private lands, with several boating access points. Increasing boat access and passage through diversion structures is an ongoing process in the community.

Stillwater boating occurs at many of the small conservation pools and larger reservoirs in the Basin. Rio Grande, Continental, Beaver Park, Big Meadows, Road Canyon, Terrace, and Platoro reservoirs provide high-mountain public access boating opportunities in the San Juan Mountains. Most boaters fish for trout while enjoying these settings. Additional boating and fishing for warm-water species occurs on the east side of the Basin at Mountain Home, Sanchez, and Smith reservoirs. When conditions allow, San Luis Lakes State Park has been a site for water sports since the 1920s; water skiing, motor boating, personal watercraft, fishing, sailing, and windsurfing are popular there when water levels are adequate.



Geese walking on a frozen slough along the Rio Grande, on the conserved Gilmore Ranch, west of Alamosa. Photo: Rio de la Vista

### 2.6.7.4 BIRDING TRAILS AND WATCHABLE WILDLIFE

Watching wildlife often takes place while residents and visitors to Colorado choose to recreate in such activities as hiking, boating, and horseback riding. The recreational, watchable wildlife opportunities in the Basin are limitless and almost impossible to track in terms of recreational user-days.

San Luis People's Ditch, the oldest water right in Colorado. Photo: Rio de la Vista

# 3 RIO GRANDE BASIN GOALS

The Rio Grande Basin Implementation Plan Steering Committee, Subcommittees, and RGBRT identified 14 goals for the Plan. These goals focus on the most important aspects of the Basin: a resilient agricultural economy, watershed and ecosystem health, sustainable groundwater resources, encouragement of projects with multiple benefits, and the preservation and improvement of recreational activities. The Basin goals ultimately strive for a resilient and healthy watershed and economy for generations to come.

Water Division 3 meeting in the Rio Grande Basin. Photo: Erich Schlegel

To provide a roadmap to measure success in meeting existing and future water needs, each goal is paired with implementation techniques, including tasks, projects and methods, and other steps needed to achieve the goal and result in measurable outcomes.

The following are the Basin goals, each accompanied by a list of which needs are met by the goal:

- Ag – agricultural
- M&I – municipal and industrial
- Env&Rec – environmental and recreational
- WAdm – water administration

For more detailed information on the Basin's goals, measurable outcomes, and implementation techniques, see Appendix 3: Rio Grande Basin Goals and Measurable Outcomes.

# RIO GRANDE

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on watershed health and ecosystem function.

Ag | M&I | Env&Rec | WAdm

2. Protect and preserve the doctrine of prior appropriation and vested water rights, and fully utilize Colorado's compact entitlements as specified under the Rio Grande and Costilla Creek compacts.

Ag | M&I | Env&Rec | WAdm

3. Sustain the confined and unconfined aquifers in accordance with Senate Bill 04-222 and operate within the State Engineer's new Rules and Regulations for the San Luis Valley.

Ag | M&I | Env&Rec | WAdm

4. Operate, maintain, rehabilitate, and create necessary infrastructure to meet the Basin's long-term water needs, including storage.

Ag | M&I | Env&Rec | WAdm

5. Manage water use to sustain optimal agricultural economy throughout the Basin's communities.

Ag | M&I | Env&Rec | WAdm

6. Support the development of projects and methods that have multiple benefits for agricultural, municipal and industrial, and environmental and recreational water needs.

Ag | M&I | Env&Rec | WAdm

Heart Lake.
Photo: Heather Dutton

# BASIN GOALS

7. Meet new demands for water, to the extent practicable, without impacting existing water rights and compact obligations.

Ag | M&I | Env&Rec | WAdm

8. Establish a long-term education and outreach effort for water use and needs in the San Luis Valley/Rio Grande Basin.

Ag | M&I | Env&Rec | WAdm

9. Make progress toward meeting applicable water quality standards throughout the Basin.

Ag | M&I | Env&Rec

10. Promote water management and administrative practices that are adaptive, flexible, and responsive to optimize multiple benefits.

Ag | M&I | Env&Rec | WAdm

11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.

Env&Rec

12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.

Ag | M&I | Env&Rec

13. Work to sustain active river flows throughout the year in cooperation with water users and administrators to restore and sustain ecological function of the rivers and floodplain habitats within the context of existing water rights and compact obligations.

Ag | M&I | Env&Rec | WAdm

14. Maintain and enhance water-dependent recreational activities.

M&I | Env&Rec | WAdm

# 4 BASIN WATER NEEDS

Hay bales in the San Luis Valley. Photo: Rio de la Vista

The Basin has a finite and fluctuating supply of water, which is predicted to decrease by as much as 30% in the future. Because the Basin's water needs are intertwined, cooperative efforts to maximize the benefits to the multiple needs identified in this Plan will be critical going forward.

## 4.1 : AGRICULTURAL NEEDS

In Colorado, over 80% of all water use is for agriculture. In the Basin, the proportion of agricultural water use to all other uses is approximately 99%. The local economy is driven by agriculture; therefore, meeting the agricultural water needs is critical not only for individual farm operators, but also for the entire Basin.

There are several components of agricultural water needs in the Basin that must be addressed to understand the complexity and immediacy of the need. There are physical shortages, where an insufficient amount of water is available to meet the needs of the crops. There are legal shortages, where water may physically be available at the point of use, but cannot be used because the water is legally obligated for other uses. Layered over both physical and legal shortages is the reliance on groundwater resources. Aquifer sustainability requirements are applying pressure to agricultural water users to change historic practices and have the potential to significantly alter agricultural water use and production in the future.

Harvesting potatoes.
Photo: Julie Messick

## 4.1.1 : PHYSICAL SHORTAGES

The Basin is water-short, meaning that demand for water exceeds the available supply. Only the most senior surface water rights holders consistently receive a full surface water supply that is sufficient to meet the potential consumptive use of their crops. Throughout the Basin, water users rely on groundwater to supplement surface water supplies, and, in some cases, groundwater is the primary or only source of water. Many irrigators utilize surface water when available, but rely on groundwater or subirrigation later in the summer when surface water supplies have decreased after the spring runoff. Physical water shortages occur when there is less irrigation water applied to a crop than the crop could potentially consume through evapotranspiration — the amount of water taken up by the roots, used for plant growth, and transpired. The combination of the relatively short runoff period, requirements of Compact administration, and water rights priorities may result in some water users receiving only a few days of annual surface water supply. The importance of a supplemental groundwater supply is further evidenced by the fact that during times of drought, the irrigated acreage of lands served by surface water decreases much more sharply than lands that have access to groundwater.

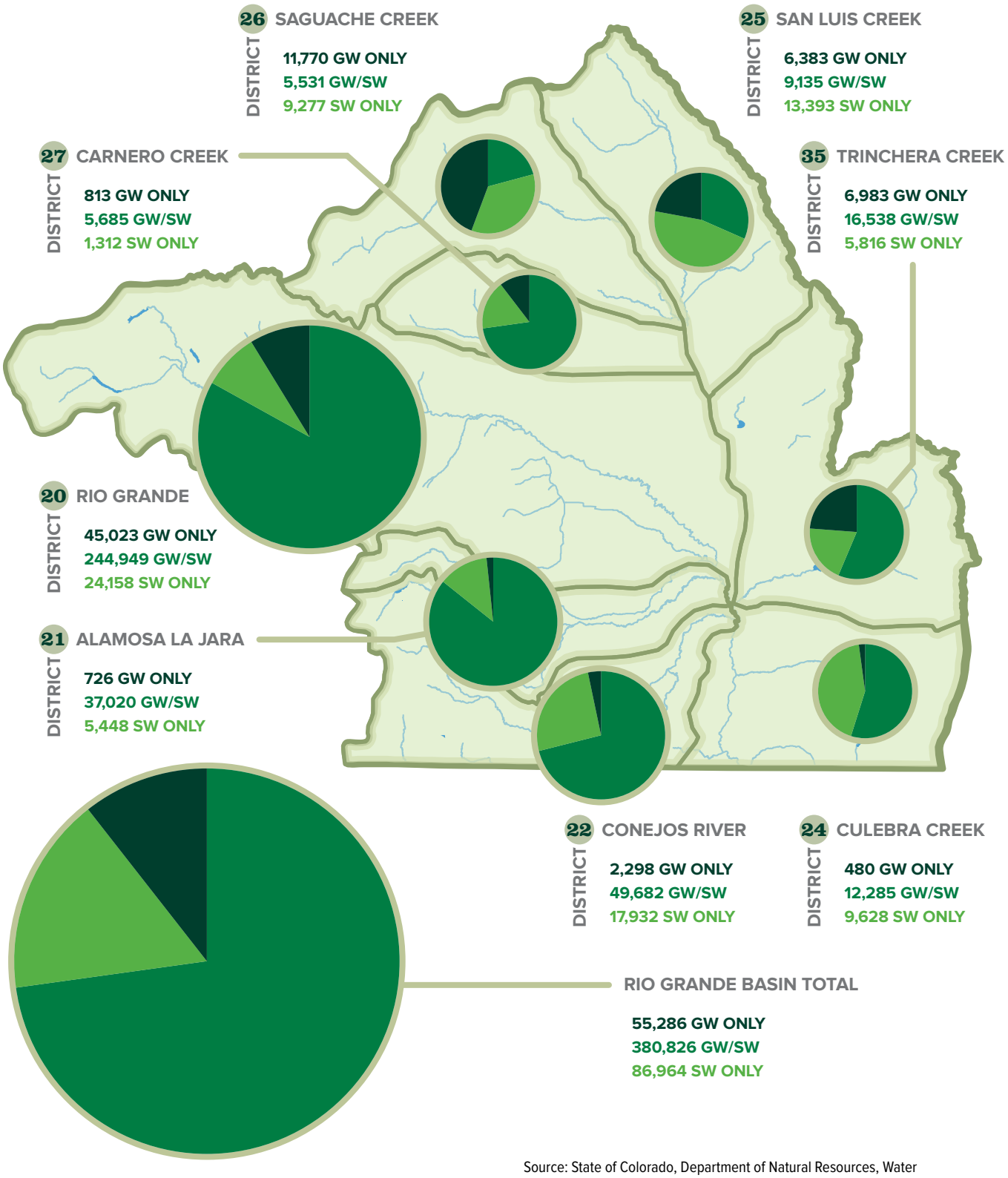
**The Basin is water-short; demand for water exceeds the available supply.**

Consumptive use estimates were prepared using StateCU Version 7.0. StateCU is a software tool developed by the Colorado Department of Natural Resources as part of Colorado's Decision Support System. It integrates crop coverage, historical weather station data, irrigation efficiency, and estimated crop and soil parameters using the Modified Blaney-Criddle Method to estimate crop consumptive use. In the 2011 Rio Grande Decision Support System, a StateCU model was developed for the Rio Grande Basin that details

**FIGURE 14.**

Irrigated acreage in Rio Grande Basin water districts.

Irrigation by groundwater (GW), surface water (SW), or both (GW/SW).




Source: State of Colorado, Department of Natural Resources, Water Conservation Board, and Division of Water Resources 2011 (RG2011 StateCU run, specifically model input in file rg2011.ipy)

monthly consumptive use by crop and ditch service area from 1950 to 2009. These results were used for Figure 14 and Table 3.

Currently, the Basin has approximately 523,000 acres irrigated through surface water, groundwater, or a combination of the two, as shown in Figure 14 and Table 3. From 2000 to 2009, crops in the Basin consumed an average of 810,000 AF of water per year. Nearly half of the irrigated acreage in the Basin is located in the Closed Basin. The use of groundwater is a vitally important component to sustain agricultural production on farms in the Closed Basin. While it provides a buffer against low surface-water supplies, it is also being over-utilized. Continued reduction in aquifer storage will lead to further diminished well yields and/or curtailment of well pumping by the State.

**TABLE 3.** Average StateCU output for the Rio Grande Basin.

Showing irrigated acreage, irrigation water requirement (IWR), consumptive use (CU), and water shortage for drought conditions experienced in 2000–2009.

| Region | Irrigated Acreage** | Potential Consumptive Use (AFY) | Actual Consumptive Use (AFY) | Difference (AFY) | Difference as Percentage of Potential |
|---|---|---|---|---|---|
| Closed Basin Ditches and Subdistrict 1 GW Only* | 169,000 | 285,000 | 242,000 | 43,000 | 15% |
| Rest of District 20 (Rio Grande) | 126,000 | 275,000 | 228,000 | 47,000 | 17% |
| District 21 (Alamosa/La Jara Rivers) | 43,000 | 100,000 | 62,000 | 38,000*** | 38%*** |
| District 22 (Conejos River) | 70,000 | 171,000 | 102,000 | 69,000*** | 40%*** |
| District 24 (Culebra Creek) | 22,000 | 53,000 | 39,000 | 14,000 | 26% |
| District 25 (San Luis Creek) | 29,000 | 69,000 | 33,000 | 36,000*** | 52%*** |
| District 26 (Saguache Creek) | 27,000 | 65,000 | 46,000 | 19,000*** | 29%*** |
| District 27 (Carnero Creek) | 8,000 | 18,000 | 13,000 | 5,000 | 28% |
| District 35 (Trinchera Creek) | 29,000 | 59,000 | 45,000 | 14,000 | 24% |
| **Total Basin** | **523,000** | **1,095,000** | **810,000** | **285,000** | **26%** |

* Acres grouped with the Rio Grande Canal, Farmer's Union Canal, San Luis Valley Canal, Prairie Ditch, and Subdistrict No. 1 groundwater only parcels in the most recent StateCU model.

** Irrigated acreage based on RGDSS model inputs. Excludes some wild-flood meadows and irrigated pasture because irrigation there is provided sporadically when surface supply is available

*** Subirrigation supplies a portion of the difference between potential consumptive use and actual consumptive use.

Source: State of Colorado, Department of Natural Resources, Water Conservation Board, and Division of Water Resources 2011 (RG2011 StateCU run, specifically model input in file rg2011.ipy)

## 4.1.2 : LEGAL SHORTAGES

A legal shortage of water occurs when water is physically available, either at a river headgate or a well, but cannot be used because it is not legally available for use at that particular location and time. The most common reason for a legal shortage is the administration of the prior appropriation system of Basin water rights and curtailment under the Compact. Water rights are satisfied in order of seniority, regardless of the location along the river. Therefore, upstream headgates may have to allow water to flow past to a downstream senior water right. The sustainability requirements of Senate Bill 04-222 may produce additional legal shortages for well users in the future.

The Rio Grande Compact is unique to its river basin and further limits the amount of water that is legally available to water users. Current administration of the Compact in Colorado involves a complete curtailment of irrigation diversions throughout the winter for delivery to the state line. During the irrigation season (April through October), the curtailment effectively acts as a superior obligation on the stream and causes a legal shortage of water for many water rights that would have diverted water but for the curtailment.

Based on the amount and timing of the physical supply, legal constraints associated with the Compact, and the legislative requirements for aquifer sustainability, the full agricultural water needs of the Basin cannot be fully satisfied with the current surface and groundwater supplies available to the Basin.

The Basin's reservoirs are critical to providing water supply for irrigation and meeting replacement of well pumping depletions in time, place, and amount. Many are in poor condition.

## 4.1.3 : REHABILITATION OF RESERVOIRS

The Basin's reservoirs are critical to providing water supply for irrigation and meeting replacement of well pumping depletions in time, place, and amount. Many are in poor condition. Rio Grande, Santa Maria, Continental, Beaver Park, and Mountain Home reservoirs are pre-Compact agricultural storage facilities that are in need of repair. Pre-Compact storage facilities are able to store water under certain conditions, as discussed in **Section 2.5.2: Surface Water Administration**, when post-Compact reservoirs are not. These five reservoirs provide approximately 130,000 acre-feet of vital pre-Compact storage. Rehabilitation of these and other reservoirs' dams, spillways, and outlet works is necessary to provide water storage capacity to meet agricultural and other needs as well as to ensure public safety. Costs for rehabilitation are in the tens of millions of dollars for most of these reservoirs. The agricultural shareholders and landowners in these reservoirs do not have the financial ability to pay for the entirety of these needed repairs, even with CWCB loans.

## 4.1.4 : REHABILITATION OF RIVER DIVERSION STRUCTURES AND HEADGATES

A need exists to improve aging and poorly functioning agriculture diversions and headgates along Basin rivers and streams. Many diversion structures have outlived their engineered life or were never engineered. A significant number of diversion dams are "push-up dams," meaning the ditch companies use heavy equipment to push river bottom materials to form diversion dams each year, incurring high annual maintenance costs. The old irrigation infrastructure can impact fisheries, riparian areas, recreation, Compact administration, and diversion efficiency. Projects that improve agriculture infrastructure can have great benefits to surrounding riparian areas and fisheries, and facilitate new recreation opportunities. The Rio Grande Headwaters Restoration Project is working with ditch companies to pursue projects that benefit multiple users and needs.

For more detailed information about the Basin's agricultural water needs, see Appendix 4: Basin Water Needs, Section 4.1: Agricultural Needs.

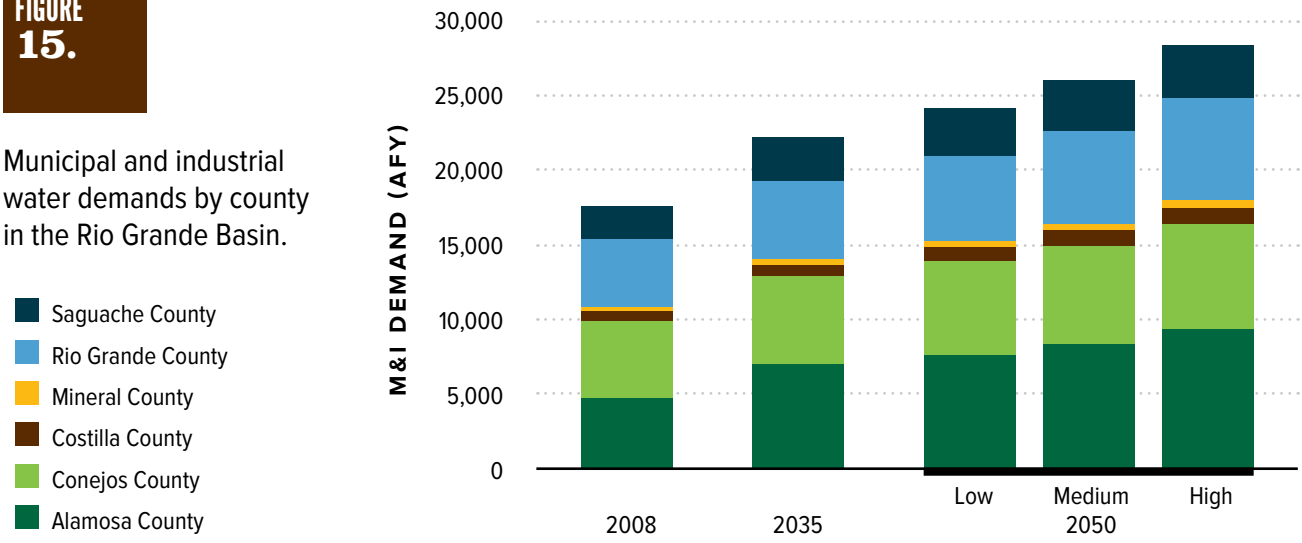
McDonald Ditch diversion and headgate. Photo: Heather Dutton

## 4.2 : MUNICIPAL AND INDUSTRIAL NEEDS

The combined municipal, rural residential, industrial, and commercial water use, which is primarily met with confined aquifer pumping, represents a very small part of water use in the Basin. The current population of the Basin is approximately 46,400 and projected to increase to approximately 79,600 by 2050. Saguache County is presently the fastest growing county, and Crestone is the fastest growing town. Figure 15 shows municipal and industrial water demands by county in the Basin. This figure, pulled from the 2010 Statewide Water Supply Initiative (SWSI) report, shows an estimate of future needs based on a low, medium, or high use calculation.

**FIGURE 15.**

Municipal and industrial water demands by county in the Rio Grande Basin.




Source: State of Colorado, Department of Natural Resources, Water Conservation Board 2011, Figure 5-19


San Luis Valley Brewery in the City of Alamosa. Photo: Emma Regier

Municipal water use, based on figures from three of the largest towns in the San Luis Valley, is approximately 245 gallons per capita per day (GPCD); rural and residential water use is estimated at 143 GPCD. These usage rates are in line with those of several other basins listed in the SWSI 2010 Rio Grande Basin report, including the South Platte, Colorado, and North Platte basins. It is clear that actual water use is substantially lower than previous SWSI estimates of per capita water use in the basin, as shown in Figure 16 and Table 4.

Many of the Basin's M&I water providers have a service area population of less than 1,000. These smaller water providers do not have staff or resources to compile the information necessary for refined water demand projections. As part of the Plan, the M&I Subcommittee was formed of volunteers within the Basin to assist in data collection and analysis and to refine water demand projections.

Due to the relatively minor water use represented by municipal users, there is little pressure for water conservation as a new water supply strategy. However, as municipal water rates increase to fund needed capital improvements and provide for augmentation supplies, the response to higher rates will tend to reduce water use.

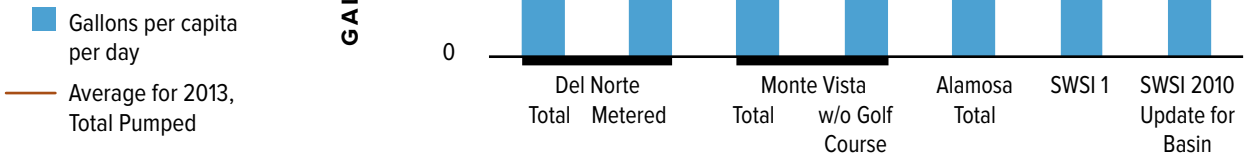
The municipal water systems of 16 communities in the Basin, shown in Figure 17, were evaluated and municipal officials interviewed, where possible. In general, the municipal water systems of many of the communities are antiquated and in need of major and costly repair, replacement, and/or upgrades within the next 10 years. The water quality of the wastewater

**The population, currently estimated at 46,400, is projected to increase to approximately 79,600 by 2050.**

Town of Creede. Source: Will Blanchard, http://www.gottrout.com/info/creede_colorado.htm

**FIGURE 16.**

Comparison of calculated 2013 GPCD for select San Luis Valley towns vs. values reported in the SWSI 2010 report for the Rio Grande Basin.




Sources: State of Colorado, Department of Natural Resources, Water Conservation Board 2011. Water supply and wastewater effluent quantities provided by City governments of Alamosa, Del Norte, and Monte Vista.

## TABLE 4.

Rio Grande Basin M&I Subcommittee estimates of population and M&I water needs 2013–2050.

| County | Population | | Water Demand | | Consumptive Use | |
|---|---|---|---|---|---|---|
| | 2013 | 2050 | 2013 | 2050 | 2013 | 2050 |
| Alamosa | 15,800 | 22,800 | 3,700 | 5,340 | 1,620 | 2,340 |
| Rio Grande | 11,500 | 12,200 | 2,410 | 2,560 | 1,010 | 1,070 |
| Conejos | 8,200 | 8,800 | 2,670 | 2,860 | 1,150 | 1,230 |
| Saguache | 6,600 | 16,500 | 1,290 | 3,220 | 490 | 1,220 |
| Costilla | 3,500 | 3,700 | 640 | 210 | 680 | 220 |
| Mineral | 700 | 800 | 350 | 1,440 | 160 | 650 |
| Hinsdale | - | - | - | - | - | - |
| Misc. municipal | | | 550 | 790 | 280 | 400 |
| Total population and municipal water needs | 46,300 | 64,800 | 11,610 | 16,420 | 5,390 | 7,130 |
| Industrial water needs | | | 7,850 | 9,850 | 1,180 | 1,480 |
| Total population and M&I water needs | | | 19,460 | 26,270 | 6,570 | 8,610 |

Explanatory notes:

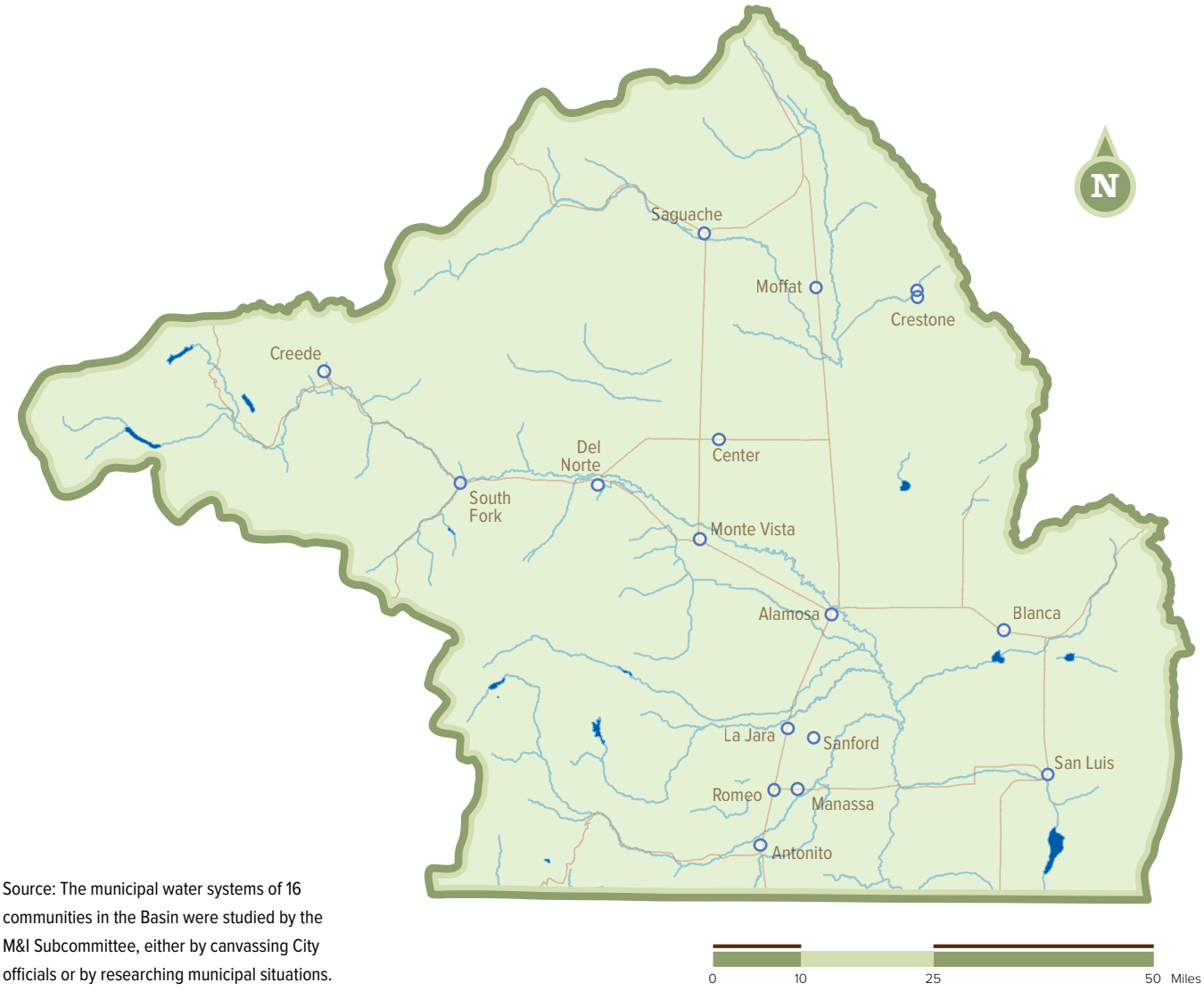
Population figures rounded to the nearest 100

Water figures rounded to the nearest 10

Population growth rates range between 0.25% and 2.5% per year and average 0.9% per year for all counties in the Basin.

Alamosa at twilight. Photo © Adriel Heisey / www.adrielheisey.com

**FIGURE 17.** Map of water providers in the Rio Grande Basin.




Source: The municipal water systems of 16 communities in the Basin were studied by the M&I Subcommittee, either by canvassing City officials or by researching municipal situations.

discharges nominally meet current Colorado Department of Public Health and Environment discharge permit standards. If new and more stringent requirements are imposed for arsenic and other water quality standards, few of the towns have the ability or are prepared to fund the capital improvements required to upgrade the water and wastewater systems. Funding sources for municipal water and wastewater treatment improvements are not as readily available as for other types of water projects. For the majority of towns, the existing treated water infrastructure is believed to have adequate capacity to meet the treated water demands for the foreseeable future. A few of the towns, including Sanford, Romeo, and Baca Grande, may require the development of additional water resources in the future.

**TABLE 5.** Summary of water supply, infrastructure, and water rights for Basin towns.

| Town | Current Population (Estimate) | Sources of Physical Supply: Confined Wells | Sources of Physical Supply: Unconfined Wells | Sources of Physical Supply: Alluvial wells/ surface water rights | Supply Availability: Adequate Physical Supply | Supply Availability: Adequate Legal supply | Infrastructure Assessment: Water Treatment Infrastructure | Infrastructure Assessment: Wastewater Treatment Infrastructure | Comments |
|---|---|---|---|---|---|---|---|---|---|
| Alamosa | 9,018 | X | | | Yes | Yes | Good | Good | Potential arsenic rules will be costly to meet. |
| Monte Vista | 4,355 | X | X | | Yes | In process | Upgrades needed | Upgrades needed | Acquired storage lease in Rio Grande to assist with augmentation. Acquiring water rights. |
| Center | 2,267 | X | | | Yes | In process | Upgrades needed | Upgrades needed | Evaluating individual augmentation or joining groundwater management subdistrict. |
| Del Norte | 1,652 | | | X | Yes | In process | Good | In process | Depletions are likely owed only to the Rio Grande. |
| Manassa | 9,78 | X | | | Yes | Will need plan to augment pumping depletions | Acceptable | Upgrades needed | Replacement of well pumping depletions may be required to multiple streams. Town has irrigation water rights. |
| Sanford | 868 | X | | | Uncertain | Assessing need to augment pumping depletions | Upgrades needed | Upgrades may be needed in the future | Replacement of well pumping depletions may be required to multiple streams. 25% of town is not served by the Town's water and wastewater system. |
| La Jara | 808 | X | | | Yes | Will need plan to augment pumping depletions | Acceptable | Upgrades may be needed in the future | Replacement of well pumping depletions may be required to multiple streams. |
| Antonito | 771 | X | | X | Yes | Will need plan to augment pumping depletions | Acceptable | Acceptable | Replacement of well pumping depletions may be required to multiple streams. Town has senior surface rights that may be useful in replacing depletions. |
| San Luis | 614 | X | | | | Will need plan to augment pumping depletions | Upgrades needed | Upgrades needed | |
| Saguache | 496 | X | | | Yes | Will need plan to augment pumping depletions | Acceptable | Acceptable | Town owns surface water rights that are used for irrigation in Town that may be useful for replacing depletions. |

table continues

continued

**TABLE 5.** Summary of water supply, infrastructure, and water rights for Basin towns.

| Town | Current Population (Estimate) | Sources of Physical Supply: Confined Wells | Sources of Physical Supply: Unconfined Wells | Sources of Physical Supply: Alluvial wells/ surface water rights | Supply Availability: Adequate Physical Supply | Supply Availability: Adequate Legal supply | Infrastructure Assessment: Water Treatment Infrastructure | Infrastructure Assessment: Wastewater Treatment Infrastructure | Comments |
|---|---|---|---|---|---|---|---|---|---|
| Romeo | 400 | X | | | Marginal; may need additional well if growth continues | Assessing need to augment pumping depletions | Acceptable | Acceptable | Town owns surface water rights that are used for irrigation in Town that may be useful for replacing depletions. |
| South Fork | 375 | | | X | | Some existing small system wells are augmented | Does not exist | Does not exist | Town does not have a water or sewer system, but is seeking funding to develop a system. |
| Blanca | 372 | X | | | | Joining the groundwater management subdistrict | Recent upgrades, but additional upgrades may be needed in the future | | Town limits lawn watering. |
| Creede | 292 | | | X | X | May need to acquire additional augmentation sources | Good | Good | Creede may need to seek additional water sources for its augmentation water to the extent that it is unable to obtain water from the Nelson Tunnel or alternatively from Windy Gulch. |
| Crestone | 152 | X | | | X | Actively seeking augmentation supplies. May join the groundwater management sub district when formed. | Good | Served by Baca Grande | Replacing depletions in the required locations is a concern. A portion of the Town decided to remain on individual wells. |
| Baca Grande | 900 | X | | | May need an additional well if growth continues | | Distribution system needs additional repairs to address excessive leakage | Good | USFWS provides augmentation per agreement. |

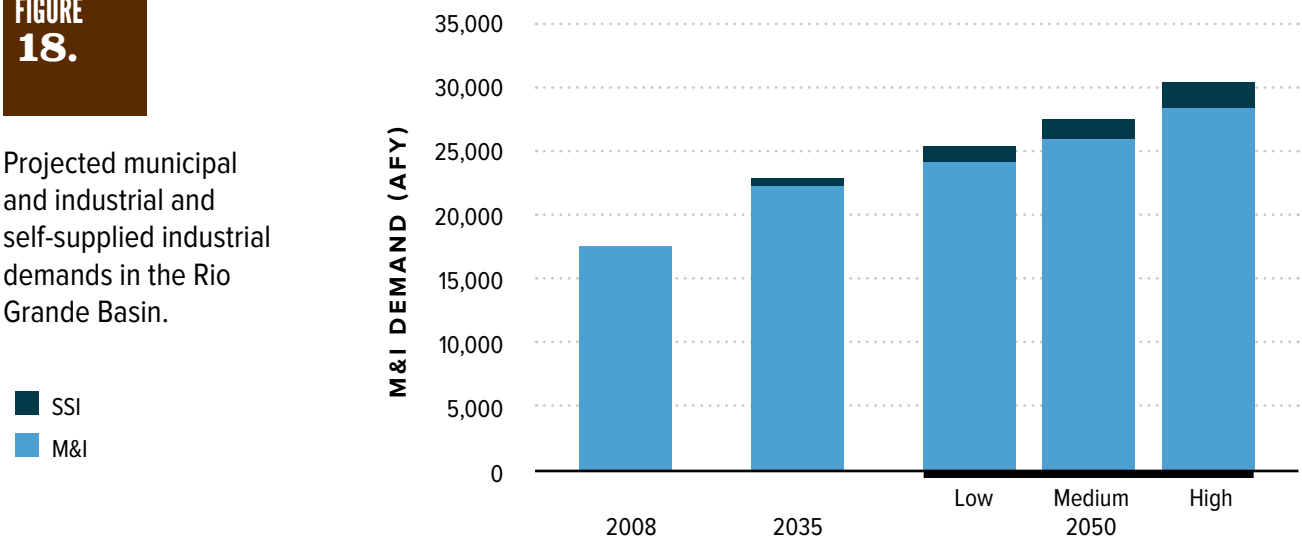
The towns that pump from unconfined or confined aquifer wells will be required to replace their well pumping depletions to rivers and streams. Most of the towns will face the challenge of having to acquire additional augmentation water sources and the storage and/or recharge facilities necessary to replace well pumping depletions in location, time, and amount. A viable alternative for the towns will be to join an appropriate Groundwater Management Subdistrict that will be formed to provide for augmentation of well pumping within the subdistrict boundaries.

In addition to water for municipal needs, the Plan also evaluated self-supplied industrial (SSI) water needs. The principal industrial water uses are for fisheries, aquaculture, and agricultural product processing. Water for solar power generation is minimal, but it is anticipated to increase dramatically by 2050 due to increased economic interest in and anticipated rapid expansion of alternative energy production. Water use for oil and gas production is expected to remain relatively small over the next 10 years due to the combined effect of diminished oil company interest in the Basin, public concern in the San Luis Valley for water source protection, and opposition to oil and gas development.

The combined M&I and SSI demand is estimated to increase from 18,000 AFY in 2008 to approximately 30,000 AFY in 2050 under a high-demand scenario, as shown in Figure 18 below. M&I water use is projected to increase with population growth, while agricultural water use is under pressure to decrease in order to reduce drawdown of the subsurface water table. As a result, M&I water use is projected to increase to about 3.0% of agricultural use by 2050.

**FIGURE 18.**

Projected municipal and industrial and self-supplied industrial demands in the Rio Grande Basin.




Source: State of Colorado, Department of Natural Resources, Water Conservation Board 2011, Figure 5-21

For more detailed information about the Basin's M&I water providers and water needs, see Appendix 4: Basin Water Needs, Section 4.2: Municipal and Industrial Needs.

## 4.3 : ENVIRONMENTAL AND RECREATIONAL NEEDS

The Basin has an abundance of terrestrial and aquatic wildlife populations, rare and important habitats, diverse ecosystems, and exceptional recreational opportunities. However, the increasingly water-short nature of the Basin makes sustaining these attributes challenging. The Environmental and Recreational Subcommittee identified the needs of numerous ecosystem types, species and their habitats, and recreation areas of concern in the Basin. These have been and will continue to be the focus of many projects and methods meant to meet such needs.

Upper Rio Grande River.
Photo: John Fielder

## 4.3.1 : WATERSHED HEALTH AND ECOSYSTEM FUNCTIONS

The high mountains of the Basin make up the watershed, which collects snowpack, the primary source of water supply, and produces water for water users downstream of Colorado. In addition to supplying water, the watershed provides critical ecosystem services, such as forests and rangelands, healthy soils and riparian areas, and critical habitat to area wildlife and fish.

**Seral stages** are distinct plant and animal communities that, occur during ecosystem succession.

**Resistance** is the ability of a system to absorb the impacts from a disturbance while retaining essential processes, such as supplying water, providing habitat, maintaining floodplain function, and preserving healthy soils.

**Resiliency** is the ability of a system to recover from disturbance, such as drought, fire, spruce bark beetle outbreak, or climate change.

Because the majority of the watersheds are forested, forest health is a key concern. The forests within the RGNF are in a **seral stage** transition, following recent landscape-scale disturbances, such as wildfires, long-term drought, and current beetle and disease outbreaks. Additional threats to the forests include invasive species, climate change, and future land use changes. As such, it is important to improve the **resistance** to and **resiliency** following disturbances to watershed functions to protect the water supply source. Resilience can be added into the system by such things as improving the diversity of species and age classes of forest stands, identifying areas where risks to critical water supply, storage, and conveyance facilities can be reduced or mitigated, restoring ecosystem functions through forest and riparian restoration projects, and conserving habitat and associated water rights in key areas.

## 4.3.2 : RIPARIAN NEEDS

Many riparian areas in the Basin are in need of additional efforts to improve and safeguard the critical ecosystem functions they provide. The Rio Grande Headwaters Restoration Project 2001 Study, 2007 Strategic Watershed Restoration Plan, Alamosa River Watershed Plan, Willow Creek Restoration Plan, and Kerber Creek Restoration Project are among the current Basin plans that are driving improvement projects in key riparian systems in the Valley. Riparian restoration and stabilization projects are needed to maintain

Erosion along the Rio Grande, near Alamosa. Photo: Heather Dutton.

and improve riparian habitat, water and sediment conveyance, stream bank stability, and floodplain function. Improvements to water quality that is impaired from historic mining is another significant need; Willow Creek, Kerber Creek, and the Alamosa River continue to be impacted from mining runoff, which affects habitat, recreation, water supplies, and agriculture users.

### 4.3.3 : WETLAND NEEDS

Many types of wetlands with differing needs and water regimes exist in the Basin. Riparian wetland systems require flood and drought in order to maintain the health, quality, and diversity of the wetland. A significant number of wetlands are tied to the unconfined aquifer; thus, they are affected by fluctuating groundwater levels. Many of the large complexes of perennial wetlands in the Valley are actively managed, and, in some areas, water is supplied through irrigation wells to mimic natural processes that no longer occur due to extensive alterations to the ecosystem. As such, these areas will be subject to groundwater rules and regulations, and the managing agencies will have to comply with subdistrict rules or obtain augmentation plans.

Though much has already been accomplished, additional efforts to protect and revitalize riparian areas and wetlands are underway to sustain and improve water quality, groundwater recharge, floodplain function, and critical bird, fish, and wildlife habitats. Many past successes have been multi-faceted to protect and restore a variety of wetland types on both private and public lands. This approach will continue to guide the Basin's future efforts.

Greater sandhill cranes on the Monte Vista National Wildlife Refuge. Photo: Rio de la Vista

## 4.3.4 : HABITAT NEEDS FOR SENSITIVE SPECIES (THREATENED, ENDANGERED, CANDIDATE, AND INDICATOR SPECIES)

The Basin's rivers and streams provide the backbone for the communities, economies, and ecosystems of the Valley.

Mule deer in the Alamosa Valley.
Photo: Juanjo Sergura

This Plan recognizes that addressing the water and habitat needs of specific species will inherently address the needs of many others. Therefore, completed projects that benefit threatened, endangered, candidate, or indicator species have high value toward improving environmental attributes.

Past estimates indicate there are approximately 200,000 acres of nationally and internationally important wetlands in the Basin, much of which is sustained by the Valley's underlying aquifers and/or irrigation for agricultural and/or wildlife purposes. An updated analysis of the extent, condition, and trend of the Basin's wetlands is an identified need, which will assist in evaluating water needs and identifying next steps for the long-term sustainability of key habitat areas.

The following bird species are currently listed as endangered or threatened by State or federal agencies, or are proposed for listing as a candidate species or as a species of concern: the southwestern willow flycatcher, yellow-billed cuckoo, sage thrasher, snowy plover, and Gunnison sage grouse. The Basin provides important habitat for these species, and significant associated water needs exist in order to sustain populations; a variety of efforts are underway to address these needs.

Basin entities have partnered with the USFWS to provide long-term protection of the southwestern willow flycatcher and yellow-billed cuckoo through a regional Habitat Conservation Plan (HCP). The HCP process was initiated by the RGWCD in 2004 and is a partnership with the State of Colorado and Alamosa, Conejos, Costilla, Rio Grande, Saguache, and Mineral counties. The HCP is a community-based plan to conserve endangered species while allowing private land use and management to continue. Without the HCP, Basin landowners could be regulated under the Endangered Species Act. The HCP ensures protection of the two bird species by maintaining a bank of sufficient quality habitat. Meanwhile, landowners are authorized to modify habitat through routine agriculture operations, community infrastructure maintenance, and riparian restoration and conservation.

Basin entities are also working to address the needs of the Rio Grande cutthroat trout, the Rio Grande chub, and the Rio Grande sucker, which face decline due to habitat loss, competition with non-native fish species, hybridization with rainbow trout (the cutthroat trout), persistent drought, wildfire, climate change, and disease. Also, the boreal toad has experienced dramatic population declines over the past two decades from infections of chytrid fungus and loss of habitat. Habitat was greatly impacted by the 2013 West Fork Complex Fire in the upper Basin, as seen in Figure 19. Recovery and regeneration of the boreal toad habitat is tied with forest recovery and will require overall and brood-rearing habitat protection on public lands as well private lands where boreal toads occur.

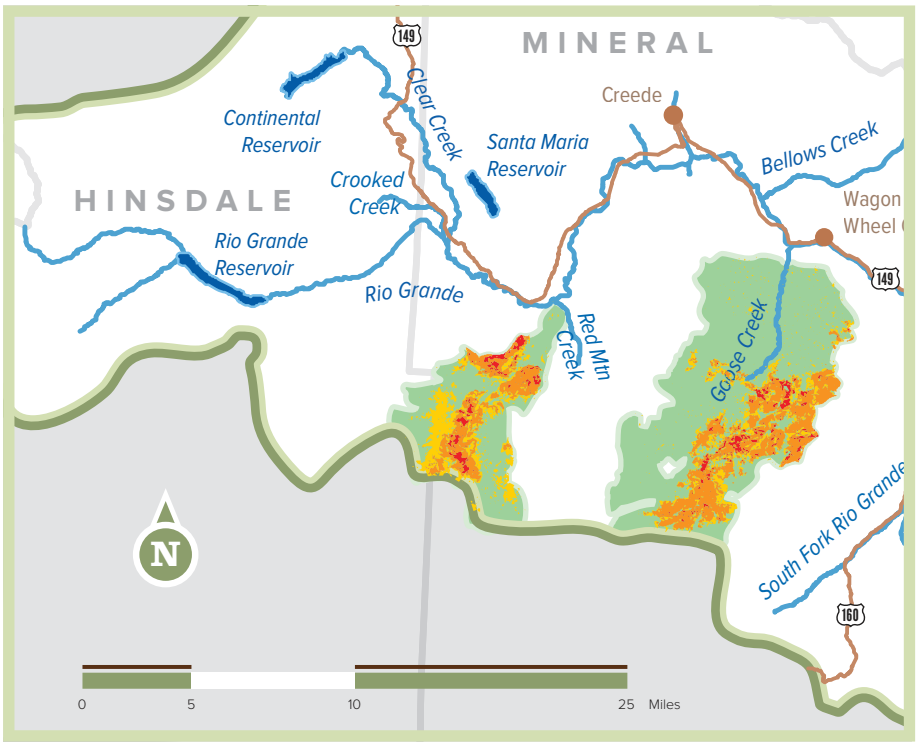
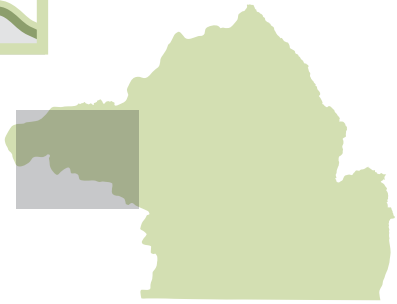



**FIGURE 19.**

Boreal toad habitat impacted by the West Fork Complex Fire.

- Burned Areas (low)
- Burned Areas (moderate)
- Burned Areas (high)
- Boreal Toad Habitat



Sources: Email correspondence with Christopher Kurtz at CDM containing data from work done for CWCB in conjunction with The Nature Conservancy for CWCB's state water plan efforts, May 2014 (for West Fork Fire Complex layer)

State of Colorado, Department of Natural Resources, Parks and Wildlife 2014 (for boreal toad layer)

Other wildlife species found in the Basin that are considered key or indicator species that rely upon wetland and riparian habitat for some or all of their life cycle events are the greater sandhill crane, white-faced ibis, bald eagle, golden eagle, northern leopard frog, slender spiderflower, Canada lynx, and river otter.

Spawning Rio Grande cutthroat trout at Haypress Lake on Humphreys Ranch, high in the Goose Creek corridor. Photo: Rio de la Vista

Boating the Rio Grande past the conserved Rocky River Ranch, west of Del Norte. Photo: Rio de la Vista

## 4.3.5 : RECREATIONAL NEEDS—ENSURE PROTECTIONS, RESTORATION, WATER, AND ENHANCEMENT OF FACILITIES

Given the Basin's exceptional recreation attributes on both public and private lands, the Environmental and Recreational Subcommittee identified ways to build upon the existing amount and quality of opportunities. In the short term, studies on the Rio Grande and Conejos River are needed to gather information about optimal recreational flows, timing of different types of recreation (e.g., white-water boating, float fishing, and wading fishing) during different flows, and late-season recreation developments. Specifically, a project to evaluate and develop means to enhance boatable days on the Rio Grande upstream of Del Norte can be achieved using the Rio Grande Basin Planning Model, as described in **Section 5.3.3: Boatable Days**. Similarly, this Planning Model can be used to evaluate the streamflows to enhance fish habitat.

Many projects that would benefit recreational needs may benefit other sectors as well. In addition to meeting agricultural and water administration needs, the rehabilitation of aging diversion structures and headgates (see Section 4.1.4) can be implemented to improve fisheries, riparian areas, and recreation through the addition of boat and fish passages, where appropriate. In general, boat passages are supported by the surrounding community and are part of a larger recreation plan. Fish passage should be incorporated with consultation from CPW, as fish barriers are needed in some locations to protect high-quality fisheries from predatory species. Projects that enhance riparian and aquatic habitat are a great asset to the angling community, provide a boost in recreational opportunities, and should be pursued in conjunction with infrastructure improvements.

For more detailed information about the Basin's Environmental and Recreational needs, see Appendix 4: Basin Water Needs, Section 4.3: Environmental and Recreational Needs, and contact the many local entities that are involved directly in these efforts.

## 4.4 : WATER ADMINISTRATION NEEDS

The future management and administration of surface and groundwater is critical to the long-term viability of the Basin's water resources.

### 4.4.1 : SURFACE WATER ISSUES

As discussed in **Section 2.5.1** and **Section 2.5.2**, compliance with the Compact is the Basin's first priority regarding surface water administration. As has been demonstrated in the past, the support of this effort has come from multiple sources and through multiple projects:

- Riparian restoration, reducing sediment loading that increases the ability of Rio Grande and Conejos River to transport sediment loads through the system (Rio Grande Headwaters Restoration Project).
- Installation of automated headgates on diversions to ensure irrigators are diverting only their legal entitlement of irrigation water. This has occurred on the Rio Grande and Conejos River (Conejos Water Conservancy District).
- Application of data collection and subsequent diversion control, allowing water administrators to have greater control of the allocation of irrigation water within the legal limits. This has occurred on the Conejos River.
- Consolidation of headgates and automation of headgates is being considered on the Rio Grande, again providing the opportunity to simplify Compact administration.
- Improvement in streamflow forecasting techniques that will provide better source data for Compact administration. New radar

technology is being applied in the Conejos watershed in an attempt to improve snowpack data collection.

- A commitment in the Basin to support the Division Engineer in the administration of the Compact. Opportunities will continue to be identified to carry on this effort.

These projects are examples of efforts to improve water resources in the Rio Grande while improving the ability of the Basin to meet its Compact obligations. Further multi-discipline efforts are needed and will continue to be a RGBRT priority, as the ability to manage surface water supplies is projected to become increasingly difficult.

**The critical need for accurate streamflow forecasting has become more apparent as drought has continued, snowpacks have declined, and runoff becomes less predictable.**

Recent years have highlighted the critical need for accurate streamflow forecasting. This need has become more apparent as drought has continued, snowpacks have declined, and runoff becomes less predictable. Accurate streamflow forecasts can enhance administration of the Compact by minimizing over- and under-deliveries to downstream states, better predicting Compact curtailments, and minimizing stream dry-ups. Efforts are already being made to apply new technologies to snowpack measurements, including depth and snow water equivalent, from which the subsequent streamflow forecasting is determined. The work to date has included initiatives by local water users, the DWR, and CWCB, who, in turn, have been able to engage the National Weather Service, NASA, and researchers from the University of Oklahoma. The application of radar techniques has attracted interest from others who are attempting to make streamflow forecasts in the changing ambient conditions being experienced across the Western U.S. It is anticipated that as results and findings are produced from these latest efforts, refinements will be proposed and additional techniques and technologies will be applied to the issue. The role of the RGBRT will be to facilitate and support continuation of seeking answers to the basic issues associated with streamflow forecasting until it has been determined the best possible forecasting techniques are being applied, and forecasts are accurate and consistent.

Flexible administration and operation of reservoirs that allow for cooperative agreements to be implemented are needed to enhance the ability to store water for Compact, agricultural, municipal and industrial, and environmental and recreational needs, and to provide for retimed releases to meet multiple purposes while protecting downstream water rights. The Rio Grande Cooperative Project — between the San Luis Valley Irrigation District, with its Rio Grande Reservoir, and CPW, with its Beaver Reservoir — is a breakthrough partnership that provides for rehabilitation of both reservoirs and new operating strategies in the future to meet multiple needs. It is anticipated that this Cooperative Project will develop, and additional participants will be included as the multiple benefits are identified and realized. While this initiative is taking place with reservoirs on the Rio Grande, a cooperative project has been in place on the Alamosa River and the Terrace Reservoir to store instream flow waters. Basin water users hope that as the success of these types of arrangements is realized, new opportunities will be identified and implemented. Again, it will be the role of the RGBRT to assist in identifying such opportunities and facilitate their implementation.

## 4.4.2 : GROUNDWATER

As discussed in **Section 5.2.3: Improving Streamflow Forecasting**, groundwater users across a spectrum of disciplines are working to reach sustainable aquifer levels. This is being accomplished through meeting the requirements of SB 04-222, the State's proposed Well Rules and Regulations, and the established and pending Groundwater Management Subdistricts throughout the Valley. The RGWCD anticipates that up to six subdistricts will be created. The RGBRT will continue to support the efforts to attain sustainability of both the confined and unconfined acquirers to support the long-term viability of the Basin's associated agricultural, environmental, and recreation economies.

Winter snowpack on Montezuma Peak in the San Juans. Photo: Heather Dutton

Rio Grande and center-pivot hayfield, just above Del Norte. Photo © Adriel Heisey / www.adrielheisey.com

# 5 CONSTRAINTS AND OPPORTUNITIES

Southwestern willow flycatcher at McIntire-Simpson BLM property. Photo: BLM

The Basin will face several key challenges with respect to water management over the next 40 years, including:

- Groundwater is a key component of water use in the Basin for M&I, agriculture, and many areas of wildlife habitat; groundwater use is at unsustainable levels and its management presents an ongoing challenge.
- There may be significant economic impacts from reduced agriculture in light of reduced groundwater and surface water supplies.
- The Compact is increasingly difficult to administer with the effects of prolonged and lingering drought, changes to runoff timing and amounts, and other environmental factors impacting surface water supplies.
- Drought, climate change, wildfires, dust on snow, and forest succession due to diseases and insect outbreaks impact hydrology within the Basin.
- Residential, commercial, and industrial growth is creating a need for augmentation water supplies to replace depletions associated with these uses.
- Aquatic-dependent wildlife species are being considered for or already listed as a threatened or endangered species under the Endangered Species Act.

Planning for future modified water availability in light of these constraints will be an ongoing challenge.

## 5.1 : CONSTRAINTS

The constraints identified in this section of the Plan describe the Basin's current and anticipated water-related challenges. Future, unforeseen constraints may emerge that influence the development of projects and methods to meet the needs identified in this Plan.

### 5.1.1 : RIO GRANDE COMPACT

The Rio Grande Compact plays a central role in the administration of water in the Basin. See **Section 2.5.1: Rio Grande Compact**, **Section 2.5.2: Surface Water Administration**, and Appendix 2: Basin Overview for a brief history and description of administration of the Compact. The Compact requires a portion of the annual flow in the Rio Grande and Conejos River be delivered to New Mexico, where it is further distributed to Texas and Mexico. The amount of water that must be delivered is determined by a sliding scale, with increasing delivery requirements as the total streamflow increases. The Compact requires deliveries to New Mexico regardless of changes to Basin hydrology or climate; thus, meeting the Compact obligations in a potentially drier future will create further decreases in surface water supplies.

Meeting Rio Grande Compact obligations in a potentially drier future will create further decreases in surface water supplies.

## 5.1.2 : FACTORS AFFECTING HYDROLOGY

### 5.1.2.1 PROLONGED AND LINGERING DROUGHT

An extended drought that began in 2002 and continues into 2015 has resulted in significantly lower snowpack accumulation and runoff in the Basin than the long-term historical average. The average river flow since 2000 has been 15% lower than the long-term historical average. Some climate change scenarios indicate that flows could decrease by 30% from the long-term average (see **Section 5.1.2.5: Climate Change** for additional detail).

Over the past 15 years, this decline has led to over-reliance on groundwater, depletion of the aquifers, and the urgent need to rebalance the water uses to achieve a sustainable water supply. If the flows in the Rio Grande and Conejos River continue at the 2000 to 2013 levels, the water available for aquifer recharge will be further reduced, along with increased demand on groundwater. See **Section 2.5.3: Groundwater Administration** and **Section 5.1.3: Aquifer Sustainability** for additional information about the impacts of changes in flows and Compact deliveries on the groundwater resources in the Basin. **The effects of prolonged and lingering drought have broad implications for water management and have also been contributing factors to erratic wildfire behavior, beetle outbreaks, and dust on snow events.**

Great Sand Dunes National Park and Preserve. Photo: Heather Dutton

West Fork Complex Fire near Del Norte. Photo: Travis Smith

Little Squaw Canyon after the West Fork Complex Fire. Photo: Heather Dutton

#### 5.1.2.2 FOREST FIRES

Across the West, wildfires are increasing in size and frequency. With historic suppression of fires, reduced numbers of forest thinning and logging projects, and chronic insect outbreaks, heavy fuel loads exist. As such, wildfires are burning at a higher intensity and causing more severe impacts to watersheds. Research and recent fire history predict an increase in the geographic extent, intensity, and length of fire seasons.

In June 2013, three wildfires were started by lightning strikes in the upper Rio Grande: the West Fork fire, Papoose fire, and Windy Pass fire. The three wildfire events were managed by incident commanders as the West Fork Complex Fire (WFCF).

The WFCF was deemed "contained" by the USFS on January 1, 2014, after consuming 109,500 acres, with roughly 88,000 acres on the RGNF and the remaining 21,500 acres on the San Juan National Forest. In addition to public safety and private property concerns, there were concerns for damage to natural resources within the watershed, as the fire was situated at

the headwaters of the main stem of the Rio Grande and many of its major tributaries.

The fire was fueled primarily by beetle-killed spruce trees, and its erratic behavior was driven by high temperatures, winds, and low humidity. The ability of crews to fight the fire was limited by steep terrain and minimal road access, as huge areas of the burn occurred in roadless areas and the Weminuche Wilderness Area. Therefore, the primary priority of fire managers was protecting structures and keeping crews safe from high-hazard areas. Incredibly, only a shed and a pump house were burned.

As shown in the USFS's Burned Area Reflective Classification (BARC) map, over 60% of watersheds within the WFCF perimeter were moderately to severely burned. The high level of burn severity subsequently resulted in unstable slopes and areas of flooding and debris flow.

Wildfires have several impacts upon hydrology and water quality. As has been documented in other post-wildfire landscapes, snowpack, spring runoff levels, and timing of flows will likely be altered by a lack of overstory vegetation to gather and shade ground snowpack, and by the black, charred backdrop that increases solar intensity and melting. On the other hand, lack of overstory reduces evapotransporation, which results in greater infiltration.

For more information on forest fires and their impacts to hydrology in the Basin, see Appendix 5: Constraints and Opportunities, Section 5.1.2.2: Forest Fires.

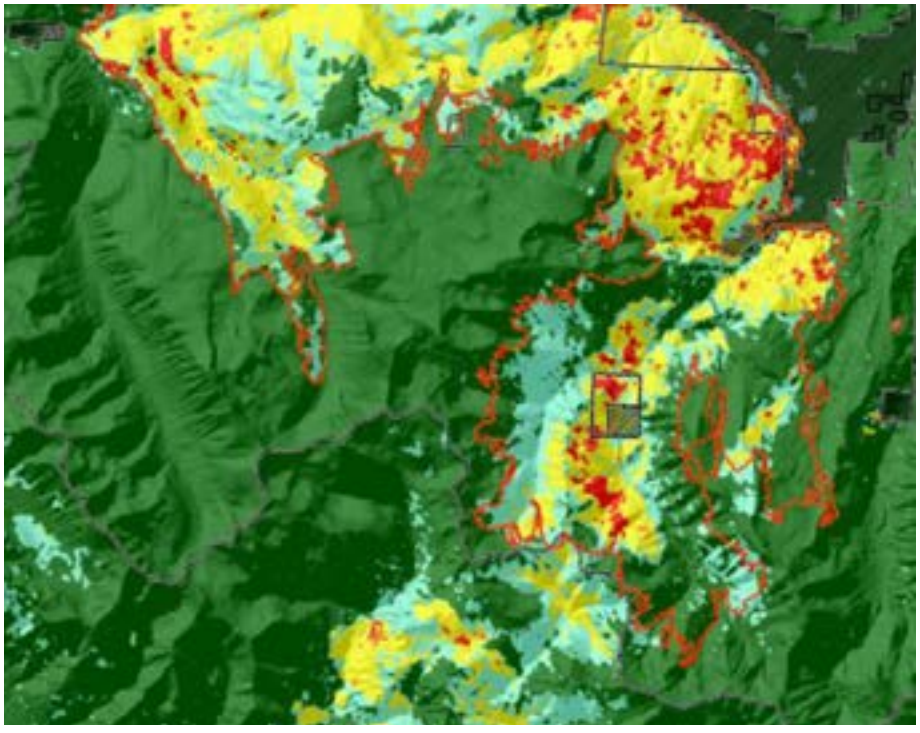


FIGURE 20.

BARC Map for West Fork Complex Fire.

### 5.1.2.3 BEETLE KILL

Beetle infestations in Colorado's forests result in complex impacts to hydrology and other watershed characteristics. Spruce bark beetles, native to the RGNF, have killed vast spruce forests in headwaters areas. The beetles kill the trees by burrowing under bark and eating through the vital layers of xylem and phloem. This causes a break in these layers of vascular tissue, inhibiting their ability to transport water and nutrients and resulting in the tree's death.

An adult spruce beetle bores into the bark of a spruce. Source: Grand Mesa Uncompahgre and Gunnison National Forests

Since 2005, 480,000 acres of the RGNF have been impacted by spruce beetles or other beetles and diseases. This equates to approximately 85% of the total spruce-fir forest, as shown in Figure 21. In 2013 alone, the infestation on the RGNF expanded an additional 98,000 acres, as detected by a Colorado State Forest Service forest health aerial survey.

The hydrologic impacts of landscape-scale changes in forest condition, such as die-offs from beetle infestations, can last for decades. Similar to the impacts of wildfire, the impact of beetle-killed forests is significantly less overstory, leading to changes in snowpack accumulation and rate of melt, ablation, infiltration, evapotranspiration, and rate of runoff. However, the patchwork nature of beetle infestations and resulting forest succession may reduce the magnitude of these impacts to the hydrologic regime.

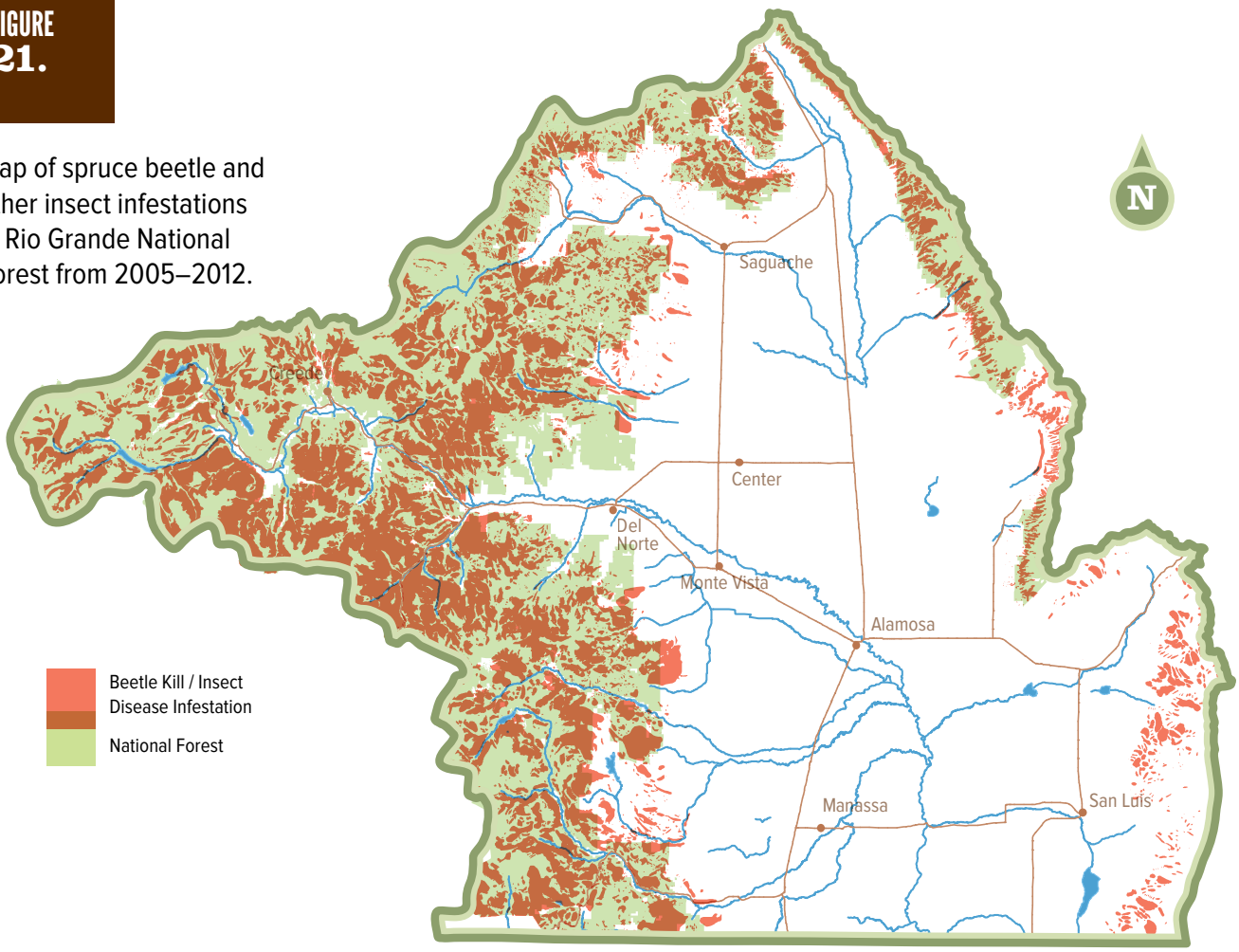
Beetle kill in the Rio Grande National Forest. Photo: US Forest Service

There is a great deal of interest in the impacts of bark beetles on fire regimes in Colorado forests. It is believed that the severe drought, high temperatures, high wind, and stand structure of the dead spruce impacted behavior of the 2013 WFCF on the RGNF and the San Juan National Forest. The spruce beetle-killed forests burned at a much hotter level, and fires moved from ground to the crown at a much faster rate than observed in live forests. A GIS analysis of the WFCF completed for the Plan indicates that 67% of the low-intensity burned area had beetle infestation, while 87% of the medium- and high-intensity burned areas had beetle infestation.

For more information on beetle kill and its impact to hydrology in the Basin, see Appendix 5: Constraints and Opportunities, Section 5.1.2.3: Beetle Kill.

**FIGURE 21.**

Map of spruce beetle and other insect infestations in Rio Grande National Forest from 2005–2012.



Dust on snow at the top of Red Mountain Pass. Photo: Steve Vandiver

### 5.1.2.4 DUST ON SNOW

Dust on snow has long been a phenomenon occurring in Colorado. However, deteriorating range conditions in upwind and source locations (both outside of and within Colorado) have increased severity of dust on snow events, and recent studies are revealing the extent of its impacts. Initiated by strong winds, desert dust blows into the Colorado high country and settles in layers on the snowpack in the headwaters of river basins. As temperatures warm in the spring, these layers emerge, and snow covered with dark particles absorbs more of the sun's rays and melts faster than clean white snow. Exacerbating the problem, the dust layers grow darker and more concentrated as the snow beneath them melts, thus accelerating the runoff rate even more as the sun's intensity grows with the approach of summer. Dust on snow has significant impacts on runoff, evapotranspiration, and snow cover, including:

- More absorption of solar radiation from dust on snow can shorten snow cover by several weeks.
- Shortened snow cover causes peak runoff to occur an average of three weeks earlier.
- A longer snow-free season results in earlier plant germination and increases evapotranspiration losses.
- Evapotranspiration losses are estimated to decrease annual runoff by 5% of the annual average flow.
- The highest snow accumulation areas show the greatest sensitivity in date of snowpack disappearance.

Dust on snow in the Rio Grande headwaters. Photo: Heather Dutton

The source of dust that deposits on snow in the Rio Grande headwaters comes from a complex mixing from multiple source areas, with the Four Corners region being an important source of dust. No data have been published at this time, but the Colorado Dust on Snow (CODOS) program collects dust from snow sites and performs chemical analysis to tie the dust back to samples collected by USGS in the Colorado Plateau source area. Similarly, the Valley is a source of dust for other parts of Colorado, including the western side of the Sangre de Cristo mountain range.

Dust on snow is a current problem within the Basin. Furthermore, studies show that future climate changes will also impact snowmelt and runoff. To evaluate combined dust on snow and climate change impacts, Deems et al. (2013) compared combinations of dust and climate scenarios to the medium dust historical scenario that represents current conditions. The Deems et al. (2013) model results show that a future, warmer climate has a substantial impact on snow cover duration relative to the current climate and dust environment. The study further suggests that earlier runoff as a result of dust on snow will continue under future climate scenarios, but the effects of climate change and dust on snow are not completely additive. For example, if dust on snow results in a two-week-earlier runoff and climate change results in a three week-earlier runoff, the combined effect will be significant, but likely less than the inferred five-week sum.

For more information on dust on snow and its effect on hydrology in the Basin, see Appendix 5: Constraints and Opportunities, Section 5.1.2.4: Dust on Snow.

#### 5.1.2.5 CLIMATE CHANGE

Climate change describes the observed and projected trends and variability associated with long-term weather patterns. The Basin hydrology is driven predominately by precipitation and temperature. Over many decades, decision making and policy for water management have been based upon existing hydrology. With the changes already observed and climate change science suggesting even greater change, new decision-making protocols and policy should consider the best available science, forecasts, and understanding of uncertainty in order to minimize negative impacts from these changes in hydrology.

Studies suggest that Basin climate change impacts include decreased precipitation and snowfall, earlier snowmelt, and increased evaporation. The predicted result is reduced streamflows, an increase in stream water temperatures, increased evapotranspiration and subsequent irrigation requirements, shortages to water users, and reduced recharge and subsequent groundwater levels.

Studies suggest that impacts include decreased precipitation and snowfall, earlier snowmelt, and increased evaporation.

The Upper Rio Grande Impact Assessment (Dagmar and Vaddey 2013) was performed by the Bureau of Reclamation in partnership with Sandia National Laboratories and the U.S. Army Corps of Engineers to assess the impact

of climate change on the Upper Rio Grande Basin from the headwaters in Colorado to Caballo Reservoir in south central New Mexico. The report's findings show impacts to the Rio Grande and Conejos systems. Key results from the report include:

- Flows at the index stream gages (Rio Grande near Del Norte, Conejos River near Mogote, Los Pinos River near Ortiz, and San Antonio River at Ortiz) will decrease by approximately one-third overall by 2100.

- The peak flows will shift to earlier in the year — from June to May.

- Downstream, flows will decrease by 50% at the Rio Grande near Lobatos gage.
  - This reduction is greater than the reduction at the index gages, suggesting the Rio Grande Compact structure may buffer consumptive use in San Luis Valley at the expense of downstream deliveries to New Mexico.

- Fewer water rights are served on average as a result of the decreased flow.
  - From 1950 to 1999, the average junior-most water right to be served in June on the Rio Grande was a 1910 priority, whereas by 2100 it is anticipated to be an 1890 priority.

For a more detailed description of the report, the model used to generate the results, and plots of key results, see Appendix 5: Constraints and Opportunities, Section 5.1.2.5: Climate Change.

#### 5.1.2.6 SUMMARY OF FACTORS AFFECTING HYDROLOGY

The current factors affecting hydrology, combined with the projected impacts of climate change, can lead to cascading impacts. For example, more intense droughts and higher temperatures lead to a greater moisture deficit in the region's forests. Trees that are not receiving adequate water are more susceptible to beetle infestations, and infected weakened and dead trees may increase the intensity of wildfires. Climate change may add compounding effects to areas already infested with bark beetles, including even earlier runoff and smaller runoff amounts. The combination of faster and increased snowmelt due to dust on snow, direct climate warming impacts on snow accumulation, and the rate and timing of snowmelt threaten an amplified impact on snowpack. An overview of the impacts on hydrology from these factors — dust on snow, beetle kill, forest fires, and climate change — is provided in Figure 22.

The current factors affecting hydrology, combined with the projected impacts of climate change, can lead to cascading impacts.

**FIGURE 22.** Summary schematic of environmental impacts on hydrology.

| FACTOR | Forest Fires — immediate impact | Beetle Kill — red and grey phases | Dust on Snow | Climate Change |
|---|---|---|---|---|
| **IMPACT ON...** | | | | |
| **Timing of Runoff Flow and Peak Runoff** | EARLIER<br>Increased, up to 2–3 weeks earlier | EARLIER<br>Up to 1 week earlier in the red phase due to decreased albedo | EARLIER<br>3–6 weeks earlier for UCRB | EARLIER<br>Up to 1 month earlier (from June to May) |
| **Volume of Runoff Flow** | INCREASE<br>Increased, varies by watershed, climaate and fire severity, but up to 100 times those previously recorded | MIX<br>Undetermined. Higher rates of sublimation and increased sunlight penetration, but up to 5% rise in streamflow due to forest canopy loss, offset by increased growth rate of surviving understory trees, patchwork nature of infestations, slow progression of tree death and decomposition | DECREASE<br>Reduce by about 5% due to evapotranspiration, does not include sublimation for UCRB | DECREASE<br>Decrease by approximately 1/3 overall at the index gages and by 50% at the Lobatos Gage by 2100 |
| **Snow Accumulation** | INCREASE | INCREASE<br>Grey Phase - 5%–15% more total snow accumulation | No Impact | DECREASE<br>Projected to decline by 10-20% by 2050 in Colorado |
| **Water Infiltration** | DECREASE<br>Reduced, dead trees do not consume as much water, higher instances of sediment loading | INCREASE<br>Increased or No change, surviving trees can grow up to 3x faster in beetle kill conditions, up-taking 3x more water | No Impact | MIX<br>Undetermined, maybe earlier or later due to several factors |
| **Time of Snow Disappearance** | EARLIER<br>several weeks earlier and more rapid | EARLIER | EARLIER<br>50–43 days earlier, shortened duration of snow cover | EARLIER<br>Earlier up to 1 month, similar to peak runoff |
| **Data Sources:** | Gleason et al. 2012; Neary et al. 2011 | Gordon et al. 2014 | Deems et al. 2013; Landry 2014 | Llewellyn and Vaddey 2013 |

## 5.1.3 : AQUIFER SUSTAINABILITY

The Basin has realized both the practical and legal needs to restore and sustain the aquifer levels that support the many important attributes of the region. As discussed in **Section 2.5.3: Groundwater Administration**, Basin groundwater users will be required by law to restore and maintain the aquifer at sustainable levels. Since 2002, water levels have declined in the aquifers significantly. Meeting the sustainability requirement will be a very difficult challenge for the Basin and will require significant reductions in pumping, unless snowpack and streamflows increase over a prolonged period of time (Vandiver 2014).

Since 2000, the average surface water consumption permissible under the Compact on the Rio Grande and Conejos River combined is approximately 565,000 AF. The State's most recent estimate of Basin agricultural consumptive use for 2000 to 2009 is 810,000 AF (see Table 3). The difference of 245,000 AF is derived from surface water inflows directly into the Closed Basin and drafts on aquifer storage. The annual inflows to the Closed Basin, based on State of Colorado's groundwater modeling, are estimated at 160,000 AF per year, indicating an annual draft on aquifer storage averaging 85,000 AF per year.

Because the sustained and lingering drought since 2002 has not been matched with a decline in agricultural consumptive use, use of the aquifers is unsustainable. To date, only one Groundwater Management Subdistrict has been formed, and Well Rules and Regulations have not been implemented, so there have been limited efforts to address aquifer sustainability and stream depletions associated with groundwater pumping. The result has been continuing drawdown of the unconfined aquifer and reduced pressure in the confined aquifer.

Based on the estimated current average annual over-draft of the unconfined aquifer of 85,000 AF, water users are faced with reducing consumptive use unless streamflows significantly increase. Based on current crops grown and

Confined well discharge to ditch. Photo: Kelly DiNatale

irrigation methods, this reduction of consumptive use represents a more than 10% decrease in agricultural production, with an associated decrease in the economic output of the Basin's agricultural sector.

Deeper groundwater levels translate into higher pumping costs. The eastern area of the Closed Basin and some parts along the far western edge near the blue clay line have seen significant drops in water levels that have resulted in reduced pumping yields and well surging. If aquifer storage levels continue to drop, the physical supply of water available to well users may continue to decrease and make it increasingly difficult to irrigate some lands.

Groundwater users in the Basin will be required to develop plans to replace injurious well pumping depletions. Many agricultural groundwater users are forming Groundwater Management Subdistricts to jointly develop replacement plans. M&I well users will be subject to the same Well Rules and will need to find replacement water supplies to continue pumping into the future. While M&I pumping makes up only a very small fraction of the overall groundwater pumping in the Basin, a potential requirement to augment approximately 25% of total pumping is a new and difficult addition to the operation of a municipal system. With M&I pumping anticipated to climb to nearly 20,000 AF by 2035, M&I providers will need to replace approximately 5,000 AF of groundwater pumping to meet this obligation.

Further, many state wildlife areas, USFWS refuges, and BLM wildlife refuges utilize wells to create habitat and grow food for local and migrating wildlife; they are currently working to determine how they will comply with the Rules and Regulations.

Aquifer sustainability is likewise important to many surface and subsurface hydrologic features of the Basin, such as the hydrology of the Great Sand Dunes, the health of countless wetland complexes, and the ability of producers to harvest hay and graze livestock in historically subirrigated pastures.

For more information on aquifer sustainability, see Appendix 5: Constraints and Opportunities, Section 5.1.3: Aquifer Sustainability.

Wetlands greening up in the spring, looking east to the Sangre de Cristos, on the conserved Gilmore Ranch, along the Rio Grande west of Alamosa. Photo: Rio de la Vista

### 5.1.4 : FUNDING

The Basin has a history of positive cooperation in protecting water resources and implementing water-related projects.

Funding of water projects, both in the Basin and statewide, will continue to be a significant challenge. Regardless, implementation of the projects identified in the Plan is critical. The Basin has a history of positive cooperation in protecting water resources and implementing water-related projects. Multi-purpose projects and public/private partnerships that provide multiple benefits have a strong track record of success and broad-based support for securing funds and achieving implementation. Many Basin entities have succeeded in obtaining such funding as State and federal grants, loans, donations, and in-kind contributions; they will continue to seek diverse support for needed projects. The RGBRT will also continue to encourage cooperative projects and diversified funding.

For more information on project funding for municipal and industrial and for environmental and recreational projects, see Appendix 5: Constraints and Opportunities, Section 5.1.4: Funding.

## 5.2 : OPPORTUNITIES

The opportunities identified in this section of the Plan are meant to describe potential currently known Basin opportunities. These are not meant to limit projects that can address future, unforeseen opportunities, but rather are intended to give only an overview of current circumstances and how they may be addressed.

### 5.2.1 : GROUNDWATER MANAGEMENT SUBDISTRICTS

As discussed in **Section 2.5.3: Groundwater Administration** and **Section 5.1.3: Aquifer Sustainability**, Groundwater Management Subdistricts were enabled in 2004 with the passage of Senate Bill 222 (SB 04-222). The Bill addressed declining aquifer levels in the Valley and potential injury to senior water rights caused by stream depletions from well pumping in the Basin. As such, groundwater users in the Basin are in the process of forming Groundwater Management Subdistricts. So far, Subdistrict No. 1 is the only established subdistrict. Other subdistricts are being formed, and the State has developed preliminary estimates of stream depletions caused by well pumping in areas that are anticipated to approximately align with the future subdistricts. This will allow groundwater users to comply with SB 04-222 and the expected Well Rules and Regulations for Groundwater Management in Division 3.

If the other subdistricts are not formed, well owners elect not to obtain individual augmentation plans, stream depletions are not replaced, and the aquifers are not restored to sustainable levels, the State may promulgate additional rules and require all wells to augment their own depletions and be subject to a currently unknown and unspecified curtailment of well use in

the Valley. The Groundwater Management Subdistricts represent a proactive opportunity for water users to avoid potentially onerous administration or the significant expense of decreeing individual augmentation plans for their individual wells.

For more information on Groundwater Management Subdistricts and related projects, see **Section 6: Projects and Methods** and Appendix 5: Constraints and Opportunities, Section 5.2.1: Groundwater Management Subdistricts.

## 5.2.2 : ADDITIONAL USES FOR BASIN RESERVOIRS

Coordinated operation of reservoirs in the Basin will improve the management of surface water resources. The continued cooperation of reservoir owners to optimize storage and release opportunities will help meet agricultural demands, enhance river flows to meet environmental needs, increase recreational opportunities, provide a reliable supply of augmentation water for agricultural, domestic, and M&I users, and assist in Compact compliance. The rehabilitation of existing reservoirs is necessary to maintain the safety and long-term viability of these facilities. There are opportunities through cooperation to improve the operation of the pre- and post-Compact reservoirs in the Basin in a way that achieves multiple benefits. The pre-Compact reservoirs are beneficial for fully developing and retiming Compact deliveries, groundwater augmentation, and other water deliveries from State agencies.

Rio Grande Reservoir.
Photo: Rio de la Vista

#### 5.2.2.1 STORAGE IN PRE-COMPACT RESERVOIRS

There are four pre-Compact reservoirs located in the Basin upstream of Del Norte: Rio Grande, Santa Maria, Continental, and Beaver Park. When these reservoirs store in-Basin supplies, they do not trigger a delivery obligation until the water is released and passes the Del Norte gage. The storage in these reservoirs can be used to manage Compact deliveries to prevent over-delivery and provide for a more consistent and equitable curtailment. These reservoirs can also meet other water needs through cooperative storage agreements.

Benefits of cooperative storage agreements may include:

- Direct flow storage for agricultural users
- Storage for Groundwater Management Subdistricts, an important component of annual replacement plans to meet stream depletions
- Storage to towns, the San Luis Valley Water Conservancy District, and other users to provide for augmentation of out-of-priority well pumping depletions
- Opportunities for improved water administration with more consistent curtailment percentages, creating potential equity among all water users
- Maximizing the beneficial use of water within Colorado within the legal framework of the Compact
- Limiting the potential for over-delivery by holding over water until the next water year if Compact deliveries will be satisfied
- Retiming releases to provide for instream environmental and recreational benefits while protecting downstream water rights
- Consistent curtailment and elimination of over-delivery, minimizing the dry-up of the Rio Grande by creating a live stream all the way to the state line

Rio Grande enters Rio Grande Reservoir.
Photo © Adriel Heisey / www.adrielheisey.com

Maintaining a live stream and eliminating dry-up locations, in addition to the environmental and recreational benefits, ensures the ability to maintain deliveries to downstream users in the Basin and Compact deliveries by not having to replenish the stream alluvium that was drained during periods of dry-up.

The Rio Grande Cooperative Project has demonstrated that cooperative agreements among reservoir owners, State agencies, water rights holders, and environmental interests can result in benefits to multiple parties.

#### 5.2.2.2 AUGMENTATION DELIVERIES

Well users throughout the Basin will increasingly need to provide replacement water for well pumping depletions. Pumping from a confined or unconfined aquifer well results in stream impacts that are lagged over many months or years, depending on the location of the well and geology in the region. Under Colorado water law, any legally injurious lagged stream impacts must be replaced or augmented, to the stream at the time and location of the impact. Currently, the San Luis Valley Water Conservancy District (SLVWCD) provides augmentation water for many non-irrigation wells. Groundwater Management Subdistrict No. 1 provides augmentation water for stream impacts due to pumping within its boundaries. As the Well Rules and Regulations are implemented, most well users, including agriculture and environmental irrigators, towns, and industrial users that pump groundwater, will need to find a source of augmentation water, most likely through a Groundwater Management Subdistrict.

As the Well Rules and Regulations are implemented, most well users will need to find a source of augmentation water.

The reservoirs in the Basin can act as regulating vessels for delivery of the augmentation water to specific streams. Augmentation supplies can be stored in reservoirs and then released at the rate, in the amount, and to the location of the stream impact. The use of reservoirs throughout the Basin will become increasingly important because impacts are anticipated along many different stream reaches. A letter from the State Engineer dated May 2, 2014, states that stream impacts will likely need to be augmented on the Rio Grande, Conejos River, Alamosa River, upper and lower reaches of La Jara Creek, Trinchera Creek, Saguache Creek, San Luis Creek, and Crestone Creek. Reservoirs that may be utilized for these areas include Rio Grande, Santa Maria, Continental, Beaver Park, Platoro, Trujillo Meadows, Terrace, La Jara, Mountain Home, Smith, and potentially other smaller reservoirs. Most of these reservoirs are privately owned, and subdistricts and other water users needing storage for augmentation water will need to negotiate storage contracts with the reservoir owner.

For more information on additional uses for Basin reservoirs and projects related to improving Basin reservoir infrastructure and operation, see **Section 6: Projects and Methods** and Appendix 5: Constraints and Opportunities, Section 5.2.2: Additional Uses for Basin Reservoirs.

## 5.2.3 : IMPROVING STREAMFLOW FORECASTING

Accurate measurement and prediction of streamflow are critically important to Basin water users, particularly for annual Rio Grande Compact administration and daily determination of curtailment on diversions for the Rio Grande and Conejos River, as described in **Section 2.5.1: Rio Grande Compact**. Ideally, these forecasts should be based on accurate estimates of snowfall, careful monitoring of the water content and behavior of snowpack, and a good understanding of snowmelt, runoff, and streamflow. However, the ability to accurately collect all of these data is limited. **Section 2.5.2: Surface Water Administration**, describes how the DWR uses the forecast to estimate Compact deliveries and set curtailment. **Section 4.4: Water Administration Needs** describes the need for improved forecasting.

An overestimation of streamflow, leading to a higher-than-required curtailment through peak runoff, may result in reduced opportunities for junior water rights to divert and/or reservoirs to store. In the Rio Grande, this can mean less water diverted into the Closed Basin for groundwater replenishment. On the Conejos, it can result in lost opportunities to implement direct flow storage in the Platoro Reservoir for release to irrigators later in the season. Eliminating the risk of over-delivery through improved streamflow forecasting will also minimize the dry-up of the river that often occurs in late summer or fall when it appears an over-delivery may occur.

If the streamflow forecast is too low, the curtailment will be set low, as the delivery as a percentage of the index gages is less at lower streamflows. If it is determined after runoff that there is a chance for under-delivery under the Compact, the curtailment may be increased. Since the flows are lower after runoff, the increased curtailment is more likely to affect senior water rights holders. Improving streamflow forecasting in the Basin could prevent such issues. To understand how forecasts can be improved, the difference between streamflow forecasts and actual streamflow was compared. The years 2006 through 2012 are shown in Figure 23, revealing large discrepancies between forecasted and actual April through September flow at the Rio Grande near Del Norte gage.

Improved streamflow forecasting would be very beneficial to water users in the Basin. The Division Engineer's office would also have better data for its water administration decisions and determining curtailment percentages. The Conejos Water Conservancy District is conducting a Radar Project that is intended to generate streamflow forecasts using the National Weather Service hydrologic models to better understand forecast errors and to use data on snow-covered areas to improve snow modeling and water supply forecasts.

For more information on improving streamflow forecasting and related projects, see **Section 6: Projects and Methods** and Appendix 5: Constraints and Opportunities, Section 5.2.3: Improving Streamflow Forecasting.

Doppler on wheels deployed during the late summer of 2013. Photo: Joshua Wurman, Center for Severe Weather Research

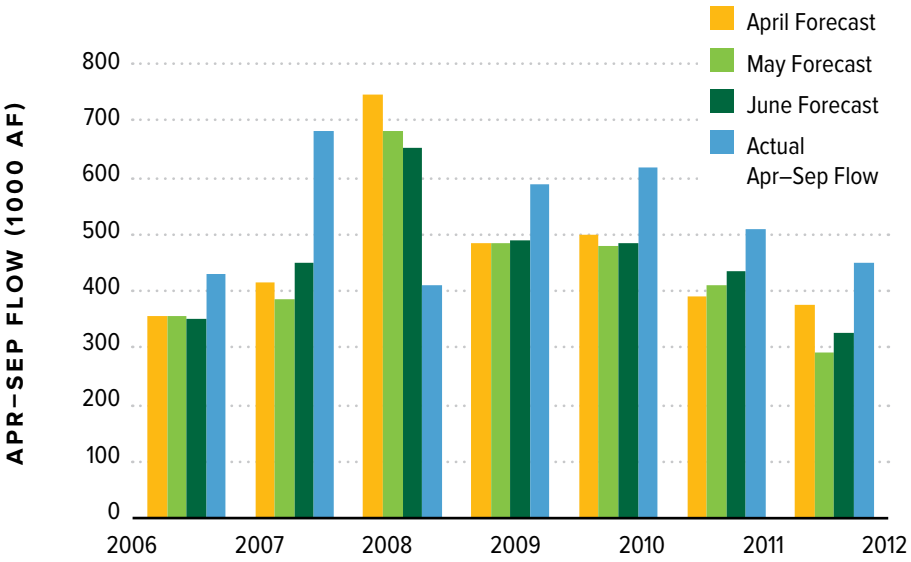



**FIGURE 23.**

NRCS-forecasted and actual April–September flow at the Rio Grande near Del Norte gage.

Sources: U.S. Department of Agriculture, Natural Resources Conservation Service, National Water and Climate Center n.d.; U.S. Geological Survey, National Water Information System, USGS 08220000 Rio Grande Near Del Norte, Colo. n.d.

## 5.2.4 : IMPROVING WATERSHED HEALTH

The upper Rio Grande watershed encompasses forests, rangelands, wetlands, riparian areas, and farmlands. Currently, these ecosystems are threatened by water scarcity, erosion, insect outbreaks, wildfire and ensuing floods, decreased biodiversity, and drought. Potential post-wildfire floods and erosion also pose a threat to river function and downstream habitats.

Opportunities exist to enhance the health of the watershed through projects that target improving forest resiliency, safeguarding water supplies, and protecting public safety by altering forest stand structure to include multi-aged trees and building fuel breaks to reduce fire risk. Other opportunities include enhancing soil health by improving grazing management on rangelands and building organic matter on farms to increase the water-holding capacity and resiliency.

Cattle in early morning mist, on the conserved Gilmore Ranch, along the Rio Grande west of Alamosa. Photo: Rio de la Vista

Fireweed growing near Little Squaw Creek after the West Fork Complex Fire. Photo: Heather Dutton

#### 5.2.4.1 IMPROVING FOREST HEALTH

In order to protect the ecosystem services offered by healthy watersheds, such as water supplies and wildlife habitat, projects can be completed to improve public and private forests in the Basin. Management prescriptions vary depending on the species composition and age class of the forest. Ponderosa pine and mixed-conifer forests would benefit from thinning and prescribed fire in order to maintain greater space between trees and frequent burning, as was typical historically. Subalpine spruce-fir forests evolved to grow for long periods of time, up to 400 years, before regenerating through a stand-replacing event, such as a fire, blow down, or insect infestation. While the spruce-fir forests on the RGNF are within the range of the historic disturbance regime, it is unprecedented for a stand of this size to die all at once. It is assumed that drought and climate change have stressed the trees to the point that they are more susceptible to beetle infestations, and a higher proportion of trees have been affected. While this may be the natural progression of the forest, there is concern from land managers and local entities that the massive spruce die-off will lead to significant changes in the watershed. For example, loss of canopy cover could change snowpack accumulation and rate of melt, increase infiltration, and reduce evapotranspiration. It is unknown how these changes will impact the overall amount and timing of inputs to the local water budget. Additionally, there is concern that the dead and dying trees may impact infrastructure, such as power lines, and lead to erratic fire behavior that may inhibit the ability of crews to protect communities while maintaining escape routes and safety zones during wildfires.

Therefore, there are numerous opportunities to improve forest and watershed health by building fire breaks, creating patches of differing age classes, and clearing dead trees from critical infrastructure, such as power lines, roads, and reservoirs. With 85% of the RGNF affected by beetle infestations, there is regional interest in utilizing standing dead trees as a way to remove hazards from the forest while improving the local economy. Findings from a study by the USFS suggest that an opportunity exists to harvest beetle-killed trees, resulting in the benefit of dampening the behavior and intensity of potential future wildfires through reduced fuel loading and tree densities.

The RGNF and Colorado State Forest Service are working to improve forest health and resiliency on public and private lands, respectively. A local, nongovernmental organization that is working with these agencies to improve forest conditions in the Basin is the Rio Grande Watershed Emergency Action Coordination Team (RWEACT). RWEACT, a collaboration of over 70 partners, was formed in the midst of the West Fork Complex Fire in July

River Hill. Photo: Heather Dutton

2013 and has since worked in partnership with the USFS to identify post-wildfire hazard mitigation and watershed stewardship priorities. RWEACT will continue to work to improve watershed health and implement efforts to enhance public safety, while transitioning into a nonprofit organization.

#### 5.2.4.2 POST-WILDFIRE WATERSHED ASSESSMENTS

In 2014, RWEACT recognized the importance of understanding how the WFCF would impact water quality and fisheries conditions within and below the burn scar, as well as water availability in the Basin. RWEACT subsequently partnered with the Colorado School of Mines (CSM) to develop a water quality study on the Upper Rio Grande and a study of the effects of the fire and beetle kill on the hydrographs of the Rio Grande and its tributaries.

The overarching goal of the RWEACT and CSM partnership is to better understand landscape disturbance impacts on water supply (both quantity and quality) in the headwaters of the Rio Grande. In order to achieve this goal, spatial and temporal streamflow and water quality data during the spring runoff season immediately following the West Fork Complex fire were captured. Water quality, fish, insect, and habitat sampling was completed to monitor post-fire effects on aquatic organisms. The findings of the first year of study showed the Rio Grande main stem to be resilient and able to absorb the impacts from the WFCF. Some tributaries, however, experienced significant ash and debris flow events, which resulted in fish kills. RWEACT will continue its water quality monitoring and watershed assessment programs as long as feasible.

Water quality monitoring probe. Photo: Heather Dutton

Farmland and riparian areas along the Rio Grande in the San Luis Valley. Photo: Erich Schlegel

#### 5.2.4.3 IMPROVING WETLANDS AND RIPARIAN HEALTH

Implementation of strategies to improve riparian areas and wetlands in the Basin are aimed at enhancing existing conditions, restoring historical conditions, or shifting conditions towards a new habitat type to help meet limited resources. Many opportunities and ongoing projects exist to improve the Basin's riparian areas. The Rio Grande Headwaters Restoration Project (RGHRP) works to improve the Rio Grande's riparian areas, habitat, floodplain function, ability to supply agriculture users, and opportunities for recreation. The RGHRP, in close partnership with the NRCS, has projects in differing stages of funding, design, implementation, and monitoring. Many other entities, such as CPW, USFWS, USFS, BLM, Willow Creek Reclamation Committee, and Trout Unlimited are also developing and implementing wetland and riparian improvement projects.

Ducks on Rio Grande wetland. Photo: Rio de la Vista

Wetland and riparian management and monitoring plans should be dynamic and informed by the observed changes to habitats over time, resulting from a variety of management strategies. Ultimately, a diverse composition of vegetation communities at various successional stages offers the greatest resources to a wide range of wildlife and aquatic species. Potential management strategies may include burning, mowing/haying, grazing, tilling, herbicide treatments, seeding, drought, and flooding. Other strategies may include the installation of new water control structures,

delivery ditches, and levees. In some cases, the alteration of existing infrastructure, including potentially removing these structures, may occur in order to allow sheet flow across the landscape. The final and critical step in implementing any habitat management plan is the evaluation and monitoring of the plan after methods have been applied. Monitoring of the strategy should occur to determine how each community responds to the prescription and resultant use by wildlife and aquatic species over time.

Southwest Conservation Corp members planting willows. Photo: Heather Dutton

### 5.2.4.4 CONSERVATION EASEMENTS

Colorado's projected population growth will result in further land development for residential, commercial, and industrial uses, and pressure to transfer water from agriculture to meet the water needs of the growing population. Voluntary, incentive-based conservation of private land is one tool that communities have available to work with willing landowners. Conservation easements secure key lands from future development and tie water rights to the land. This is especially effective on sites where agriculture and important wildlife habitat converge. Protecting critical water sources on private land is a key objective in the Basin. Wetland habitat in the Basin is often found on private lands where ranchers irrigate native hay meadows and pastureland for livestock. Protection of these wetland habitat types can help ensure proper drying and flooding cycles while maintaining historic water use patterns in wetland basins that are beneficial to wildlife.

Land protection is a relatively new practice in the Basin, and most conservation easements have been completed since 2000. However, during this short time frame, close to 300,000 acres of land have been protected, which indicates strong public support for land and water protection. Citizens in the Basin understand that the rural way of life, agricultural economy, and extensive wildlife habitat make the area unique, and they seek to protect these attributes. They recognize that conservation easements are a voluntary tool to keep working farms and ranches and water rights intact, along with protecting critical wildlife habitat.

For more information on projects related to improving watershed, wetland, and riparian health as well as conservation easements, see Appendix 5: Constraints and Opportunities, Section 5.2.4: Improving Watershed Health.

Historic barn adjacent to wetlands on the conserved Gilmore Ranch, west of Alamosa. Photo: Rio de la Vista.

## 5.2.5 : STRATEGIC CROP DEVELOPMENT AND IRRIGATION IMPROVEMENTS

Agriculture is the primary economic driver in the Basin. Potatoes, alfalfa, grass hay, canola, oats, quinoa, carrots, lettuce, spinach, honey, wheat, garlic, and pumpkins are crops grown in the Valley. Some Basin producers have expressed interest in growing hemp and, in 2014, several hemp plots were licensed in the Valley.

The amount of water available to irrigators is projected to decrease, as discussed extensively in this Plan. As such, some producers may want to explore opportunities to reduce pumping through alternative cropping rather than drying up productive farm ground. Incorporating alternative crops and farming methods that reduce consumptive water use are opportunities to maintain an economically stable future for agricultural producers but have challenges, as equipment needs and market conditions make switching to new crops complex.

Valley producers may consider growing fewer acres of higher-value crops, such as organics. Demand for locally grown, organic food continues to rise. Assistance for growers wanted to diversify their operations, switch to organic farming altogether, or enter into grower cooperatives would be a great benefit to expanding this option. Local farmers' markets have become a major source of local foods and are now a regular summer-into-fall feature in towns throughout the Valley.

Field of canola near Center, Colo. Photo: Julie Messick

Center-pivot irrigated alfalfa fields. Photo © Adriel Heisey / www.adrielheisey.com

Growers can also reduce water use by incorporating green manure into their crop rotation. Green manure is a mix of crops, such as mustards, radishes, and sorghum-sudan grass, which is specifically grown to be turned into the soil. Green manures improve soil health, as discussed in **Section 5.2.6: Improving Soil Health**, and require less water to go than other rotational crops. While the grower would not be selling a product in these years, the improvement to their operations has been shown to pay back the investment in green manure.

Farmers can also consider improved technology to reduce water use. Conversion from flood irrigation practices to higher-efficiency methods, such as those using pressurized sprinklers, micro sprays, and drip systems, can decrease the amount of water needed to apply to a crop; however, these methods may not reduce the overall consumptive use and will likely lead to a reduction in aquifer recharge. A careful analysis is required when evaluating the savings from increased efficiency. There are water savings through such methods as drip irrigation that will be realized through reduced evaporation losses. In addition to more efficient water use, the subsurface irrigation system may produce a higher quality of crop with less herbicides and pesticides required. However, the widespread viability of subsurface irrigation has not yet been demonstrated in the Valley.

Improved water management techniques, such as irrigation scheduling, can also boost efficiency without reducing crop yields. Finally, such practices as deficit irrigation — giving crops just enough water to produce a minimal profit — may be a noteworthy technique for water rights holders on the cusp of receiving deliveries.

For more information on alternative cropping and increased irrigation efficiency for agriculture — and on related projects in these areas — see Appendix 5: Constraints and Opportunities, Section 5.2.5: Strategic Crop Development and Irrigation Improvements.

Moving cattle on the conserved Rio Oxbow Ranch, above Creede. Photo: Rio de la Vista

## 5.2.6 : IMPROVING SOIL HEALTH

The potential for enhancing soil health in the Basin is a vital component of improved water management and has a proven track record of providing increased agricultural production, reducing the use of chemicals and irrigation, and increasing the water-holding capacity, organic matter, and beneficial microbes in soils. Similarly, improved grazing management on rangelands can build soil health, thereby enhancing water-holding capacity, stream and aquifer recharge, forage productivity for both livestock and wildlife, and diverse species composition.

**Farming and ranching practices that increase soil health can help reduce water demands in the long term.**

Farming and ranching practices that increase soil health can help reduce water demands in the long term. Some Valley farmers and ranchers have focused on soil health through grazing management on rangelands and pastures and, where possible, reintegrating livestock into cropland management. Using livestock to harvest crop residue helps to break down plant material and to provide natural fertilizer that helps return nutrients to the land to complete several nutrient cycles.

Farmers have adopted biotic approaches that include adding soil primers, such as companion crops like legumes and green manure crops that enrich the soil, in rotation with potato crops. Green manures — crops grown to be tilled into the soil — are also quite popular, as they improve organic matter and reduce harmful microbes. The water savings from these methods are substantial, with some operations saving up to six inches of water for the rotation crops and up to four inches of water for the potatoes. Using less water protects potatoes against blight and rot, and keeps fields from getting waterlogged, helping to safeguard the crop while saving money on sprinkler and pumping costs.

In addition to local farmer actions, the Rio Grande Water Conservation District (RGWCD) is partnering with the Center Conservation District on a large-scale Soil Health Project. The RGWCD obtained property that allows the organization to put in place soil health improvement practices, including rotating crops of potatoes and various cover crops. The RGWCD wants to illustrate to agricultural producers in the San Luis Valley and elsewhere that by having healthy soil, farmers and ranchers can achieve numerous benefits, including minimizing soil erosion, protecting water and air quality, and enhancing water quantity, while protecting agricultural yields. The Soil Health Project also shows that healthy soils require application of less water when growing crops and reduce wind erosion.

Spuds! Photo: Heather Dutton

Soil health also impacts the accumulation of dust on snow. Three factors are required for dust production: winds sufficient to suspend soil particles, exposed soils (often through the reduction of vegetation), and soils having characteristics making them vulnerable to wind erosion. Adopting dust- and wind-reducing land management strategies and practices can help keep snow on mountains longer. Constructing physical windbreaks or planting vegetation can reduce wind speeds at ground level. Vegetative cover reduces soil exposure; thus, sites currently dominated by annual plants (e.g., abandoned croplands and heavily disturbed sites) can be rehabilitated by establishment of perennial grasses and shrubs that provide protection, even in drought years. Managing lands for increased ground cover through good grazing practices while reducing detrimental disturbances, such as those from off-road vehicles, can also help reduce dust sources. There are many opportunities for dust mitigation on private lands, and additional research is needed to determine the most effective strategies.

For more information on improving soil health and related projects, see Appendix 5: Constraints and Opportunities, Section 5.2.6: Improving Soil Health.

Haying on the conserved Shadow Ranch, south of Monte Vista. Photo: Rio de la Vista

## 5.3 : RIO GRANDE BASIN PLANNING MODEL

A surface water model was developed to better characterize constraints and opportunities that face the Basin in the future, including identification of supply and demand imbalances. An existing RiverWare model that was developed as part of the Rio Grande Cooperative Project was adapted for use on the Rio Grande and Conejos River systems, incorporating data developed through the RGDSS, where available and appropriate.

RiverWare is a river and reservoir modeling platform developed by the Center for Advanced Decision Support for Water and Environmental Systems (CADSWES) at the University of Colorado (http://www.riverware.org). Through the Basin modeling effort, characteristics of the Basin with regards to hydrology, physical infrastructure, water rights, demands, and legal and administrative policy are captured. The model allows for the assessment of future conditions, including:

- climate change
- wildfires
- dust on snow events
- infrastructure projects
- changed water rights
- changes in administrative policy

Flexibility in the RiverWare modeling platform allows for simulation of variable reservoir operations and administration of the Rio Grande Compact. The Rio Grande Basin Planning Model simulates multiple reservoir accounts in the Rio Grande, Continental, Santa Maria, Beaver Park, and Platoro reservoirs. The model also incorporates much of the logic used by

Rio Grande near Rio Grande Canal headgate. Photo: Arista Hickman

the Division Engineer to determine the Compact curtailment. Despite the differences between modeled and historical curtailment, the model matches the Division Engineer's ability to deliver an appropriate amount of water annually to New Mexico under the terms of the Rio Grande Compact without accruing a large debit or credit.

### 5.3.1 : ADJUSTED HYDROLOGY

The historical hydrology of the Basin was adjusted in several ways to account for climate change, dust on snow, beetle kill, and forest fires. These adjusted hydrologic inflows were then used as input to the RiverWare model to assess how the changes to the river inflow affect irrigation, reservoir operations, the Rio Grande Compact, and all other modeled components of the Basin's surface water.

Table 6 shows average changes from historical inflow hydrology to the Rio Grande and Conejos River with adjusted hydrologic inflows. All of the climatic and environmental changes modeled cause a shift to earlier runoff than experienced from the historical 1980–2008 period. Dust on snow events are estimated to cause a three- to six-week shift to earlier runoff due to lower albedo and higher rates of evaporation. Similarly, forest fires and beetle kill cause a decrease in canopy cover and lower rates of insolation, resulting in a one- to three-week shift to earlier runoff. Climate change projections for the Rio Grande predict an average six-day-earlier runoff between 2009–2038 and 12-day-earlier runoff between 2067–2096. The Conejos River Basin is expected to experience an even greater shift, with runoff arriving 10 days earlier between 2009–2038 and 14 days earlier between 2067–2096.

| | Rio Grande Inflow Volume | Rio Grande Inflow Timing | Conejos Inflow Volume | Conejos Inflow Timing |
|---|---|---|---|---|
| Climate Change 2009–2037 | -18% | 6 days earlier | -16% | 10 days earlier |
| Climate Change 2038–2066 | -32% | 9 days earlier | -16% | 13 days earlier |
| Climate Change 2067–2096 | -42% | 12 days earlier | -20% | 14 days earlier |
| Dust on Snow | -5% | 21 days earlier | -5% | 21 days earlier |
| Beetle Kill | +5% | 7 days earlier | +5% | 7 days earlier |
| Forest Fire | +5% | 14 days earlier | +5% | 14 days earlier |

**TABLE 6.**

Statistics from projected inflows used in the RiverWare Basin Planning Model.

## 5.3.2 : MODEL RUNS OF DIFFERENT HYDROLOGIC SCENARIOS

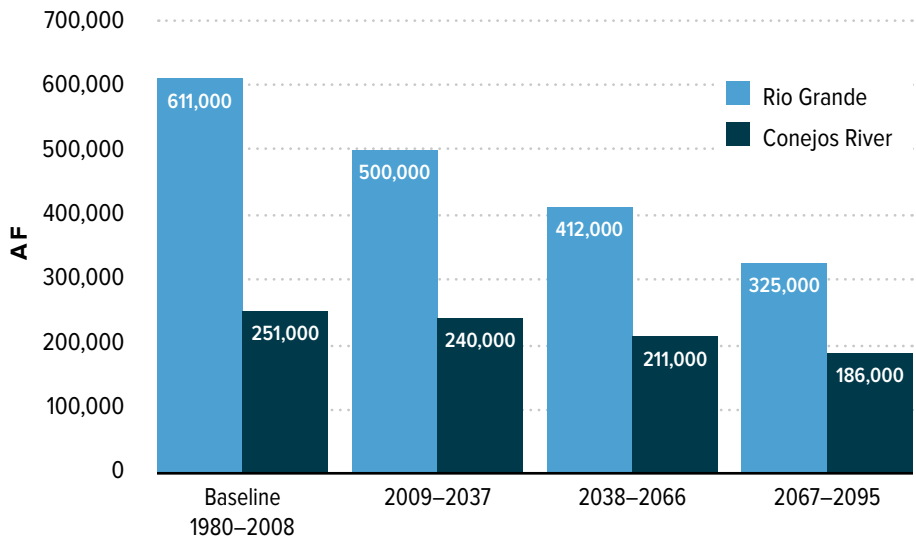
The RiverWare Basin Planning Model was used in conjunction with the predicted hydrologic inflows to model the effects of predicted climatic and environmental changes in the Basin and their effects on the surface water system. Model runs show that throughout the 21st century, climate change will have a drastic impact on diversions in the Rio Grande and Conejos River basins (Figure 24). From 2009–2037, diversions from the Rio Grande are expected to decrease by 18% while diversions from the Conejos are expected to decrease by 4%. From 2038–2066, diversions from the Rio Grande and Conejos River are expected to decrease by 33% and 16%, respectively, and from 2067–2095, diversions from the Rio Grande and Conejos River are expected to decrease by 47% and 26%, respectively.

The "Big 6 Canals" that divert from the Rio Grande (Rio Grande, Farmers Union, San Luis, Empire, Monte Vista, and Prairie) are responsible for the majority of the water diversions and are vitally important to the agricultural economy in the Valley. They have many unique water rights and can take advantage of storage in several reservoirs through storage and direct flow water rights with alternative delivery locations. Under various alternative hydrology scenarios, each canal will respond differently based on the priority of its water rights and storage. For example, very senior water rights will not be affected by an average reduction in flow, and very junior water rights may also be in priority nearly as often if high-flow events happen as often as they have historically. Water rights that come in and out of priority near historically average flows may be the most seriously affected by an average decrease in flow expected under climate change conditions, as the hydrograph will rise above the priority threshold for a smaller amount of time each year. Similarly, with an increase in flow and change of timing expected in areas affected by beetle kill and forest fire, some water rights may benefit from a

**FIGURE 24.**

Anticipated diversions from the Rio Grande and Conejos River under climate change conditions in the 21st century.

The climate change projections are the average results from five sets of climate change inputs during each time period.



small increase in average flow, as they will be in priority more frequently. Under the climate change scenarios from 2038–2066, all of the Big 6 Canals see reductions in diversions. On average, diversions by the Big 6 Canals under the climate change scenarios decrease by 43%.

The RiverWare Basin Planning Model will be used to evaluate projects and their ability to maximize opportunities and address constraints. The Rio Grande Cooperative Project has already been evaluated using this model; results show that the Rio Grande and Beaver Park reservoirs can work in conjunction to better utilize CPW's water rights and provide storage space in the Rio Grande Reservoir for river administration and retiming of deliveries for streamflow enhancements without impacting downstream water rights.

The Rio Grande canal begins just above Del Norte. Photo © Adriel Heisey / www.adrielheisey.com

## 5.3.3 : BOATABLE DAYS

The Rio Grande Basin Planning Model was used to quantify the number of days that are deemed passable for boats through several reaches on the Rio Grande main stem (boatable days). The model was used to quantify the number of days under current hydrological conditions and then predict the number of boatable days under climate change conditions. Low-flow thresholds for several boating reaches were provided by Kevin Terry of Trout Unlimited (TU), spanning from below Rio Grande Reservoir to Del Norte. The flow thresholds are based on TU's discussions with recreational water users and are shown in Table 7.

**TABLE 7.**

Flow thresholds for boatable days.

Source: Terry 2015

| Reach | Boatable Flow Threshold (cfs) |
|---|---|
| Below Rio Grande Reservoir through Box Canyon | 350 |
| Deep Creek to Wagon Wheel Gap | 350 |
| Wagon Wheel Gap to Upper Coller | 400 |
| South Fork to Del Norte | 300 |

The number of boatable days at each location was totaled using the historical gage records, the baseline model run (which simulates current hydrological conditions), and the three climate change hydrology time periods discussed in **Section 5.3.2: Model Runs of Different Hydrologic Scenarios** (2009–2037, 2038–2066, and 2067–2095). The results are shown in Figure 25 for all scenarios; the number of boatable days is projected to decrease by about 10% for the earlier 2009–2037 period, and by about 33% for the later climate change periods. The decreases occur primarily during the late summer and early autumn months (July, August, September, and October). The boatable days results are presented by month in Appendix 5: Constraints and Opportunities, Section 5.3.3: Boatable Days.

These results are part of Phase 1 of the Boatable Days Flow Evaluation Project described in **Section 6.2**. Phase 2 of the project contemplates design of reservoir releases to increase the number of boatable days, likely as part of a larger multiple-benefit project, such as the Rio Grande Cooperative Project.

For more information about the model development, configuration, components, testing, calibration, and model run results, see Appendix 5: Constraints and Opportunities, Section 5.3: Basin Planning Model.

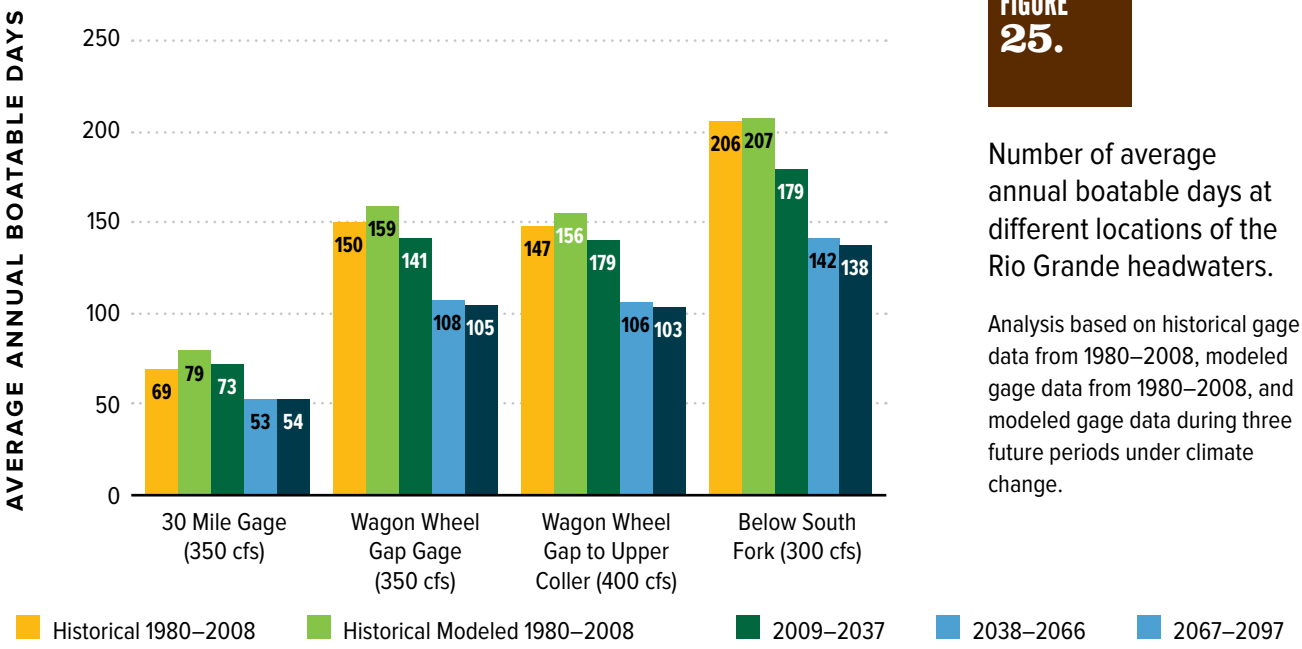



**FIGURE 25.**

Number of average annual boatable days at different locations of the Rio Grande headwaters.

Analysis based on historical gage data from 1980–2008, modeled gage data from 1980–2008, and modeled gage data during three future periods under climate change.

Boat on the bank of the Rio Grande in the Rio Grande Natural Area. Photo: Emma Regier

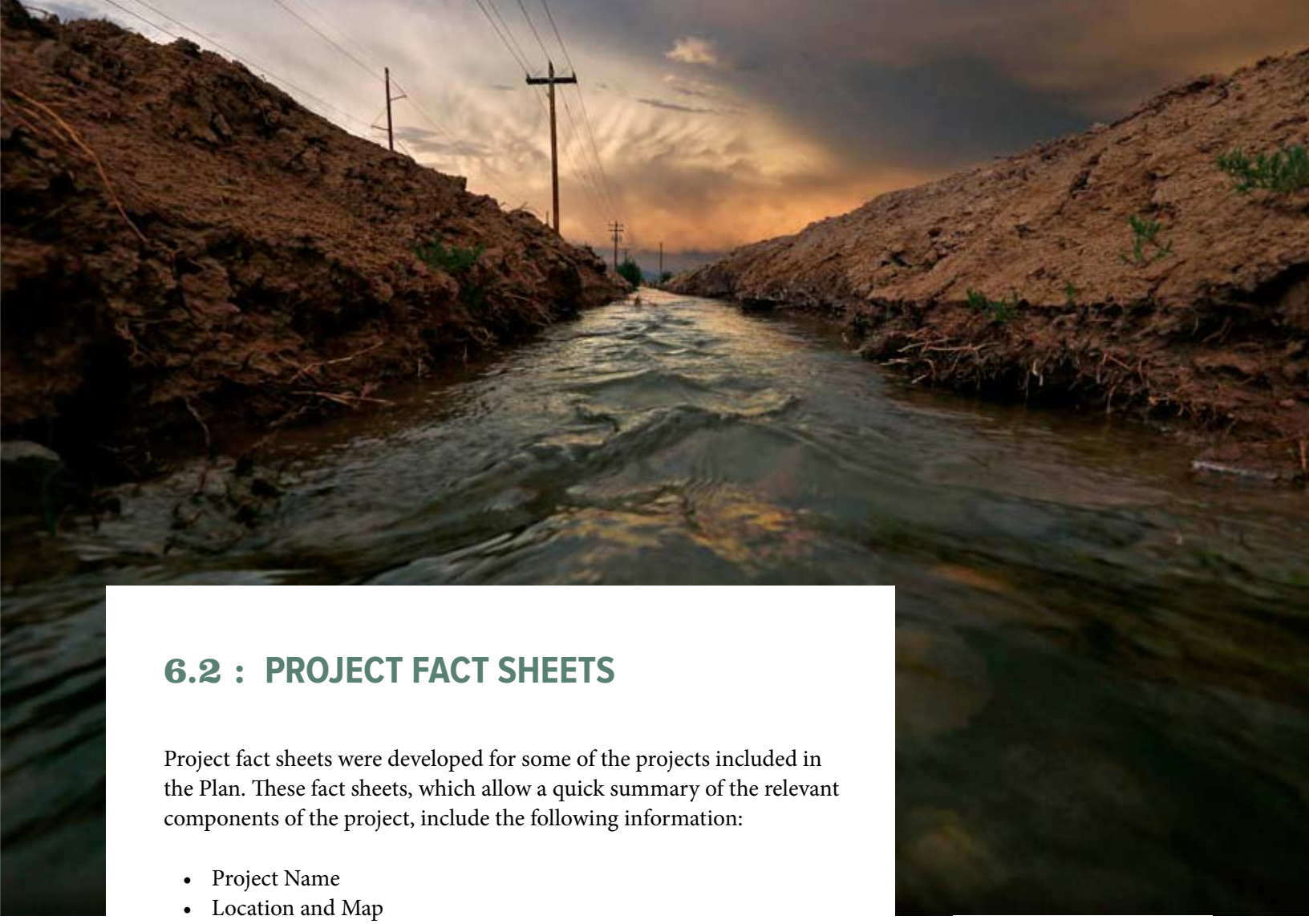
# 6 PROJECTS AND METHODS

This section identifies projects and methods that meet the goals listed in Section 3, address the needs identified in Section 4, and factor in the constraints and opportunities described in Section 5. The projects and methods are designed to help minimize the impacts on agriculture and the Valley way of life, while protecting the environment and recreation opportunities. The projects, methods, and the overall Plan represent a holistic approach to water management; healthy watersheds and soils, along with rehabilitated reservoirs and diversion structures, can provide the resiliency to adapt to changing conditions and lead to a sustainable water future for multiple uses.

Discharge from a confined aquifer artesian well. Photo: Kelly DiNatale

## 6.1 : INTRODUCTION

Identifying relevant projects and methods is the next step in the development of the Basin's path forward. The RGBRT recognizes that other projects will be developed in the future and that several of the projects listed in this Plan have not been evaluated by the full RGBRT. The identification and prioritization of projects will be dynamic, 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. While criteria do not currently exist for project ranking, they may be developed in the future. This Plan is a living document that will be updated periodically as additional information is collected and new focus areas are identified.



Sunset on the Monte Vista Canal. Photo: Erich Schegel

## 6.2 : PROJECT FACT SHEETS

Project fact sheets were developed for some of the projects included in the Plan. These fact sheets, which allow a quick summary of the relevant components of the project, include the following information:

- Project Name
- Location and Map
- Sponsor(s)
- Uses and Needs Met
- Plan Goals and Needs Met
- Description and Picture
- Estimated Project Costs (2014) – Estimated total project costs and timeline
- Potential Funding Collaboration/Sources
- Project Schedule and Budget – Estimated project costs for funding purposes for the following general categories:
  - Preliminary Design Analysis
  - Permitting
  - Land Acquisition
  - Final Design
  - Construction
  - Surveying, Inspection, Legal, and Administration
  - Contingency or Fiscal Agent Fee if applicable
- WSRA Funding
- Project Beneficiaries

# PROJECT FACT SHEET

## Boatable Days Flow Evaluation

Evaluate the impacts of various hydrologic scenarios on the number of days specific reaches of the Rio Grande are considered passable by boat (boatable days). Flow thresholds will be determined by survey of the boating community. The project will be split into two phases:

Phase 1: Utilize existing model runs being developed as part of the Rio Grande Basin Implementation Plan and assess the impact of such scenarios.

Phase 2: Develop multiple-benefit project operations that would target enhancing the number of boatable days.

**LOCATION**

Rio Grande main stem from Rio Grande Reservoir to Del Norte

**SPONSORS**

Trout Unlimited

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | Phase 1: $2,000<br>Phase 2: $17,500 |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | Phase 1: funding included in RGBIP |
| **PROJECT TIMELINE** | <1 year (Phase 1)<br>1–3 years (Phase 2) |
| **PROJECT START DATE** | Phase 1: 2015 |
| **WSRA FUNDING OPTION** | – Statewide – Basin |

**PROJECT BENEFICIARIES** *(Direct and Indirect)*

Recreational users, aquatic habitat

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Phase 1 Flow evaluation with existing model runs | 1 | $2,000 |
| Phase 2: Survey development/ deployment | 1 | $5,000 |
| Phase 2: Multi-benefit project operational evaluation | 1–3 | $8,000 |
| Phase 2: Modeling of multi-benefit project operation for boatable days | 1–3 | $3,000 |
| Contingency (10%) | 1–3 | $1,500 |
| Total | 1–3 | $19,500 |
| **Total** | | **$1,500,000** |

**BASIN PLAN GOALS / NEEDS MET**

**PHASE 1**

14. Maintain and enhance water-dependent recreational activities.

**PHASE 2**

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
2. Protect and preserve the doctrine of prior appropriation and vested water rights, and fully utilize Colorado's compact entitlements as specified under the Rio Grande and Costilla Creek compacts.
6. Support the development of projects and methods that have multiple benefits for agriculture, municipal and industrial, and environmental and recreational water needs.
7. Meet new demands for water, to the extent practicable, without impacting existing water rights and compact obligations.
10. Promote water management and administration practices that are adaptive, flexible, and responsive to optimize multiple benefits.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.
13. Work to sustain active river flows throughout the year in cooperation with water users and administrators to restore and sustain ecological function of the rivers and floodplain habitats within the context of existing water rights and compact obligations.
14. Maintain and enhance water-dependent recreational activities.

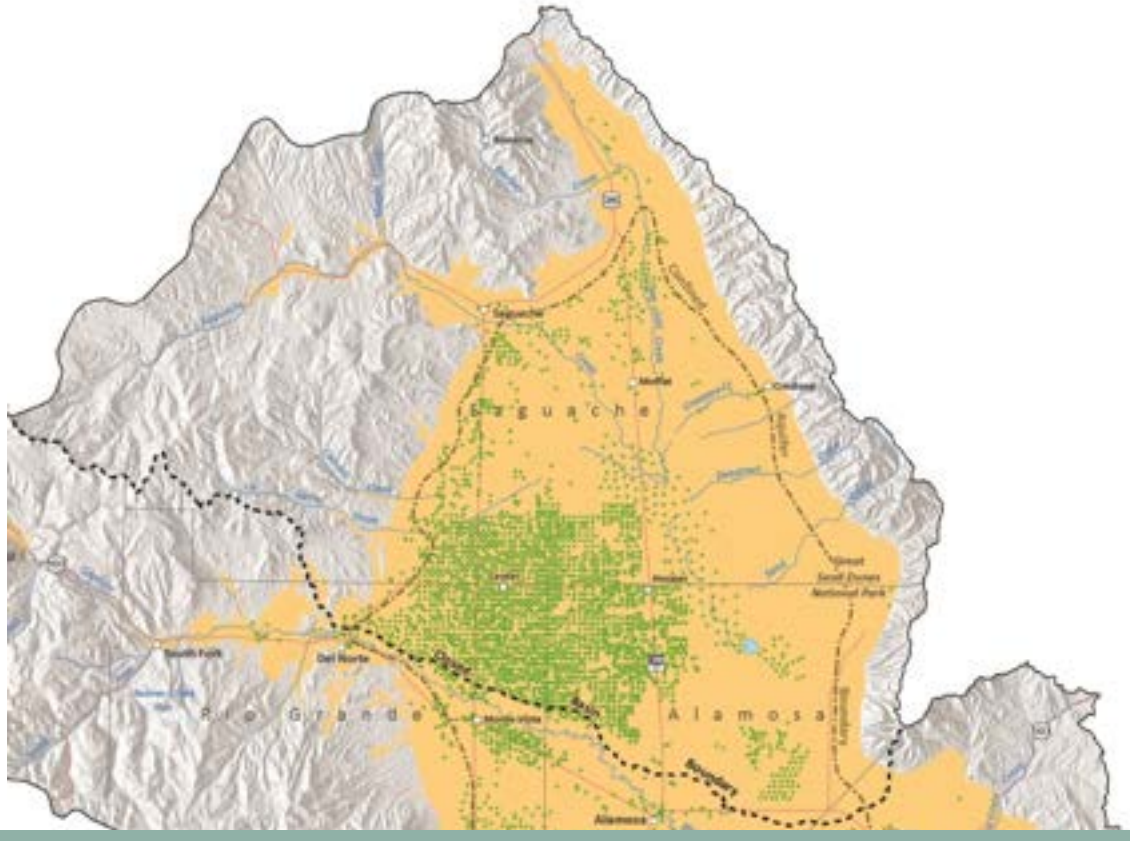
**USES / NEEDS MET**

- – Agricultural
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- – Other

# Closed Basin River/Creek and Wetland Water Table Study



Ephemeral and perennial creeks in the Closed Basin historically flowed from the north and west to the sump area at what is now the BLM Blanca Wetland Management Area. Current climatic and pumping conditions have lowered the water table and prevented creeks from flowing to this area for some time. A study is needed to determine how the water table fluctuates in these areas annually on public and private lands in order to better understand the connectivity of the system, the impact of different water uses, and how agencies and landowners can work together to help maintain a higher and more stable water table. This Study would utilize piezometers with data loggers installed at various locations to document fluctuations in groundwater across historic creek channels. Data could then be collected and analyzed over several years in order to help quantify annual variation. This study would also help show if different management strategies in Subdistrict #1 are affecting water tables across land ownership.



# Closed Basin River/Creek and Wetland Water Table Study



## LOCATION

Creeks and associated wetlands in the Closed Basin from the north and west to the sump area

## SPONSORS

RiGHT, Wetland Dynamics, LLC, BLM, CPW, TNC, Sub-district #1
(These are potential partners, to be confirmed)

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | TBD |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | BLM, CPW, TNC, Intermountain West Joint Venture |
| **PROJECT TIMELINE** | 2015–2020 |
| **PROJECT START DATE** | March 2015 |
| **WSRA FUNDING OPTION** | – Statewide ✓ **Basin** |

## PROJECT BENEFICIARIES *(Direct and Indirect)*

San Luis Valley federal, state, organizations, private landowners

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Preliminary Design Analysis | 2 months | |
| Permitting | | |
| Land Acquisition | NA | |
| Final Design | 2 months | |
| Construction | 1 month | |
| Surveying, Inspection, Legal, and Administration | | |
| Analysis and Reporting | Annually for 5 years | |
| **Total** | | |

## BASIN PLAN GOALS / NEEDS MET

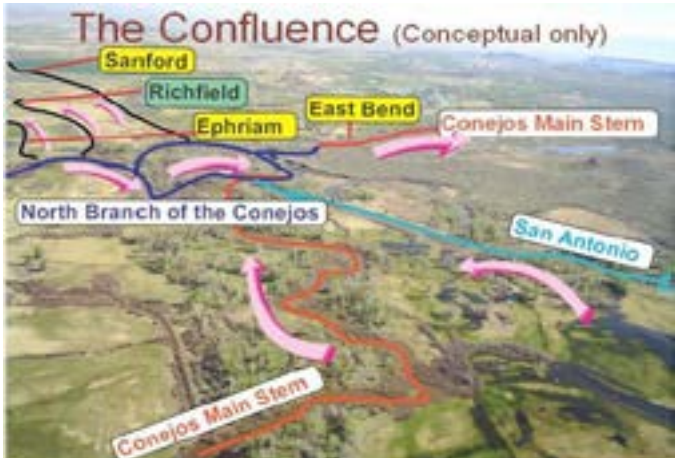
1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
2. Protect and preserve the doctrine of prior appropriation and vested water rights, and fully utilize Colorado's compact entitlements as specified under the Rio Grande and Costilla compacts.
3. Sustain the confined and unconfined aquifer in accordance with Senate Bill 04-222 and operate within the State Engineers new Rules and Regulations for the San Luis Valley.
4. Operate, maintain, rehabilitate, and create necessary infrastructure to meet the Basin's long-term water needs, including storage.
6. Support the development of projects and methods that have multiple benefits for agricultural, municipal and industrial, and environmental and recreational water needs.
10. Promote water management and administration practices that are adaptive, flexible, and responsive to optimize multiple benefits.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.
13. Work to establish active river flows throughout the year in cooperation with water users and administrators to restore and sustain ecological function of the rivers and floodplain habitats within the context of existing water rights and compact obligations.
14. Maintain and enhance water dependent recreational activities.

**USES / NEEDS MET**

- ✓ **Agricultural**
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- ✓ **Other**

# PROJECT FACT SHEET

## Conejos River System Confluence Management Project




The project extends the Conejos Water Conservancy District's whole-river strategy to (1) improve, replace, or install new diversion structures on critical reaches of the Conejos River; (2) extend the growing network of electronic gaging stations and automated control gates within the District; and (3) gain precise knowledge about water flows in this complex region by installing additional web-based telemetry to these three ditch systems. Grant and loan funds will be used to construct concrete core and diversion structures at the Sanford, Ephraim, and East Bend canal diversions; to equip the three diversions with weirs and automated control gates; and to quantify and communicate those flows to the District through a web-based system of telemetry.

**LOCATION**

Conejos Subbasin

**SPONSORS**

Conejos Water Conservancy District

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $584,000 |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | Ditch companies, loans, Conejos Water Conservancy District, NRCS Engineering, WSRA funding |
| **PROJECT TIMELINE** | 2014–2016 |
| **PROJECT START DATE** | 2014 |
| **WSRA FUNDING OPTION** | ✓ **Statewide** ✓ **Basin** |

**USES / NEEDS MET**

- ✓ **Agricultural**
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- – Other

**PROJECT BENEFICIARIES** *(Direct and Indirect)*

Ditch irrigators, river administrators, conservationist, recreational users, communities

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Final Design and Feasibility | 2014 | $55,000 |
| Construction | 2014–2016 | $480,000 |
| Surveying, Inspection, Legal, and Administration | 2014–2016 | $49,000 |
| **Total** | | **$584,000** |

**BASIN PLAN GOALS / NEEDS MET**

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
2. Protect and preserve the doctrine of prior appropriation and vested water rights, and fully utilize Colorado's compact entitlements as specified under the Rio Grande and Costilla Creek compacts.
4. Operate, maintain, rehabilitate, and create necessary infrastructure to meet the Basin's long-term water needs, including storage.
5. Manage water use to sustain optimal agricultural economy throughout the Basin's communities.
6. Support the development of projects and methods that have multiple benefits for agriculture, municipal and industrial, and environmental and recreational water needs.
10. Promote water management and administration practices that are adaptive, flexible, and responsive to optimize multiple benefits.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.
14. Maintain and enhance water-dependent recreational activities.

# PROJECT FACT SHEET

## Consolidated Ditch Diversion and Headgate Rehabilitation Project

The Consolidated Ditch diversion dam and headgate are aging and poorly functioning. The Project includes replacing the existing diversion with a more stable dam that includes fish and boat passage, and replacing the headgates with a new concrete gate structure with automated gates. Riparian areas in the project reach will be stabilized and vegetation will be restored.

### LOCATION

Rio Grande in Rio Grande County, upstream of Stoeber Lane

### SPONSORS

Colorado Rio Grande Restoration Foundation, NRCS, private landowners

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $1,500,000 |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | NRCS, private landowners, in-kind |
| **PROJECT TIMELINE** | 2014–2017 |
| **PROJECT START DATE** | Fall 2014 |
| **WSRA FUNDING OPTION** | – Statewide – Basin |

### PROJECT BENEFICIARIES *(Direct and Indirect)*

The Project will improve diversion efficiency, reduce ditch maintenance, enhance riparian and aquatic habitat, improve recreation, enhance water quality, and improve Compact accounting. In addition to providing great benefits to the nine ditch companies that are served by the diversion and headgates, the Project will benefit the local habitat and economy.

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Project Design | 2014–2015 | $200,000 |
| Diversion Replacement | 2016 | $820,000 |
| Headgate Replacement | 2016 | $325,000 |
| Riparian Restoration | 2016 | $100,000 |
| Monitoring | 2017 | $10,000 |
| Administration | 2014–2017 | $45,000 |
| **Total** | | **$1,500,000** |

### BASIN PLAN GOALS / NEEDS MET

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
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9. Make progress toward meeting applicable water quality standards throughout the Basin.
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11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.
14. Maintain and enhance water-dependent recreational activities.

**USES / NEEDS MET**

- ✓ **Agricultural**
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- – Other

# PROJECT FACT SHEET

## Doppler Radar Weather Forecasting Project

Develop and deploy a mobile Doppler on Wheels (DOW) program for the upper Rio Grande Basin

### LOCATION

Upper Rio Grande River Basin

### SPONSORS

RWEACT, CWCB, USFS, NWS

| | | |
|---|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $ 75,000 per year for 5 years. Approximately $375,000 total. | |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | RWEACT, CWCB, USFS, NWS | |
| **PROJECT TIMELINE** | 2014–2018 | |
| **PROJECT START DATE** | September 2013 | |
| **WSRA FUNDING OPTION** | ✓ **Statewide** | ✓ **Basin** |

### PROJECT BENEFICIARIES *(Direct and Indirect)*

The residents of the Basin and all water users and administrators, water recreationists, the NWS, and natural resource agencies and organizations.

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Preliminary Design Analysis | 2014–18 | |
| Permitting | N/A | |
| Land Acquisition | N/A | |
| Final Design | 2014 | |
| Construction/deployment | 2014–18 | $375,000 |
| Surveying, Inspection, Legal, and Administration | | |
| Fiscal Agent Fee | 5% | $18,750 |
| **Total** | | **$393,750** |

### BASIN PLAN GOALS / NEEDS MET

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
2. Protect and preserve the doctrine of prior appropriation and vested water rights, and fully utilize Colorado's compact entitlements as specified under the Rio Grande and Costilla Creek compacts.
6. Support the development of projects and methods that have multiple benefits for agricultural, municipal and industrial, and environmental and recreational water needs.
7. Meet new demands for water, to the extent practicable, without impacting existing water rights and compact obligations.
10. Promote water management and administration practices that are adaptive, flexible, and responsive to optimize multiple benefits.
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13. Work to establish active river flows throughout the year in cooperation with water users and administrators to restore and sustain ecological function of the rivers and floodplain habitats within the context of existing water rights and compact obligations.
14. Maintain and enhance water-dependent recreational activities.

**USES / NEEDS MET**

- ✓ **Agricultural**
- ✓ **Municipal & Industrial**
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- ✓ **Other (Public Safety)**

# PROJECT FACT SHEET

## Economic Impact Statement Analysis of the Effects of Reduced Groundwater Irrigation in the Rio Grande Basin

During the Economic Impact Analysis Study, the SLV COG will identify sectors of the region's economy affected by anticipated reduction in crop production. It will estimate the fiscal impacts of reduced crop production to the regional economy focusing on the impacts to public finance, labor, population, housing, retail, and property values. An economic activity matrix will be established that may be used to assess future crop reduction in the region. Finally, the effects and efficacy of the measures available to mitigate economic impacts of reduced pumping will be analyzed, including landowner incentives, greater irrigation efficiency, alternative crop production, and options for future return of fallowed land to production.

**LOCATION**

Rio Grande Basin

**SPONSORS**

San Luis Valley Council of Governments

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $80,400 |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | WSRA, DOLA, and in-kind contributions |
| **PROJECT TIMELINE** | 2 years |
| **PROJECT START DATE** | 2015 |
| **WSRA FUNDING OPTION** | – Statewide ✓ **Basin** |

**PROJECT BENEFICIARIES** *(Direct and Indirect)*

Irrigators who use groundwater and need to augment well depletions. Local and regional economic planners.

**BASIN PLAN GOALS / NEEDS MET**

2. Protect and preserve the doctrine of prior appropriation and vested water rights, and fully utilize Colorado's compact entitlements as specified under the Rio Grande and Costilla compacts.
3. Sustain the confined and unconfined aquifer in accordance with Senate Bill 04-222 and operate within the State Engineer's new Rules and Regulations for San Luis Valley.
5. Manage water use to sustain optimal agricultural economy throughout the Basin's communities.
8. Establish a long-term education and outreach effort for water use and needs in San Luis Valley / Rio Grande Basin.

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Economic Impact Analysis | 2015–2016 | $68,600 |
| Project Management | 2015–2016 | $8,100 |
| Publication | May 2016 | $1,000 |
| Public Meetings | June 2016 | $1,500 |
| Administration | 2015–2016 | $1,200 |
| **Total** | **2015–2016** | **$80,400** |

**USES / NEEDS MET**

- ✓ **Agricultural**
- – Municipal & Industrial
- – Environmental & Recreational
- – Water Administration
- – Other (Public Safety)

# PROJECT FACT SHEET

## Groundwater Management Subdistricts

### LOCATION

Rio Grande Basin, confined and unconfined aquifer outside of Subdistrict #1

| | | |
|---|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $66,000,000 | |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | Conservation Reserve Enhancement Program | |
| **PROJECT TIMELINE** | 15 years | |
| **PROJECT START DATE** | Ongoing | |
| **WSRA FUNDING OPTION** | ✓ **Statewide** | ✓ **Basin** |

### PROJECT BENEFICIARIES *(Direct and Indirect)*

Landowners; surface and groundwater irrigators; senior water users; agricultural industry support, including alfalfa, potato, grain, and small vegetable production within processing facilities in the Valley and bordering states; agricultural equipment sales and service; municipal water providers; industrial water users; Colorado Parks and Wildlife; Colorado Division of Water Resources; wetlands, fish hatcheries, and hunting habitat for small upland game.

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Project Schedule | Years | Preliminary Estimated Budget |
| Engineering and Modeling | 2015–2030 | $5,000,000 |
| Land Fallowing, Soil Health Improvements, and Other Incentives | 2015–2030 | $15,000,000 |
| Acquisition of Augmentation Water and Storage | 2015–2030 | 25,000,000 |
| Legal | 2015–2030 | $5,000,000 |
| Administration | 2015–2030 | $5,000,000 |
| Contingency | 2015–2030 | $11,000,000 |
| **Total** | | **$66,000,000** |

NOTE: This is a preliminary estimated budget until response functions are received and the additional five subdistricts are formed.

The overall objective of the Groundwater Management Subdistricts is to provide a water management alternative to state–imposed regulations that limits the use of irrigation wells. The subdistricts will use a system of self–regulation, including economic–based incentives that promote responsible irrigation water use and management and insure the protection of senior surface water rights. The Conservation District is actively working with landowners throughout the Valley to create subdistricts that will promote sustainability of the Valley's complex aquifer system and to prevent material injury to senior surface water rights while ensuring continued economic viability of the Valley's agricultural practices by avoiding a mass shutoff of wells without regard for the unique hydro–geologic makeup of the Valley.

### SPONSORS

Rio Grande Water Conservation District

### BASIN PLAN GOALS / NEEDS MET

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function
3. Sustain the confined and unconfined aquifers in accordance with Senate Bill 04–222 and operate within the State Engineer's new Rules and Regulations for the San Luis Valley.
5. Manage water use to sustain optimal agricultural economy throughout the Basin's communities.
6. Support the development of projects and methods that have multiple benefits for agriculture, municipal and industrial, and environmental and recreational water needs.
10. Promote water management and administration practices that are adaptive, flexible, and responsive to optimize multiple benefits.
12. Conserve, restore and maintain wetlands and riparian areas for the benefit of a healthy watershed.

**USES / NEEDS MET**

- ✓ **Agricultural**
- ✓ **Municipal & Industrial**
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- – Other

# PROJECT FACT SHEET

## Hydrologic Recharge Feasibility Study for Rio Grande Basin Augmentation

**LOCATION**

Rio Grande Basin, Conejos County

**SPONSORS**

San Luis Valley Irrigation Well Owners, Inc.

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $180,000 for Phase 1 |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | SLV Well Owners, Base and State WSRA |
| **PROJECT TIMELINE** | 2014 |
| **PROJECT START DATE** | June 2014 |
| **WSRA FUNDING OPTION** | ✓ **Statewide** ✓ **Basin** |

**USES / NEEDS MET**

- ✓ **Agricultural**
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- – Other

**PROJECT BENEFICIARIES** *(Direct and Indirect)*

Well owners, water administrators, Basin communities, recreational users, and irrigators

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Groundwater Monitoring | 2014 | $12,000 |
| Evaluate Surface Water Storage Options | 2014 | $15,000 |
| Pilot Groundwater Recharge Testing | 2014 | $30,160 |
| Aquifer Testing, Piezometers and Gradients | 2014 | $92,050 |
| Surveying, Inspection, Legal, and Administration | 2014 | $30,790 |
| **Total** | | **$180,000** |

Phase I of the overall Project will provide the Board of Directors with options with which they can make a decision on how to structure an augmentation plan. This feasibility study will also provide the majority of the engineering work needed to support and to implement the subsequent augmentation plan. Future phases will depend on the decisions formed from the outcome of this initial study; however, SLVIWO envisions that Phase 2 will develop the physical infrastructure to accomplish the plan. This phase will potentially require investing in the development of an augmentation station, recharge basins, perhaps pipelines or ditch linings, or perhaps a change in point of diversion, so that SLVIWO can physically get the Taos Valley No. 3 water to the locations where it needs to be stored or recharged. Phase 3 will involve submitting an application for an augmentation plan to Water Court and working through the subsequent proceedings required to adjudicate the plan.

**BASIN PLAN GOALS / NEEDS MET**

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
2. Protect and preserve the doctrine of prior appropriation and vested water rights, and fully utilize Colorado's compact entitlements as specified under the Rio Grande and Costilla Creek compacts.
3. Sustain the confined and unconfined aquifers in accordance with Senate Bill 04-222 and operate within the State Engineer's new Rules and Regulations for the San Luis Valley.
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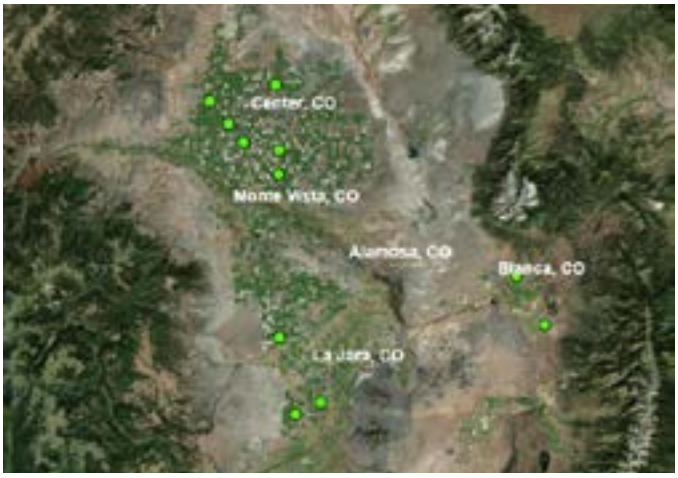
10. Promote water management and administration practices that are adaptive, flexible, and responsive to optimize multiple benefits.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.

# PROJECT FACT SHEET

## Increasing Water Holding Capacity of Soil for Agriculture Sustainability in the San Luis Valley




The purpose of this Project is to document soil health improvement levels in areas across the San Luis Valley. The Project will detail the agronomic feasibility of soil health by defining the methods, time frame, and economics of adopting these practices while growing a variety of crops in a variety of soil types. The Project will address how growers can produce economically profitable yields using less water by improving farm soil health and the potential water savings, given the crop and location. This Project will implement the practices, develop the metrics, analyze the data, and field test the economics of soil health in the San Luis Valley.

**LOCATION**

San Luis Valley

**SPONSORS**

Rio Grande Watershed Conservation and Education Initiative

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $5,403,160 |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | Landowners, NRCS, Basin WSRA |
| **PROJECT TIMELINE** | 2014–2017 |
| **PROJECT START DATE** | Fall 2014 |
| **WSRA FUNDING OPTION** | – Statewide ✓ **Basin** |

**PROJECT BENEFICIARIES** *(Direct and Indirect)*

Conejos County, Colorado Parks and Wildlife, State Land Board, Trout Unlimited

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Testing | | $25,000 |
| Soil Preparation | | $4,946,840 |
| Nutrient Management | | $299,520 |
| Monitoring | | $18,600 |
| Analysis | | $7,000 |
| Outreach and Education and Administration | | $106,200 |
| **Total** | | **$5,403,160** |

**BASIN PLAN GOALS / NEEDS MET**

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
2. Protect and preserve the doctrine of prior appropriation and vested water rights, and fully utilize Colorado's compact entitlements as specified under the Rio Grande and Costilla Creek compacts.
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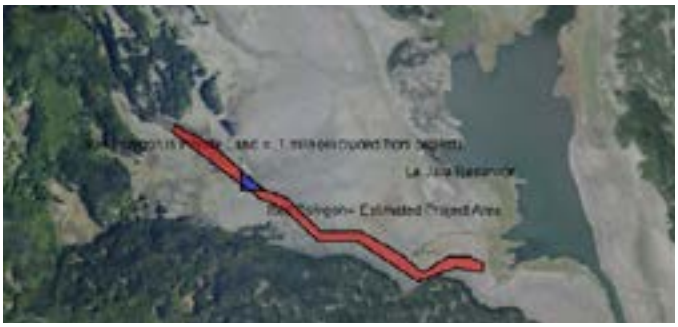
9. Make progress toward meeting applicable water quality standards throughout the Basin.
10. Promote water management and administration practices that are adaptive, flexible, and responsive to optimize multiple benefits.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.

**USES / NEEDS MET**

- ✓ **Agricultural**
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- – Water Administration
- ✓ **Other**

# PROJECT FACT SHEET

## Jim Creek Riparian Protection and Restoration Project



Approximately 5 miles of fencing will protect 2.5 miles of Jim Creek from continued erosion and habitat loss caused by cattle grazing activities, and the fence will create a riparian buffer area of at least 30 acres. By eliminating cattle grazing in the riparian buffer area and the damage caused by trampling in the stream channel and along its banks, the stream and its riparian area will begin a natural recovery. The fence will be designed with input from grazing lessees to ensure that their operations are not adversely affected, allowing for appropriately spaced access to the stream for watering and crossing of livestock. The Rio Grande cutthroat is a candidate for ESA listing, and this partnership with ranchers will protect the stream while allowing ranching operations to continue, therefore providing both a higher level of security for the future of their operations and the conservation population of native trout that resides in Jim Creek.

**LOCATION**

La Jara Creek, Conejos County

**SPONSORS**

Conejos County, Trout Unlimited, State Land Board, Colorado Mountain Club, volunteers for Outdoor Colorado

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $30,000 |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | GOCO, Rio Grande Basin Roundtable |
| **PROJECT TIMELINE** | 2–3 years |
| **PROJECT START DATE** | 2014 |
| **WSRA FUNDING OPTION** | – Statewide ✓ **Basin** |

**PROJECT BENEFICIARIES** *(Direct and Indirect)*

Conejos County, Colorado Parks and Wildlife, State Land Board, Trout Unlimited

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Preliminary Design Analysis | 2014 | In-Kind |
| Permitting | N/A | |
| Land Acquisition | N/A | |
| Final Design | 2014 | <$1,000 |
| Construction | 2014–2016 | $29,000 |
| Surveying, Inspection, Legal, and Administration | 2015 | In Kind |
| Contingency | 2014–2016 | Carryover |
| **Total** | | **$30,000** |

**BASIN PLAN GOALS / NEEDS MET**

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
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11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.

**USES / NEEDS MET**

- ✓ **Agricultural**
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- – Water Administration
- ✓ **Other**

# PROJECT FACT SHEET

## Kerber Creek Restoration Project – Middle Parcel

Restoration of six acres of mine tailings contained within the floodplain site. The reclamation of these mine tailings would coincide with 5,900 feet of instream improvements planned for 2015 by the National Resource Conservation Service (NRCS). While instream work improves aquatic habitat, bank stability, and floodplain reconnection, it does not treat the contaminated mine tailings that exist throughout. These mine tailings should be treated and stabilized in conjunction with instream work to improve short- and long-term bank stability through vegetation establishment. TU will institute phytostabilization as the treatment method of choice for the associated mine tailings.

### LOCATION

Rio Grande, Kerber Creek

### PROJECT BENEFICIARIES *(Direct and Indirect)*

Agricultural users, private landowners, downstream communities, the watershed species, and the environment

### SPONSORS

Trout Unlimited

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $278,000 |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | TU grant, Basin WSRA, Division of Reclamation Mining and Safety, NRCS |
| **PROJECT TIMELINE** | 2015–2016 |
| **PROJECT START DATE** | 2015 |
| **WSRA FUNDING OPTION** | – Statewide ✓ **Basin** |

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Clean-up of mine tailings | 2015–2016 | $57,000 |
| In-stream restoration | 2015–2016 | $208,000 |
| Monitoring | 2015–2016 | $5,000 |
| Project Administration | 2015–2016 | $8,000 |
| **Total** | | **$278,000** |

### BASIN PLAN GOALS / NEEDS MET

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
5. Manage water use to sustain optimal agricultural economy throughout the Basin's communities.
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### USES / NEEDS MET

- ✓ **Agricultural**
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- – Water Administration
- – Other

# PROJECT FACT SHEET

## Mountain Home Reservoir Dam Repair

Rehabilitation of the Mountain Home Reservoir dam outlet works will improve dam safety and reliable water level management of the reservoir. The State is now requiring TIC to repair or upgrade the gates and to restore full operating capability at Mountain Home Reservoir. The Project will also provide improved water storage management and reduced storage loss (which currently amounts to 1,350 to 2,250 AF annually). Finally, improved outlet works will provide protection of the CPW conservation pool and enhancement of environmental, recreational, and wildlife habitat assets.

### LOCATION

Costilla County, Colorado


### SPONSORS

Trinchera Irrigation Company

| | | |
|---|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $ 500,000 | |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | CWCB/WSRA + a loan component + NRCS + CPW | |
| **PROJECT TIMELINE** | 2015–2016 | |
| **PROJECT START DATE** | 2015 | |
| **WSRA FUNDING OPTION** | ✓ **Statewide** | ✓ **Basin** |

### PROJECT BENEFICIARIES *(Direct and Indirect)*

TIC, farmers and ranchers
CPW, general public, recreation and sport fishing enthusiasts
Riparian areas and wildlife habitat

### BASIN PLAN GOALS / NEEDS MET

4. Operate, maintain, rehabilitate, and create necessary infrastructure to meet the Basin's long-term water needs, including storage.
5. Manage water use to sustain optimal agricultural economy throughout the Basin's communities.
6. Support the development of projects and methods that have multiple benefits for agricultural, municipal and industrial, and environmental and recreational water needs.
7. Meet new demands for water, to the extent practicable, without impacting existing water rights and compact obligations.
14. Maintain and enhance water-dependent recreational activities.

**USES / NEEDS MET**

- ✓ **Agricultural**
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- – Other

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Preliminary Design Analysis | 2015 | $20,000 |
| Permitting | n/a | n/a |
| Land Acquisition | n/a | n/a |
| Final Design | 2015 | $20,000 |
| Construction | 2015–2016 | $350,000 |
| Surveying, Inspection, Legal, and Administration | 2015–2016 | $100,000 |
| Contingency | 2015–2016 | $10,000 |
| **Total** | **2015–2016** | **$500,000** |

# The Plaza Project – Phase 3: Prairie Ditch Implementation Project



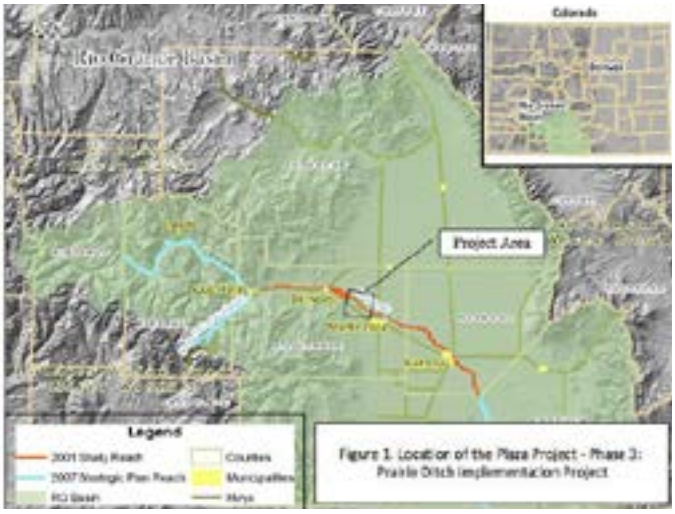



Figure 1. Location of the Plaza Project - Phase 3: Prairie Ditch Implementation Project

The objectives of Phase 3 are to (1) improve diversion efficiency and reduce maintenance by replacing the aging Prairie Ditch headgate, installing automated water gates, and replacing the Prairie Ditch diversion dam; (2) enhance water quality by reducing erosion and sediment input; (3) improve riparian condition by stabilizing up to 1,000 feet of stream banks in the project area; (4) increase the capacity of the Rio Grande to transport sediment; (5) improve aquatic and wildlife habitat; (6) enhance local recreation by including fish and boat passage in the new diversion dam; and (7) promote public involvement in water improvement activities through public outreach and education.

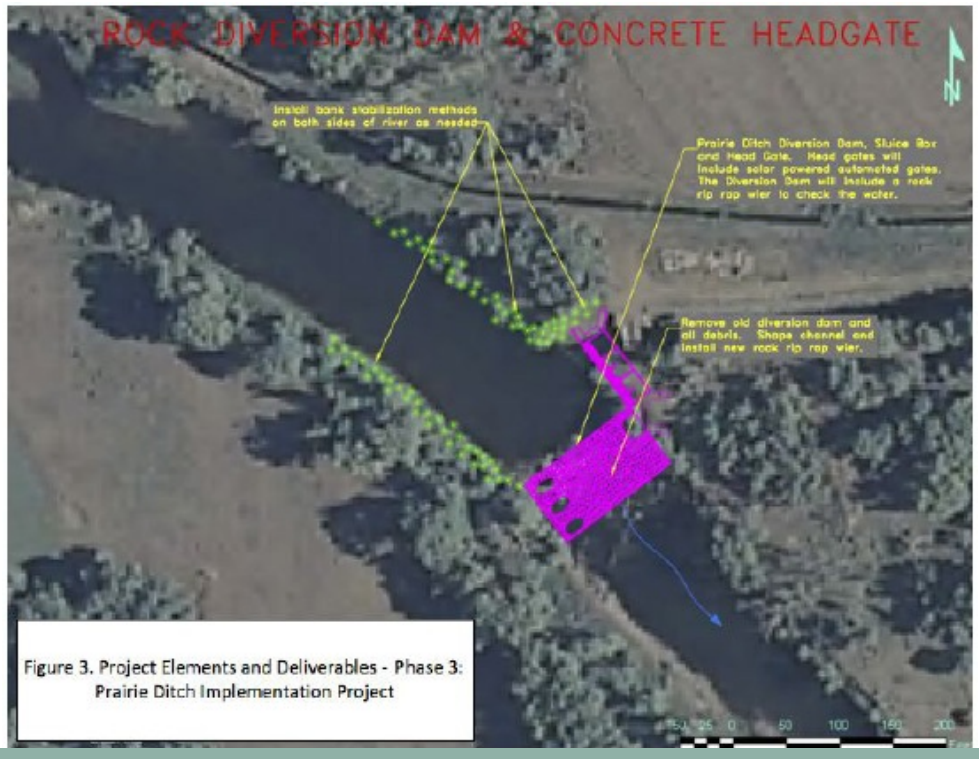



Figure 3. Project Elements and Deliverables - Phase 3: Prairie Ditch Implementation Project

# PROJECT FACT SHEET

## The Plaza Project – Phase 3: Prairie Ditch Implementation Project



### LOCATION

Rio Grande in Rio Grande County

### SPONSORS

Colorado Rio Grande Restoration Foundation

| | | |
|---|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $975,000 | |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | Rio Grande Basin WSRA, statewide WSRA, Cooperative Conservation Partnership Initiative, landowners, in-kind services | |
| **PROJECT TIMELINE** | 2014–2017 | |
| **PROJECT START DATE** | Spring 2014 | |
| **WSRA FUNDING OPTION** | ✓ **Statewide** | ✓ **Basin** |

### PROJECT BENEFICIARIES *(Direct and Indirect)*

Prairie ditch irrigators, landowners, farmers, ranchers, San Luis Valley nonprofits and organizations, recreators, special districts, Rio Grande County, and State and federal agencies

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Finalize Design | 2014 | $90,000 |
| Diversion Replacement | 2014 | 481,000 |
| Headgate Replacement | 2014 | 332,000 |
| Channel Shaping and Stream Bank Stabilization | 2014–2015 | $12,000 |
| Monitoring | 2015–2017 | $4,500 |
| Outreach and Education | 2014–2017 | $3,500 |
| Administration | 2014–2017 | $52,000 |
| **Total** | | **$975,000** |

### BASIN PLAN GOALS / NEEDS MET

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
2. Protect and preserve the doctrine of prior appropriation and vested water rights, and fully utilize Colorado's compact entitlements as specified under the Rio Grande and Costilla Creek compacts.
4. Operate, maintain, rehabilitate, and create necessary infrastructure to meet the Basin's long-term water needs, including storage.
5. Manage water use to sustain optimal agricultural economy throughout the Basin's communities.
6. Support the development of projects and methods that have multiple benefits for agriculture, municipal and industrial, and environmental and recreational water needs.
8. Establish a long-term education and outreach effort for water use and needs in San Luis Valley / Rio Grande Basin.
9. Make progress toward meeting applicable water quality standards throughout the Basin.
10. Promote water management and administration practices that are adaptive, flexible, and responsive to optimize multiple benefits.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.
14. Maintain and enhance water-dependent recreational activities.

**USES / NEEDS MET**

- ✓ **Agricultural**
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- – Water Administration
- – Other

# PROJECT FACT SHEET

## Post-Fire Lynx Habitat Assessment Study

Study lynx habitat use for forest restoration projects. NEPA analysis on USFS projects.

### BASIN PLAN GOALS / NEEDS MET

**11.** Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.

**12.** Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.

### USES / NEEDS MET

- – Agricultural
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- – Other

### LOCATION

Rio Grande National Forest

### SPONSORS

USFS, CPW, RWEACT

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $78,750 |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | USFS, CPW, RWEACT, Rio Grande Basin |
| **PROJECT TIMELINE** | 2 years |
| **PROJECT START DATE** | 2016 |
| **WSRA FUNDING OPTION** | – Statewide ✓ **Basin** |

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Preliminary Design Analysis | N/A | |
| Permitting | N/A | |
| Land Acquisition | N/A | |
| Equipment and Staff | 2016–2017 | $35,000 |
| Project Implementation | 2016–2017 | $40,000 |
| Surveying, Inspection, Legal, and Administration | | |
| Fiscal Agent Fee 5% | | $3,750 |
| **Total** | | **$78,750** |

### PROJECT BENEFICIARIES *(Direct and Indirect)*

Water administrators and users in RG Basin, Forest Service, CPW, RWEACT, citizens, and public lands users

# PROJECT FACT SHEET

## Post-Fire Test Plot Project

Burned tree removal, seeding, mulching, and monitoring of 1-acre test plots on USFS lands.

### LOCATION

FS 520 Road and Crooked Creek

### SPONSORS

RWEACT/USFS and CRGRF

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $5,000 |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | RWEACT, cost share with mulch company |
| **PROJECT TIMELINE** | 2014–2015 |
| **PROJECT START DATE** | October 2013 |
| **WSRA FUNDING OPTION** | – Statewide ✓ **Basin** |

### PROJECT BENEFICIARIES *(Direct and Indirect)*

USFS, private landowners, public land users

### BASIN PLAN GOALS / NEEDS MET

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.

**USES / NEEDS MET**

- – Agricultural
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- – Water Administration
- – Other

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Preliminary Design Analysis | 2014 | $5,000 |
| Permitting | N/A | |
| Land Acquisition | N/A | |
| Final Design | 2014 | |
| Construction | 2014–2015 | |
| Surveying, Inspection, Legal, and Administration | | |
| Fiscal Agent Fee | 5% | $200 |
| **Total** | | **$5,200** |

# PROJECT FACT SHEET

## Rehabilitation of Richfield Canal Core and Diversion at Confluence of Rio San Antonio and the Conejos River


Construct two concrete diversion dams with sluice and turnout on the Conejos River to protect stream banks, divert irrigation water, and prevent over-payment to the Rio Grande Compact. This Project establishes the infrastructure, installs the technology, and improves the management practices for Richfield to more equitably deliver water to all of its shareholders. By improving safety and stability of structures, it ensures continued deliveries throughout the system and provides significant reductions in maintenance. This project will cure multiple problems and practices that are ineffective, expensive, and cause problems to the riparian areas and main stem of the Conejos River, providing benefits to water quality and fishery, stream bank stability, riparian habitat, and the safety of downstream recreational activities.

### LOCATION

Rio Grande Basin, Conejos River watershed, Conejos County, Subdistrict #3

### SPONSORS

Richfield Canal Company

| | | |
|---|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $240,000 | |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | CWCB Loan | |
| **PROJECT TIMELINE** | 1.5 years | |
| **PROJECT START DATE** | Spring 2016 | |
| **WSRA FUNDING OPTION** | ✓ **Statewide** | ✓ **Basin** |

### PROJECT BENEFICIARIES *(Direct and Indirect)*

Richfield participants, consisting of 45 users, serving 6,080 irrigated acres. Neighboring and collaborating diversions of Sanford Canal Company, Ephraim Ditch Company, and East Bend Ditch. Integrates system into gaging stations and telemetry of Conejos Water Conservancy District. Helps Colorado not to over- or under-pay the Rio Grande Compact.

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Preliminary Design Analysis | 2014 | |
| Permitting | | |
| Land Acquisition | | |
| Final Design | 2015 | |
| Construction | 2016–2018 | $240,000 |
| Surveying, Inspection, Legal, and Administration | 2015 | |
| Contingency | | |
| **Total** | | **$240,000** |

### BASIN PLAN GOALS / NEEDS MET

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
2. Protect and preserve the doctrine of prior appropriation and vested water rights and fully utilize Colorado's compact entitlements as specified under the Rio Grande and Costilla Compacts.
4. Operate, maintain, rehabilitate, and create necessary infrastructure to meet the Basin's long-term water needs, including storage.
5. Manage water use to sustain optimal agricultural economy throughout the Basin's communities.
6. Support the development of projects and methods that have multiple benefits for agricultural, municipal and industrial, and environmental and recreational water needs.
9. Make progress toward meeting applicable water quality standards throughout the Basin.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.
14. Maintain and enhance water-dependent recreational activities.

**USES / NEEDS MET**

- ✓ **Agricultural**
- – Municipal & Industrial
- – Environmental & Recreational
- ✓ **Water Administration**
- – Other

# PROJECT FACT SHEET

## Rio Culebra Community Watershed Plan

Rio Culebra Watershed stakeholders have attempted several times to create a comprehensive watershed plan, but lack of local capacity has hindered the completion of these efforts. The Sangre de Cristo Acequia Association has taken the lead, forming the Culebra Watershed Working Group, and has partnered with the Colorado Watershed Assembly to complete The Rio Culebra Community Watershed Plan. Building on previously identified goals and priorities, the Plan will identify culturally appropriate solutions to improve natural resource values of the Rio Culebra Watershed.

### LOCATION

Culebra Creek Subbasin, Costilla County, Water District 24

### SPONSORS

Sangre de Cristo Acequia Association

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | TBD (rough estimate of $150 –200,000) |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | Bureau of Reclamation WaterSMART program, Costilla County Conservation District |
| **PROJECT TIMELINE** | 2014–2016 |
| **PROJECT START DATE** | Fall 2014 |
| **WSRA FUNDING OPTION** | – Statewide ✓ **Basin** |

**USES / NEEDS MET**

- ✓ **Agricultural**
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- – Water Administration
- – Other

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Preliminary Design Analysis | 2014 | |
| Permitting | | |
| Land Acquisition | | |
| Final Design | 2016 | |
| Construction | | |
| Surveying, Inspection, Legal, and Administration | 2014–2016 | |
| Contingency | | |
| **Total** | | |

### BASIN PLAN GOALS / NEEDS MET

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
4. Operate, maintain, rehabilitate, and create necessary infrastructure to meet the Basin's long-term water needs, including storage.
5. Manage water use to sustain optimal agricultural economy throughout the Basin's communities.
6. Support the development of projects and methods that have multiple benefits for agricultural, municipal and industrial, and environmental and recreational water needs.
8. Establish a long-term education and outreach effort for water use and needs in San Luis Valley/Rio Grande Basin.
9. Make progress toward meeting applicable water quality standards throughout the Basin.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.

### PROJECT BENEFICIARIES *(Direct and Indirect)*

23,000 privately held acres, mostly farmed under the traditional Hispanic acequia system of irrigation (of national cultural/historic interest). The Town of San Luis and several smaller communities. The watershed supports significant riparian habitat, including habitat for the Rio Grande cutthroat trout, as well as a variety of ecosystem services and recreational interests. Project design analysis will begin in 2014 with final Plan completion in 2016.

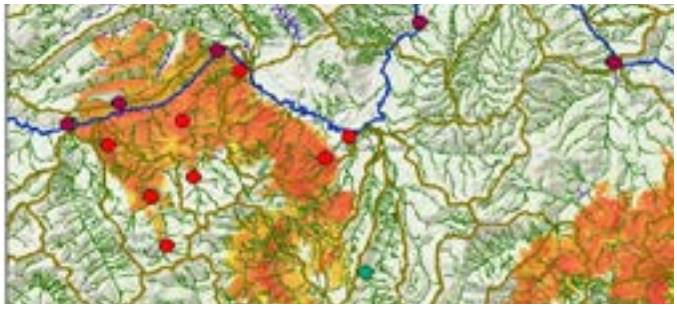
# PROJECT FACT SHEET

## Rio Grande Basin Hydrology Study (Long-Term)

Funds provided by RWEACT for the 2014 summer season and analyzed data will offer the first step to better understanding and quantifying long-term effects forest fires, beetle infestations, and prolonged drought have on stream health and seasonal water supply in the Rio Grande headwaters region. Continued field work will be extended in the Rio Grande. Key data will be attained beginning in the summer of 2015 to be integrated into specific hydrologic models, such as the WRF-Hydro and USGS PRMS-SN Temp hydrologic-stream temperature model.

### LOCATION

Rio Grande River (Headwaters to Del Norte)



*Current and proposed instrumentation in the Papoose burned area.*

### SPONSORS

RWEACT and CRGRF

| | | |
|---|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $115,000 | |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | RGB Funds (WSRA), RWEACT | |
| **PROJECT TIMELINE** | 2015–2019 | |
| **PROJECT START DATE** | June 2015 | |
| **WSRA FUNDING OPTION** | ✓ **Statewide** | ✓ **Basin** |

| **PROJECT SCHEDULE** | **YEARS** | **PROPOSED BUDGET** |
|---|---|---|
| Preliminary Design Analysis | 2014–2015 | |
| Permitting | 2015 | |
| Land Acquisition | N/A | |
| Final Design | 2015 | $118,000 |
| Construction/Implementation | 2015–2019 | |
| Surveying, Inspection, Legal, and Administration | | |
| Fiscal Agent Fee | 5% | $7,000 |
| **Total** | | **$125,000** |

### BASIN PLAN GOALS / NEEDS MET

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
6. Support the development of projects and methods that have multiple benefits for agricultural, municipal and industrial, and environmental and recreational water needs.
9. Make progress toward meeting applicable water quality standards throughout the Basin.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.
14. Maintain and enhance water-dependent recreational activities.

**USES / NEEDS MET**

- ✓ **Agricultural**
- ✓ **Municipal & Industrial**
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- – Other

### PROJECT BENEFICIARIES *(Direct and Indirect)*

All water rights owners, users, recreationists, and the public of the state of Colorado, U.S. Forest Service, and ultimately, the integrity of the watersheds of the Rio Grande Basin.

# PROJECT FACT SHEET

## Rio Grande Cooperative Project

### LOCATION

Rio Grande Reservoir on main stem in Hinsdale County upstream of Creede and Beaver Park Reservoir on Beaver Creek upstream of South Fork

### SPONSORS

San Luis Valley Irrigation District
Colorado Division of Parks and Wildlife (CPW)

| | | |
|---|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $22 million | |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | CWCB and project participants | |
| **PROJECT TIMELINE** | 4 years | |
| **PROJECT START DATE** | 2014 | |
| **WSRA FUNDING OPTION** | ✓ **Statewide** | ✓ **Basin** |

**USES / NEEDS MET**

- ✓ **Agricultural**
- ✓ **Municipal & Industrial**
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- – Other

### PROJECT BENEFICIARIES *(Direct and Indirect)*

San Luis Valley Irrigation District, Colorado Parks and Wildlife, San Luis Valley Water Conservancy District, Groundwater Management Subdistricts, Town of Monte Vista and other towns and users requiring augmentation or storage

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Preliminary Design Analysis | 2012 | Completed |
| Permitting | 2014–2016 | $300,000 |
| Land Acquisition | 2014–2016 | $200,000 |
| Final Design | 2014–2016 | $1,000,000 |
| Construction | 2016–2017 | $16,000,000 |
| Surveying, Inspection, Legal, and Administration | 2014–2017 | $1,000,000 |
| Contingency | | 3,500,000 |
| **Total** | | **$22,000,000** |

The Project's primary objectives are to store and regulate decreed water rights to better meet irrigation and augmentation demands, maximize the use of certain CPW water rights, and to provide storage space in Rio Grande Reservoir for river administration. It is anticipated these objectives can be accomplished through the rehabilitation of the pre-Compact 54,000 AF Rio Grande and 4,500 AF Beaver Park Reservoir as well as coordination of future operations both within and between these two reservoirs.

### BASIN PLAN GOALS / NEEDS MET

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
2. Protect and preserve the doctrine of prior appropriation and vested water rights, and fully utilize Colorado's compact entitlements as specified under the Rio Grande and Costilla Creek compacts.
3. Sustain the confined and unconfined aquifer in accordance with Senate Bill 04-222 and operate within the State Engineer's new Rules and Regulations for the San Luis Valley.
4. Operate, maintain, rehabilitate, and create necessary infrastructure to meet the Basin's long-term water needs, including storage.
5. Manage water use to sustain optimal agricultural economy throughout the Basin's communities.
6. Support the development of projects and methods that have multiple benefits for agricultural, municipal and industrial, and environmental and recreational water needs.
7. Meet new demands for water, to the extent practicable, without impacting existing water rights and compact obligations.
9. Make progress toward meeting applicable water quality standards throughout the Basin.
10. Promote water management and administration practices that are adaptive, flexible, and responsive to optimize multiple benefits.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.
13. Work to establish active river flows throughout the year in cooperation with water users and administrators to restore and sustain ecological function of the rivers and floodplain habitats within the context of existing water rights and compact obligations.
14. Maintain and enhance water-dependent recreational activities.

# PROJECT FACT SHEET

## Rio Grande Cutthroat Trout (RGCT) County Coalition Project

The RGCT County Coalition was established to serve on behalf of the Colorado counties sponsoring the Project. The Coalition was developed with the purpose of creating one, unified entity that will operate to consistently interact with, communicate with, and make official comments to the U.S. Fish and Wildlife Service during the Rio Grande Cutthroat Trout Species Assessment process, potential Proposed Listing Decision Process and any subsequent actions regarding listing of the species under the ESA. The Coalition intends to ensure that reasonable and adequate work is being conducted and shall continue to be conducted to reach the goal of increasing the current abundance, viability, and vitality of the Rio Grande cutthroat trout and its habitat.

### LOCATION

All counties within the Rio Grande Basin (Hinsdale, Mineral, Rio Grande, Conejos, Costilla, Alamosa, Saguache, Archuleta, San Juan) and Las Animas County

### SPONSORS

Colorado Counties of Hinsdale, Mineral, Rio Grande, Conejos, Costilla, Alamosa, Saguache, Archuleta, San Juan and Las Animas

### BASIN PLAN GOALS / NEEDS MET

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.

**USES / NEEDS MET**

- – Agricultural
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- – Water Administration
- – Other

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $40,000 |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | CWCB and project participants |
| **PROJECT TIMELINE** | 2–3 years |
| **PROJECT START DATE** | December 2013 |
| **WSRA FUNDING OPTION** | – Statewide – Basin |

### PROJECT BENEFICIARIES *(Direct and Indirect)*

Rio Grande cutthroat trout species, its habitat, and other species within its habitat

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Preliminary Design Analysis | N/A | |
| Permitting | N/A | |
| Land Acquisition | N/A | |
| Final Design | N/A | |
| Construction | N/A | |
| Surveying, Inspection, Legal, and Administration (Tasks 1.1- 1.4) | 2014–2016 | $38,000 |
| Fiscal Agent Fee | 2014–2016 | $2,000 |
| **Total** | | **$40,000** |

# Rio Grande Headwaters Restoration Project



The Rio Grande Headwaters Restoration Project (RGHRP) (www.riograndeheadwaters.org) was formed to implement the recommendations of a restoration master plan, completed in 2001, for 91 miles of the Rio Grande in Colorado. The 2001 Study was initiated by local stakeholders who recognized the deterioration of the historical functions of the Rio Grande. Sponsored by the San Luis Valley Water Conservancy District and funded with a $200,000 grant from the CWCB, the Study analyzed the condition of the riparian area and structures along the project reach and provided recommendations for improvement.

In 2004, the Colorado Rio Grande Restoration Foundation was established to serve as the governing body and fiscal agent for the Rio Grande Headwaters Restoration Project. In 2007, the RGHRP completed a Watershed Restoration Strategic Plan for the entire Rio Grande Basin in Colorado. The Strategic Plan highlighted additional restoration priorities and the need for continued efforts to implement the recommendations from the 2001 Study.

The mission of the RGHRP is to restore and conserve the historical functions and vitality of the Rio Grande in Colorado for improved water quality, agricultural water use, riparian health, wildlife and aquatic species habitat, recreation, and community safety while meeting the Rio Grande Compact.

The Rio Grande Headwaters Restoration Project works with landowners and local, state, and federal partners to implement the following programs:

**Riparian Restoration and Streambank Stabilization Program:**

The principal program of the RGHRP is the Riparian Restoration and Streambank Stabilization Program. The main environmental goals of the riparian stabilization projects are to improve stabilization of the streambanks, improve riparian and fish habitat, enhance the function of floodplains, and increase capacity of the river to transport sediment. Benefits of the projects are reduced sediment loading, improved water quality, enhanced and increased fish and wildlife habitat, and reduced damage during flood conditions. A typical riparian stabilization project includes bank shaping and installation of streambank stabilization structures. Structures include willow bundles and clump plantings, log structures, and rock structures, including "J" hooks, weirs, and rock barbs. These structures move the flows away from the bank, thereby halting lateral movement of the stream channel and reducing sediment loading; this allows for vegetation to become re-established in the riparian zones. Grazing management and bioengineering enhance the riparian habitat and further stabilize the streambank. The RGHRP has worked with partners and 50 landowners on six projects to improve the condition of over nine miles of streambanks on the Rio Grande. By implementing the recommendations from the 2001 Study across different sections of the Rio Grande, overall continuity and function of the river is improved. Directly, these projects benefit the participating landowners, local water users, and downstream water users. Indirectly, local, state, and regional communities benefit from the enhanced water quality, river function, riparian condition, wetlands, and habitat. These benefits stem from increased land value, water availability and quality, tourism opportunities, and habitat potential.

### Watershed Stewardship Program:

The RGHRP has recognized the need to play a significant role in regional efforts to safeguard the Upper Rio Grande Watershed as a source of water, habitat, and extraordinary natural and cultural resources. As such, the RGHRP is working with stakeholders and partners through RWEACT to complete wildfire restoration and hazard mitigation projects, and will include future projects to improve water security through efforts to reduce the threat of catastrophic wildfire and improve forest health.

### In-Stream Infrastructure Improvement Program:

One of the priorities highlighted by the 2001 Study was the need to address aging and poorly functioning diversion dams and headgates. Many of the existing structures are inefficient, hazardous, and impassible by boats, fish, and wildlife. Through the In-Stream Infrastructure Improvement Program, the RGHRP is working with ditch companies and irrigators to improve and replace poorly functioning diversion dams and headgates. New structures improve diversion efficiency, include state of the art automated headgates, provide fish passage or barriers (as the location indicates), boat passage (where possible and in collaboration with willing landowners), and enhanced wildlife habitat.

### Outreach and Education Program:

The RGHRP administers a robust Outreach and Education Program. Informative press releases are provided to local and regional media with project updates. Talks and tours are routinely given to Rio Grande Basin schools, community groups, and water-related organizations. The volunteer and youth events encourage community members to be involved and connected with the Rio Grande in a direct way. The content of the Outreach and Education program includes details about projects, partnerships, funding entities, and the importance of protecting and conserving the Rio Grande.

Riparian restoration projects are a critical component of the Basin's water plan, as they improve the overall function of the river by improving water quality, floodplain connectivity, riparian and wildlife habitat, agriculture infrastructure, recreation opportunities, and the ability to meet the Rio Grande Compact obligations. In addition, restoration projects indirectly benefit the broader community by increasing land value, water availability and quality, and tourism opportunities.

Overall, the demand for the restoration work on the ground, the studies, and the partnership with other watershed restoration efforts continues to be strong and growing. Thanks to its successes, credibility and abilities, the RGHRP is evolving into one of the overarching watershed organizations for the Rio Grande Basin. It contributes on many levels to the sustainability of the Basin's water management. The demand for its services and, thus, needs for future funding, is expected to be high for the foreseeable future.

See the project sheet for the Consolidated Ditch Diversion and Headgate Rehabilitation Project, which is an example of an RGHRP Project.

# PROJECT FACT SHEET

## Rio Grande Initiative: Conservation Easements

*This photo was taken on the Haywood Ranch, which was supported by the RGBRT and received WSRA funding. The conservation easement was completed at the end of 2013 and protects over 400 acres on the Rio Grande, including a portion of the #1 water right on the river. (Photo: Rio de la Vista)*

RiGHT is continuing its work to implement voluntary, incentive-based conservation easements with willing landowners on working lands along the Rio Grande and Conejos River corridors and elsewhere across the Rio Grande Basin that may protect important conservation values, such as wildlife habitat. These projects provide multiple benefits to sustaining agriculture, protecting wetlands and wildlife habitat, and, in some cases, assisting with water administration through keeping senior water rights and historical water use patterns intact. The photo illustrates the kind of productive agricultural land, with important riparian wildlife habitat, that RiGHT is working to protect.

**LOCATION**

Rio Grande and/or Conejos River corridor

**SPONSORS**

Rio Grande Headwaters Land Trust (RiGHT)

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | Overall: $14 million + |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | GOCO, CPW, North American Wetlands Conservation Act, NRCS's Agricultural Land Easements, private foundations, landowners, and others |
| **PROJECT TIMELINE** | 3–5 years |
| **PROJECT START DATE** | Overall project started in 2007 |
| **WSRA FUNDING OPTION** | ✓ **Statewide** – Basin |

**USES / NEEDS MET**

- ✓ **Agricultural**
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- – Other

**PROJECT BENEFICIARIES** *(Direct and Indirect)*

Direct beneficiaries are the landowners who chose to conserve their land. The overall watershed, a number of wildlife species, the community at large, and DWR (who has supported past projects) all benefit through the completion of these projects.

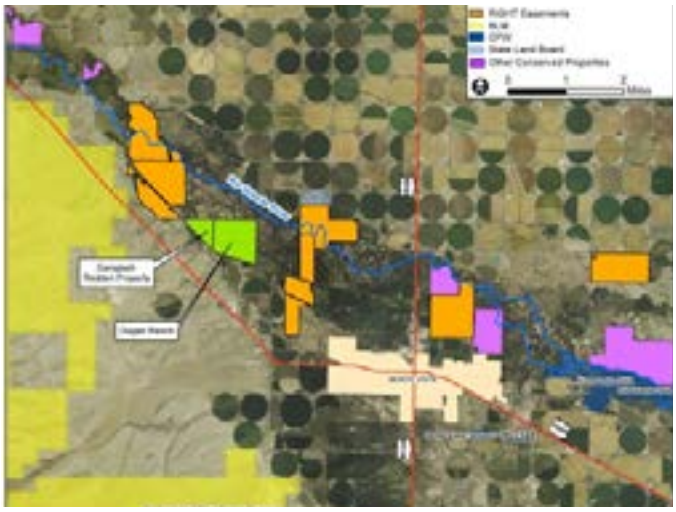
**BASIN PLAN GOALS / NEEDS MET**

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
6. Support the development of projects and methods that have multiple benefits for agricultural, municipal and industrial, and environmental and recreational water needs.
8. Establish a long-term education and outreach effort for water use and needs in San Luis Valley/Rio Grande Basin
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Preliminary Design Analysis | Ongoing | |
| Permitting | | |
| Land Acquisition-Easement Acquisition | When funding secured & due diligence is completed | Approximately $14 million total—typically at least a 70% or more match for WSRA funds |
| Final Design | | |
| Construction | | |
| Surveying, Inspection, Legal, and Administration | | |
| Contingency | | |
| **Total** | **3 to 5 years for next phase of RGI** | |

# PROJECT FACT SHEET

## Rio Grande Initiative: Conservation Easement Projects on the Campbell-Redden Property and Dugan Ranch, Rio Grande County, Colorado



Campbell-Redden Property: Purchase a conservation easement on a 90+ acre Rio Grande floodplain ranch.

Dugan Ranch: Purchase a conservation easement on a 300+ acre Rio Grande floodplain ranch.

The two ranches are adjacent, for a total of over 400 acres conserved.

### LOCATION

Rio Grande Basin, Rio Grande County, Subdistrict #2

### SPONSORS

Rio Grande Headwaters Land Trust

| | | |
|---|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $1,045,000<br>Campbell-Redden Property:<br>WSRA Funding $110,000<br>Dugan Ranch:<br>WSRA Funding $40,000<br>Total WSRA Request: $150,000 | |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | Great Outdoors Colorado (GOCO)—Open Space Grant, Gates Family Foundation (GFF) Focus Area Grant | |
| **PROJECT TIMELINE** | 1.5–2.5 years | |
| **PROJECT START DATE** | November 2014 | |
| **WSRA FUNDING OPTION** | **✓ Statewide** | **✓ Basin** |

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Preliminary Design Analysis | NA | NA |
| Permitting | NA | NA |
| Land Acquisition | 1.5–2.5 years | $1,005,000 |
| Final Design | NA | NA |
| Construction | NA | NA |
| Surveying, Inspection, Legal, and Administration | 1 years | $40,000 |
| Contingency | NA | NA |
| **Total** | **2.5 years** | **$1,045,000** |

### PROJECT BENEFICIARIES *(Direct and Indirect)*

Direct beneficiaries are the landowners who chose to conserve their land. The overall watershed, a number of wildlife species, the community at large, and DWR (who has supported past projects) all benefit through the completion of these projects.

### BASIN PLAN GOALS / NEEDS MET

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
2. Protect and preserve the doctrine of prior appropriation and vested water rights, and fully utilize Colorado's compact entitlements as specified under the Rio Grande and Costilla compacts.
6. Support the development of projects and methods that have multiple benefits for agricultural, municipal and industrial, and environmental and recreational water needs.
8. Establish a long-term education and outreach effort for water use and needs in San Luis Valley / Rio Grande Basin.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed

**USES / NEEDS MET**

- ✓ **Agricultural**
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- – Other

# PROJECT FACT SHEET

## Rio Grande National Forest Plan Revision

### LOCATION

Rio Grande National Forest

Full revision of the Rio Grande National Forest Plan. RWEACT staff will be involved in and facilitate public advocacy with the Forest Service.


### SPONSORS

U.S. Forest Service, RWEACT

| | | |
|---|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $78,750 | |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | CWCB,RWEACT, Rio Grande Basin, RGNF | |
| **PROJECT TIMELINE** | 3 years | |
| **PROJECT START DATE** | January 2015 | |
| **WSRA FUNDING OPTION** | ✓ **Statewide** | ✓ **Basin** |

### PROJECT BENEFICIARIES *(Direct and Indirect)*

All water interests, public land users, citizens of Colorado and the U.S.

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Public Assessment Meetings | 2015 | $5000 |
| NEPA Permitting Analysis | 2015 | $10,000 |
| Plan Development | 2015 – 2017 | $50,000 |
| Additional public outreach and meetings | 2017 | $5,000 |
| Final Review / Revision | 2017 | $5,000 |
| Fiscal Agent Fee 5% | | $3,750 |
| **Total** | | **$78,750** |

### BASIN PLAN GOALS / NEEDS MET

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
6. Support the development of projects and methods that have multiple benefits for agriculture, municipal and industrial, and environmental and recreational water needs.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.
13. Work to sustain active river flows throughout the year in cooperation with water users and administrators to restore and sustain ecological function of the rivers and floodplain habitats within the context of existing water rights and compact obligations.
14. Maintain and enhance water-dependent recreational activities.

**USES / NEEDS MET**

- ✓ **Agricultural**
- ✓ **Municipal & Industrial**
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- – Other

# PROJECT FACT SHEET

## Rio Grande Water Quality Study, Post-Wildfire Impacts

Conduct post-wildfire water quality analysis along Rio Grande main stem from Thirty Mile Campground to Del Norte Gauge. Monitor menu of water quality parameters, flow regimes, flash flood/debris flow events, and effects on aquatic life.

### LOCATION

Rio Grande headwaters, from Thirty Mile Campground to Del Norte

### SPONSORS

RWEACT, FS, Colorado School of Mines

| | | |
|---|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $157,500 | |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | RWEACT, Colorado School of Mines, USFS | |
| **PROJECT TIMELINE** | 2–3 years | |
| **PROJECT START DATE** | 2014 | |
| **WSRA FUNDING OPTION** | ✓ **Statewide** | ✓ **Basin** |

### PROJECT BENEFICIARIES *(Direct and Indirect)*

All water users of the Rio Grande Basin, citizens of both Colorado and the U.S., Compact states downstream, recreationists, anglers, DWR, CDPHE

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Initial Study | 2014–2015 | $60,000 |
| Final Study | 2015–2016 | $60,000 |
| Final Report and Analysis | 2016 | $30,000 |
| Fiscal Agent Fee 5% | | $7,500 |
| **Total** | See specific proposal from Colorado School of Mines | **$157,500** |

### BASIN PLAN GOALS / NEEDS MET

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
4. Operate, maintain, rehabilitate, and create necessary infrastructure to meet the Basin's long-term water needs, including storage.
5. Manage water use to sustain optimal agricultural economy throughout the Basin's communities.
6. Support the development of projects and methods that have multiple benefits for agriculture, municipal and industrial, and environmental and recreational water needs.
8. Establish a long-term education and outreach effort for water use and needs in San Luis Valley / Rio Grande Basin.
9. Make progress toward meeting applicable water quality standards throughout the Basin.
10. Promote water management and administration practices that are adaptive, flexible, and responsive to optimize multiple benefits.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.
13. Work to sustain active river flows throughout the year in cooperation with water users and administrators to restore and sustain ecological function of the rivers and floodplain habitats within the context of existing water rights and compact obligations.
14. Maintain and enhance water-dependent recreational activities.

**USES / NEEDS MET**

- ✓ **Agricultural**
- ✓ **Municipal & Industrial**
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- – Other

# PROJECT FACT SHEET

## Roaring Fork Rio Grande Cutthroat Trout Reclamation Project

Removal of non-native fish and restoration of Rio Grande cutthroat trout.

### LOCATION

Roaring Fork Creek, above Haypress Lake

### SPONSORS

U.S. Forest Service, RWEACT

### BASIN PLAN GOALS / NEEDS MET

**11.** Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.

**USES / NEEDS MET**

- – Agricultural
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- – Water Administration
- – Other

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $50,000 |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | CPW, FS, RWEACT, Rio Grande Basin, CWCB |
| **PROJECT TIMELINE** | 2 Weeks |
| **PROJECT START DATE** | TBD |
| **WSRA FUNDING OPTION** | – Statewide ✓ **Basin** |

### PROJECT BENEFICIARIES *(Direct and Indirect)*

State of Colorado, USFS, Citizens and anglers

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Preliminary Design Analysis | N/A | |
| Permitting | N/A | |
| Land Acquisition | N/A | |
| Final Design | 2015 | $50,000 |
| Construction | N/A | |
| Surveying, Inspection, Legal, and Administration | | |
| Fiscal Agent Fee | | |
| **Total** | | **$50,000** |

# PROJECT FACT SHEET

## SLV LiDAR Analysis for Water Flow Phase I – Rio Grande Corridor

A Light Detection and Ranging Project (LiDAR) was completed through a cooperative effort in 2012 for the entire SLV. This data set offers huge possibilities for use by all beneficiaries of the Rio Grande Basin Implementation Plan if further processed and analyzed. The Rio Grande Headwaters Land Trust, working with other organizations, is seeking funding to provide further analysis of the LiDAR to show how water flows on any parcel of land through structures and around levees, as well as return flows to the river. Phase I will occur along the Rio Grande from west of Monte Vista to the city of Alamosa throughout the 100-year floodplain. Increased water efficiency, effectiveness, and future projects would be a direct result of this analysis.

**LOCATION**

100-year floodplain of Rio Grande: Monte Vista to Alamosa

**SPONSORS**

RiGHT, Wetland Dynamics, LLC, and other partners to be confirmed

| | |
|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | TBD |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | |
| **PROJECT TIMELINE** | 1 year |
| **PROJECT START DATE** | March 2015 |
| **WSRA FUNDING OPTION** | – Statewide ✓ **Basin** |

**USES / NEEDS MET**

- ✓ **Agricultural**
- – Municipal & Industrial
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- ✓ **Other**

**PROJECT BENEFICIARIES** *(Direct and Indirect)*

San Luis Valley federal and State, organizations, private landowners

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Preliminary Design Analysis | <1 | |
| Permitting | NA | |
| Land Acquisition | NA | |
| Final Design | <1 | |
| Construction | NA | |
| Surveying, Inspection, Legal, and Administration | NA | |
| Contingency | NA | |
| **Total** | | |

**BASIN PLAN GOALS / NEEDS MET**

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
2. Protect and preserve the doctrine of prior appropriation and vested water rights, and fully utilize Colorado's compact entitlements as specified under the Rio Grande and Costilla compacts.
3. Sustain the confined and unconfined aquifer in accordance with Senate Bill 04-222 and operate within the State Engineer's new Rules and Regulations for the San Luis Valley.
4. Operate, maintain, rehabilitate, and create necessary infrastructure to meet the Basin's long- term water needs, including storage.
6. Support the development of projects and methods that have multiple benefits for agricultural, municipal and industrial, and environmental and recreational water needs.
10. Promote water management and administration practices that are adaptive, flexible, and responsive to optimize multiple benefits.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
12. Conserve, restore, and maintain wetlands and riparian areas for the benefit of a healthy watershed.
13. Work to establish active river flows throughout the year in cooperation with water users and administrators to restore and sustain ecological function of the rivers and floodplain habitats within the context of existing water rights and compact obligations.
14. Maintain and enhance water dependent recreational activities.

# PROJECT FACT SHEET

## Trujillo Meadows Reservoir Storage

This Project will create operational storage in Trujillo Meadows Reservoir through either an enlargement or acquisition and re-operations of the existing reservoir pool. The purpose is to preserve and enhance agriculture in the Conejos Water Conservancy District and provide a reliable supply of augmentation water for the Towns. In addition, the Project will also provide multiple-objective benefits, including enhanced recreational opportunity (primarily angling) at Trujillo Meadows Reservoir and environmental benefits through enhanced riparian habitat, re-timing and sustained streamflows on the Rio De Los Pinos and on the Conejos below Platoro due to the release of augmentation water to the Towns, and meeting Compact delivery requirements.

### LOCATION

Conejos River Basin, Trujillo Meadows Reservoir in the headwaters of the Rio de Los Pinos, Rio San Antonio, Platoro Reservoir in the headwaters of the Conejos River

### SPONSORS

Conejos Water Conservancy District

### BASIN PLAN GOALS / NEEDS MET

This project meets all goals listed.

**USES / NEEDS MET**

- ✓ **Agricultural**
- ✓ **Municipal & Industrial**
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- – Other

| | | |
|---|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | $15,550,000 | |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | CWCB and project participants | |
| **PROJECT TIMELINE** | 5 years | |
| **PROJECT START DATE** | January 2015 | |
| **WSRA FUNDING OPTION** | ✓ **Statewide** | ✓ **Basin** |

### PROJECT BENEFICIARIES *(Direct and Indirect)*

The Towns of Sanford, Manassa, La Jara, and Romeo; San Antonio agricultural users; Colorado Parks and Wildlife; and the riparian and aquatic environment

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| **Project Schedule** | **Years** | **Proposed Budget** |
| Preliminary Design Analysis | 2015 | $500,000 |
| Permitting | 2015–2018 | $700,000 |
| Land Acquisition | 2014 | $250,000 |
| Final Design | 2016 | $700,000 |
| Construction | 2018–2020 | $9,200,000 |
| Surveying, Inspection, Legal, and Administration | 2015–2020 | $700,000 |
| Contingency | N/A | $3,500,000 |
| **Total** | | **$15,550,000** |

# PROJECT FACT SHEET

## Upper Rio Grande Assessment

Develop a comprehensive assessment of the Upper Rio Grande relative to riparian and upland ecosystem function, habitat condition, water quality, and recreation use. The assessment will identify issues and potential projects to address needs.

### LOCATION

Rio Grande from the Headwaters to South Fork, Colo.

| | | |
|---|---|---|
| **ESTIMATED PROJECT COSTS** *(2014 Dollars)* | The estimated project cost is $450,000 based on previous efforts, such as the 2001 Rio Grande Headwaters Restoration Project Study (2001 Study), which assessed the condition of the Rio Grande between South Fork and the Alamosa/Conejos county line. | |
| **POTENTIAL FUNDING COLLABORATIONS / SOURCES** | USFS, CPW, TU, RGHRP, CWCB, WCRC, RWEACT | |
| **PROJECT TIMELINE** | 2015–2018 | |
| **PROJECT START DATE** | 2015 | |
| **WSRA FUNDING OPTION** | ✓ **Statewide** | ✓ **Basin** |

### PROJECT BENEFICIARIES *(Direct and Indirect)*

All water rights owners and users in the Rio Grande Basin across all venues (agricultural, municipal/industrial, environmental and recreational).

| PROJECT SCHEDULE | YEARS | PROPOSED BUDGET |
|---|---|---|
| Preliminary Design Analysis | 2015 | $50,000 |
| Permitting | NA | |
| Land Acquisition | N/A | |
| Final Design | 2016 | $50,000 |
| Construction | 2016–2018 | $350,000 |
| Surveying, Inspection, Legal, and Administration | N/A | |
| Fiscal Agent Fee | N/A | |
| **Total** | | **$450,000** |

### SPONSORS

Colorado Rio Grande Restoration Foundation

### BASIN PLAN GOALS / NEEDS MET

1. Protect, preserve, and/or restore the sustainability of the Rio Grande Basin watersheds by focusing on the watershed health and ecosystem function.
4. Operate, maintain, rehabilitate, and create necessary infrastructure to meet the Basin's long-term water needs, including storage.
6. Support the development of projects and methods that have multiple benefits for agriculture, municipal and industrial, and environmental and recreational water needs.
7. Meet new demands for water, to the extent practicable, without impacting existing water rights and compact obligations.
9. Make progress toward meeting applicable water quality standards throughout the Basin.
10. Promote water management and administration practices that are adaptive, flexible, and responsive to optimize multiple benefits.
11. Protect, preserve, and enhance terrestrial and aquatic wildlife habitats throughout the Basin.
13. Work to sustain active river flows throughout the year in cooperation with water users and administrators to restore and sustain ecological function of the rivers and floodplain habitats within the context of existing water rights and compact obligations.
14. Maintain and enhance water-dependent recreational activities.

**USES / NEEDS MET**

- ✓ **Agricultural**
- ✓ **Municipal & Industrial**
- ✓ **Environmental & Recreational**
- ✓ **Water Administration**
- – Other

# 6.3 : PROJECTS MEETING BASIN'S NEEDS AND GOALS

The following table includes a preliminary evaluation of each of the projects identified in **Section 6.2: Project Fact Sheets**. The table shows if the agricultural, municipal and industrial, environmental and recreational, and water administration water needs are met by the project. This table also includes which of the 14 Basin goals are met by each project. Ten of the 29 projects meet all four of the needs. Multiple Basin goals are met by 26 of the 29 projects.

**TABLE 8.** Basin needs and goals as met by identified projects, listed in alphabetical order.

| | Project or Method | Basin Needs Met | | | | | Basin Goals Met | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ag | M&I | Env/ Rec | Water Admin | Total | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | Total |
| 1 | Boatable Days Flow Evaluation | | | ✓ | ✓ | 2 | ✓ | ✓ | | | | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | 9 |
| 2 | Conejos River System Confluence Management Project | ✓ | | ✓ | | 2 | ✓ | ✓ | | ✓ | ✓ | ✓ | | | | ✓ | ✓ | ✓ | | ✓ | 9 |
| 3 | Consolidated Ditch Diversion and Headgate Rehabilitation Project | ✓ | | ✓ | ✓ | 3 | ✓ | ✓ | | ✓ | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | | ✓ | 10 |
| 4 | Closed Basin River/Creek and Wetland Water Table Study | ✓ | | ✓ | ✓ | 3 | ✓ | ✓ | ✓ | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | ✓ | ✓ | 10 |
| 5 | Doppler Radar Weather Forecasting Project | ✓ | ✓ | ✓ | ✓ | 4 | ✓ | ✓ | | | | ✓ | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | 9 |
| 6 | Economic Impact Statement Analysis of the Effects of Reduced Groundwater Irrigation on the Rio Grande Basin | ✓ | | | ✓ | 2 | | ✓ | ✓ | | ✓ | | | ✓ | | | | | | | 4 |
| 7 | Groundwater Management Subdistricts | ✓ | ✓ | ✓ | ✓ | 4 | ✓ | | ✓ | | ✓ | ✓ | | | | ✓ | | ✓ | | | 6 |
| 8 | Hydrologic Recharge Feasibility Study for Rio Grande Basin Augmentation | ✓ | | ✓ | ✓ | 3 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ | | | | 8 |
| 9 | Increasing Water Holding Capacity of Soil for Agricultural Sustainability in the San Luis Valley | ✓ | | ✓ | | 2 | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | | | | 9 |
| 10 | Jim Creek Riparian Protection and Restoration Project | ✓ | | ✓ | | 2 | ✓ | | | | | ✓ | | | | | ✓ | ✓ | | | 4 |
| 11 | Kerber Creek Restoration Project — Middle Parcel | ✓ | | ✓ | | 2 | ✓ | | | | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | | | 7 |
| 12 | Mountain Home Reservoir Dam Repair | ✓ | | ✓ | ✓ | 3 | | | | ✓ | ✓ | ✓ | ✓ | | | | | | | ✓ | 5 |
| 13 | The Plaza Project — Phase 3: Prairie Ditch Implementation Project | ✓ | | ✓ | ✓ | 3 | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | 11 |

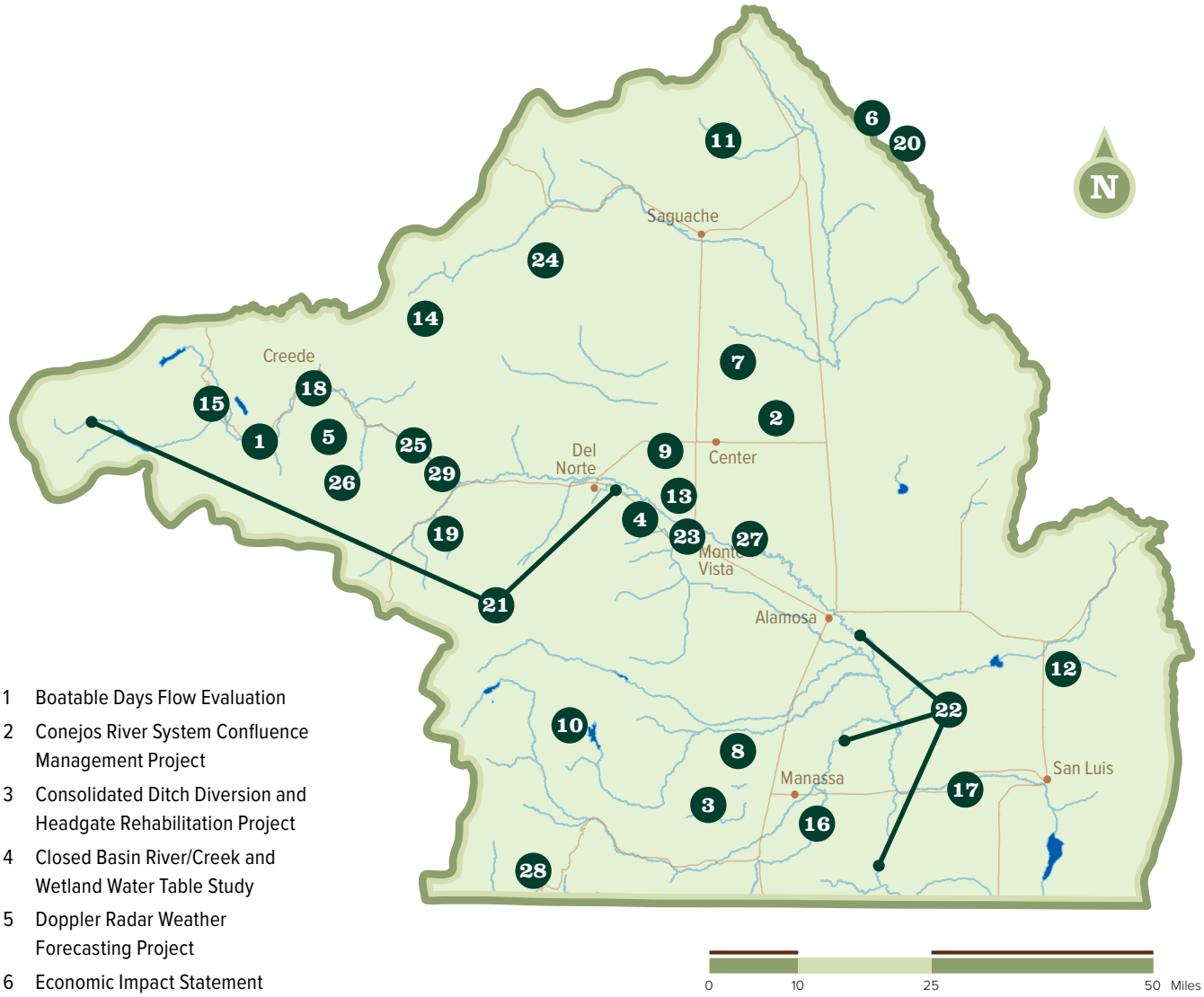
table continues

continued

**TABLE 8.** Basin needs and goals as met by identified projects, listed in alphabetical order.

| | Project or Method | Basin Needs Met | | | | | Basin Goals Met | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ag | M&I | Env/ Rec | Water Admin | Total | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | Total |
| 14 | Post-Fire Lynx Habitat Assessment Study | | | ✓ | ✓ | 2 | | | | | | | | | | | ✓ | ✓ | | | 2 |
| 15 | Post-Fire Test Plot Project | | | ✓ | | 1 | ✓ | | | | | | | | | | ✓ | ✓ | | | 3 |
| 16 | Rehabilitation of Richfield Canal Core and Diversion at Confluence of Rio San Antonio and the Conejos River | ✓ | | ✓ | ✓ | 3 | ✓ | ✓ | | ✓ | ✓ | ✓ | | | ✓ | | ✓ | ✓ | | ✓ | 9 |
| 17 | Rio Culebra Community Watershed Plan | ✓ | | ✓ | | 2 | ✓ | | | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | | | 8 |
| 18 | Rio Grande Basin Hydrology Study (Long-Term) | ✓ | ✓ | ✓ | ✓ | 4 | ✓ | | | | | ✓ | | | ✓ | | ✓ | ✓ | | ✓ | 6 |
| 19 | Rio Grande Cooperative Project | ✓ | ✓ | ✓ | ✓ | 4 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 13 |
| 20 | Rio Grande Cutthroat Trout County Coalition Project | | | ✓ | | 1 | | | | | | | | | | | ✓ | | | | 1 |
| 21 | Rio Grande Headwaters Restoration Project | ✓ | ✓ | ✓ | ✓ | 4 | ✓ | ✓ | | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 11 |
| 22 | Rio Grande Initiative Conservation Easements | ✓ | ✓ | ✓ | ✓ | 4 | ✓ | | | | | ✓ | | | ✓ | | ✓ | ✓ | | | 5 |
| 23 | Rio Grande Initiative: Campbell-Redden Property and Dugan Ranch Conservation Easement Projects | ✓ | | ✓ | ✓ | 3 | ✓ | ✓ | | | | ✓ | | ✓ | | | ✓ | ✓ | | | 6 |
| 24 | Rio Grande National Forest Plan Revision | ✓ | ✓ | ✓ | ✓ | 4 | ✓ | | | | | ✓ | | | | | ✓ | ✓ | ✓ | ✓ | 6 |
| 25 | Rio Grande Water Quality Study, Post-Wildfire Impacts | ✓ | ✓ | ✓ | ✓ | 4 | ✓ | | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 11 |
| 26 | Roaring Fork Rio Grande Cutthroat Trout Reclamation Project | | | ✓ | | 1 | | | | | | | | | | | ✓ | | | | 1 |
| 27 | SLV LiDAR Analysis for Water Flow Phase I — Rio Grande Corridor | ✓ | | ✓ | ✓ | 3 | ✓ | ✓ | ✓ | ✓ | | ✓ | | | | ✓ | ✓ | ✓ | ✓ | ✓ | 10 |
| 28 | Trujillo Meadows Reservoir Storage | ✓ | ✓ | ✓ | ✓ | 4 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 13 |
| 29 | Upper Rio Grande Assessment | ✓ | ✓ | ✓ | ✓ | 4 | ✓ | | | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ | | ✓ | ✓ | 9 |
| | **Total** | **24** | **10** | **28** | **22** | | **24** | **15** | **8** | **14** | **14** | **24** | **6** | **8** | **13** | **15** | **26** | **22** | **10** | **16** | |

**FIGURE 26.** Map of project locations.




1 Boatable Days Flow Evaluation
2 Conejos River System Confluence Management Project
3 Consolidated Ditch Diversion and Headgate Rehabilitation Project
4 Closed Basin River/Creek and Wetland Water Table Study
5 Doppler Radar Weather Forecasting Project
6 Economic Impact Statement Analysis of the Effects of Reduced Groundwater Irrigation on the Rio Grande Basin
7 Groundwater Management Subdistricts
8 Hydrologic Recharge Feasibility Study for Rio Grande Basin Augmentation
9 Increasing Water Holding Capacity of Soil for Agricultural Sustainability in the San Luis Valley
10 Jim Creek Riparian Protection and Restoration Project
11 Kerber Creek Restoration Project — Middle Parcel
12 Mountain Home Reservoir Dam Repair
13 The Plaza Project — Phase 3: Prairie Ditch Implementation Project
14 Post-Fire Lynx Habitat Assessment Study
15 Post-Fire Test Plot Project
16 Rehabilitation of Richfield Canal Core and Diversion at Confluence of Rio San Antonio and the Conejos River
17 Rio Culebra Community Watershed Plan
18 Rio Grande Basin Hydrology Study (Long-Term)
19 Rio Grande Cooperative Project
20 Rio Grande Cutthroat Trout County Coalition Project
21 Rio Grande Headwaters Restoration Project
22 Rio Grande Initiative Conservation Easements
23 Rio Grande Initiative: Campbell-Redden Property and Dugan Ranch Conservation Easement Projects
24 Rio Grande National Forest Plan Revision
25 Rio Grande Water Quality Study, Post-Wildfire Impacts
26 Roaring Fork Rio Grande Cutthroat Trout Reclamation Project
27 SLV LiDAR Analysis for Water Flow Phase I — Rio Grande Corridor
28 Trujillo Meadows Reservoir Storage
29 Upper Rio Grande Assessment

## 6.4 : ANTICIPATED FUNDING NEEDS FOR IDENTIFIED PROJECTS

To assist in the identification of funding needs, the estimated total annual costs for the majority of projects with fact sheets were compiled and are summarized in Table 9. Based on these 25 projects alone, there is a financial need of $63.3 million dollars through the year 2020.

Clockwise from top left: Turkey in Alamosa Valley, photo: Juanjo Segura; the Santa Maria pipeline, photo: Heather Dutton; camping on Stony Pass, photo: Erich Schlegel Rio Grande Reservoir with 100 years celebration sign, photo: Rio de la Vista

**TABLE 9.** Total annual costs for identified site-specific projects.

| ID | Project | Sponsor | Cost | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| 1 | Boatable Days Flow Evaluation | Trout Unlimited | $19,500 | | $11,167 | $4,167 | $4,167 | | | |
| 2 | Conejos River System Confluence Management | Conejos Water Conservancy District | $582,000 | $193,000 | $355,000 | $34,000 | | | | |
| 3 | Consolidated Ditch Diversion and Headgate Rehabilitation Project | Colorado Rio Grande Restoration Foundation, NRCS, Private Landowners | $1,500,000 | $43,450 | $173,850 | $1,258,850 | $23,850 | | | |
| 4 | Doppler Radar Weather Forecasting Project | RWEACT, CWCB, USFS, NWS | $393,750 | $78,750 | $78,750 | $78,750 | $78,750 | $78,750 | | |
| 5 | Economic Impact Statement Analysis of the Effects of Reduced Groundwater Irrigation on the Ro Grande Basin | San Luis Valley Council of Governments | $80,364 | | $38,932 | $41,432 | | | | |
| 6 | Groundwater Management Subdistricts | Rio Grande Water Conservation District | $66,000,000 | | $4,125,000 | $4,125,000 | $4,125,000 | $4,125,000 | $4,125,000 | $4,125,000 |
| 7 | Hydrologic Recharge Feasibility Study for Rio Grande Basin Augmentation | San Luis Valley Irrigation Well Owners, Inc. | $180,000 | $80,000 | $100,000 | | | | | |
| 8 | Increasing Water Holding Capacity of Soil for Agricultural Sustainability | Rio Grande Watershed Conservation and Education Initiative | $5,403,164 | $905,861 | $1,801,055 | $1,801,055 | $895,194 | | | |
| 9 | Jim Creek Riparian Protection and Restoration Project | Conejos County, TU, State Land Board, Colorado Mountain Club, Volunteers for Outdoor Colorado | $30,000 | $10,000 | $10,000 | $10,000 | | | | |
| 10 | Kerber Creek Restoration Project - Middle Parcel | Trout Unlimited | $277,667 | | $138,834 | $138,834 | | | | |
| 11 | Mountain Home Reservoir Dam Repair | Trinchera Irrigation Company | $500,000 | | $270,000 | $230,000 | | | | |
| 12 | The Plaza Project - Phase 3: Prairie Ditch Implementation Project | Colorado Rio Grande Restoration Foundation | $975,000 | $933,700 | $23,450 | $10,950 | $6,900 | | | |
| 13 | Post-Fire Lynx Habitat Assessment Study | USFS, CPW, RWEACT | $78,750 | | | $39,375 | $39,375 | | | |

table continues

continued

**TABLE 9.** Total annual costs for identified site-specific projects.

| ID | Project | Sponsor | Cost | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| 14 | Post-Fire Test Plot Project | RWEACT, USFS, and CRGRF | $5,200 | $2,600 | $2,600 | | | | | |
| 15 | Rehabilitation of Richfield Canal Core and Diversion at Confluence of Rio San Antonio and the Conejos River | Richfield Canal Company | $240,000 | | | $80,000 | $80,000 | $80,000 | | |
| 16 | Rio Grande Basin Hydrology Study (Long-Term) | RWEACT and CRGRF | $125,000 | | $25,000 | $25,000 | $25,000 | $25,000 | $25,000 | |
| 17 | Rio Grande Cooperative Project | SLVID, CPW | $22,000,000 | $1,625,000 | $1,625,000 | $9,625,000 | $9,125,000 | | | |
| 18 | Rio Grande Cutthroat Trout County Coalition Project | Colorado Counties of Hinsdale, Mineral, Rio Grande, Conejos, Costilla, Alamosa, Saguache, Archuleta, San Juan, and Las Animas | $40,000 | $26,667 | $6,667 | $6,667 | | | | |
| 19 | Rio Grande Initiative Conservation Easements | Rio Grande Headwaters Land Trust (RiGHT) | $14,000,000 | $2,000,000 | $2,000,000 | $2,000,000 | $2,000,000 | $2,000,000 | $2,000,000 | $2,000,000 |
| 20 | Rio Grande Initiative: Campbell-Redded Property and Dugan Ranch Conservation Easement Projects | Rio Grande Headwaters Land Trust (RiGHT) | $1,045,000 | | $442,000 | $402,000 | $201,000 | | | |
| 21 | Rio Grande National Forest Plan Revision | RWEACT and USFS | $78,750 | | $26,250 | $26,250 | $26,250 | | | |
| 22 | Rio Grande Water Quality Study, Post Wildfire Impacts | RWEACT, USFS, Colorado School of Mines | $157,500 | $63,000 | $63,000 | $31,500 | | | | |
| 23 | Roaring Fork Rio Grande Cutthroat Trout Reclamation Project | USFS and CPW | $50,000 | | $50,000 | | | | | |
| 24 | Trujillo Meadows Reservoir Storage | Conejos Water Conservancy District | $15,550,000 | | $1,000,000 | $1,250,000 | $1,300,000 | $4,000,000 | $4,000,000 | $4,000,000 |
| 25 | Upper Rio Grande Assessment | Colorado Rio Grande Restoration Foundation | $450,000 | | $50,000 | $166,667 | $116,667 | $116,666 | | |
| **Total** | | | **$129,761,645** | **$5,962,028** | **$12,416,554** | **$21,385,496** | **$18,047,153** | **$10,425,416** | **$10,150,000** | **$10,125,000** |

## 6.5 : OTHER PROJECTS AND METHODS

Additional potential project concepts have been proposed, but project sheets have not yet been developed for these projects.

The projects and methods listed in Table 10 were identified by the RGBRT or Basin entities for future consideration as part of this Plan effort. Since these projects are either broad in nature or in the preliminary stage, detailed information was not available for the development of project fact sheets.

**TABLE 10.** RGBRT-identified additional projects and methods.

| | Project or Method | Basin Needs Met | | | | Basin Goals Met | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ag | M&I | Env/ Rec | Water Admin | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 1 | Acquisition of Replacement Supplies for M&I Pumping Depletions | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | | ✓ | | |
| 2 | Adaptive Management to Mitigate Climate Change Impacts | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3 | Alternative Agriculture Methods and Improved Irrigation Efficiency to Reduce Consumptive Use | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ | | | | |
| 4 | Alternative Cropping Education and Promotion Program | ✓ | | ✓ | | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | | | |
| 5 | Basin-wide Water Public Education Program | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ |
| 6 | Blanca Wetlands Water Exchange | | | ✓ | | ✓ | ✓ | | ✓ | | | | | | ✓ | ✓ | ✓ | | |
| 7 | Capital Improvements for Recreation Facilities | | | ✓ | | | | | | | ✓ | | | | | | | | ✓ |
| 8 | Conejos Fish Habitat Project | | | ✓ | | ✓ | | | | | | | | | | ✓ | ✓ | | ✓ |
| 9 | Conejos Whole River Strategy | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 10 | Development of an Extreme Precipitation Dam Spillway Sizing Tool | ✓ | ✓ | | ✓ | | | | ✓ | | ✓ | | | | | | | | |
| 11 | Improved Calibration of RGDSS Groundwater Model | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | | ✓ | | |
| 12 | Improvements to Ditch and Canal Diversion Structures | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | ✓ |
| 13 | Lone Tree Creek Riparian Restoration Projects | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |

table continues

continued

**TABLE 10.** RGBRT-identified additional projects and methods.

| | Project or Method | Basin Needs Met | | | | Basin Goals Met | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ag | M&I | Env/ Rec | Water Admin | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 14 | Low Head Hydropower on Existing Diversion Structures | ✓ | ✓ | | | | | | ✓ | | | | | | | | | | |
| 15 | Protect and Enhance Watershed Health | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | | ✓ | ✓ | | ✓ |
| 16 | Rehabilitation of Reservoirs | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | ✓ | | ✓ | ✓ |
| 17 | Retirement of Irrigated Lands Necessary to Comply with Aquifer Sustainability Rules | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | ✓ | | | | ✓ | | ✓ | | |
| 18 | Riverbank Stabilization | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | | | | | ✓ | | ✓ | ✓ | | |
| 19 | Soil Health Education and Promotion Program | ✓ | | ✓ | | ✓ | | | | | ✓ | | ✓ | ✓ | | | | | |
| 20 | Streamflow Forecast Improvements | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | | | | ✓ | | | ✓ | |
| 21 | Wetland and Riparian Enhancement and Restoration | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ | | | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |
| | Total | 18 | 14 | 19 | 15 | 11 | 12 | 15 | 11 | 9 | 15 | 7 | 10 | 7 | 10 | 11 | 12 | 8 | 10 |

Meanders, oxbow lakes, and ranches on La Jara Creek. Photo © Adriel Heisey / www.adrielheisey.com

# 7 OUTREACH AND EDUCATION

## 7.1 : SUMMARY OF OUTREACH COMPLETED DURING THE PLAN DRAFT PROCESS

The Rio Grande Basin Implementation Plan was developed at the local level through the RGBRT, with guidance from the CWCB. To ensure widespread public recognition and to request public input, the Outreach and Education Subcommittee developed and implemented a comprehensive outreach program on the Plan using numerous media platforms. The outreach program entailed presentations at various public and organizational meetings throughout the Basin, newspaper articles, radio programs, the Rio Grande Water Plan website (http://www.riograndewaterplan.com), and a "Water 101" booklet developed specifically for the Basin. Details of these outreach efforts are summarized in Table 11, and a more in-depth summary is available in Appendix 7: Outreach and Education.

Wetland workshop on the conserved Gilmore Ranch, along the Rio Grande west of Alamosa. Photo: Rio de la Vista

**TABLE 11.** Basin outreach program activities.

| Outreach/Meeting Type | Number of Events | Total Number of Attendees | Meeting Location(s) | Demographics |
|---|---|---|---|---|
| Outreach sessions for general community | 7 | 87 | South Fork, La Jara, San Luis, Center, Alamosa, Creede, Crestone | General public, water users, farmers/ranchers |
| Outreach sessions for county commissioners | 7 | 57 | Rio Grande, La Jara, San Luis, Saguache, Alamosa, Creede, Lake City | County commissioners |
| Outreach sessions for interested groups | 9 | 314 | Saguache, Alamosa, Manassa, Monte Vista, Lake City | Federal agencies (USFS, BLM, and USFWS), Trout Unlimited, Conejos water users, farmers/ranchers, CPW staff, SLVWCD board members, RGWCD board members, Great Outdoors Trail group members, Wetlands Focus Group members |
| RGBRT meetings | 6 | 258 | Alamosa and other communities throughout the Basin | General public, RGBRT members |
| Plan subcommittee meetings | 21 | N/A | Alamosa | Subcommittee members |
| Newspaper articles | 27 | N/A | Distribution Basin-wide | General public |
| Radio programs | 17 | N/A | Distribution Basin-wide | General public |
| Website | N/A | N/A | Accessible Basin-wide | General public |
| Water 101 booklet | N/A | N/A | Distribution Basin-wide | General public |

Wetland workshop on the conserved Gilmore Ranch, along the Rio Grande west of Alamosa. Photo: Rio de la Vista

## 7.2 : ACTION PLAN FOR EDUCATION, PARTICIPATION, AND OUTREACH 2015 AND BEYOND

The statewide Public Education, Participation and Outreach (PEPO) Workgroup will assist the basin roundtables in strengthening their education and outreach activities. Each roundtable is expected to have a functioning education and outreach committee tasked with creating an education action plan (EAP). Therefore, the EAP for the RGBRT will detail the educational goals and tasks most effective for this roundtable. The RGBRT's EAP will identify member education activities that promote a well-informed and high-functioning roundtable. It will also define public participation objectives and appropriate implementation methods.

**TABLE 12.** Specific education and outreach goals of the Rio Grande Basin PEPO Subcommittee.

| Objective | Tasks | Leads | Timeline |
|---|---|---|---|
| Topic 1: Outreach | Monthly articles by RGBRT members | Judy Lopez<br>Partners | 2014–2015 |
| | Web page to provide latest RGBRT information and events, plus interactive opportunities | Emma Regier<br>Judy Lopez<br>Partners | 2014–2015 |
| Topic 2: Education | Outreach events designed for agricultural water users, public officials, and community members | Judy Lopez<br>Heather Dutton<br>Partners | 2014–2015 |
| Topic 3: Multiple-Use Project Implementation Discussion | Forum that brings stakeholders together to maximize multi-use projects | Judy Lopez<br>Heather Dutton<br>Emma Regier<br>Partners | 2014–2015 |
| Topic 4: Payment for Education and PEPO Liaison | Funding to educational liaison for implementation of outreach and education | Judy Lopez | 2014 – 2015 |

For more information on the Rio Grande Basin PEPO Subcommittee, see Appendix 7: Outreach and Education, Section 7.2 Action Plan for Education, Participation, and Outreach 2015 and Beyond.

## 7.3 : RIO GRANDE BASIN LONG-RANGE OUTREACH STRATEGIES

The RGBRT recognizes the importance of a balanced and ongoing outreach plan. The Basin has built its public communications on three key ideals — outreach, education, and participation — across all demographics, including water users, public officials, communities, water leaders, and stakeholders. For 2015–2020, the Basin has a goal of "outreach, education, and participation that furthers the purposes of the RGBRT, Interbasin Compact Committee, and CWCB as they relate to the preservation and sustainability of the Basin and State of Colorado's water resources." To achieve this goal, the RGBRT will use strategies such as:

- active and diverse Roundtable members
- news articles
- website pages
- e-letters
- educational opportunities
- strategic planning forums
- use of an active educational liaison who participates in the CWCB public education, participation, and outreach process

The Rio Grande winds through Alamosa, Colorado. Photo © Adriel Heisey / www.adrielheisey.com

# 8 THE RIO GRANDE BASIN PATH FORWARD

Identifying critical challenges and developing clear solutions for managing water resources is a vital step in the Basin's path forward. The ongoing economic prosperity of this unique region, the health of its environment and wildlife habitat, and the development of recreational opportunities for the community all depend upon implementation of the Plan's recommended strategies to protect and optimize the use of the Basin's water.

Sandhill cranes flying over the San Luis Valley. Photo: Julie Messick

Benefits from successful implementation of this Plan also extend beyond the Basin. Agriculture in the Basin produces the highest per acre revenue of any basin in the state, while the environmental and recreational attributes are of local, national, and international importance. Financial support from the State of Colorado, federal agencies, and private and public sources will be necessary to implement the action items outlined in the Plan.

As the San Luis Valley communities address the obstacles to protecting and enhancing the Basin's water values, new challenges will arise. For this reason, the Plan is dynamic and will adapt as future opportunities and constraints present themselves. The Plan will be updated periodically as additional information is collected, new focus areas are identified, and new issues emerge. The primary goal of the RGBRT and the Plan is to create a sustainable water future. The actions identified in this Plan for responsible stewardship of the Basin's water resources will help achieve that future and aim to preserve a balance of water uses and needs that will benefit generations to come.

Barley field at sunset.
Photo: Julie Messick

The primary goal of this Plan is to create a sustainable water future. As the Basin community works cooperatively to address the challenges to ensuring a sustainable water future and protecting and enhancing the Basin's water values, new challenges will arise. For this reason, the Plan is dynamic and will adapt as future opportunities and constraints present themselves.

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Oso Creek. Photo: Heather Dutton


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The Rio Grande, south of Alamosa National Wildlife Refuge. Photo © Adriel Heisey / www.adrielheisey.com


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Ranches and hayfields below South Fork. Back cover: Confluence of the Conejos River (right) with the Rio Grande (left) east of La Jara, Colorado, looking south. Photos © Adriel Heisey / www.adrielheisey.com


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