F. WATER RESOURCES

1. Water Conditions

Water use in the San Luis Valley may be drastically different in the 21st Century than it was in the preceding one. Water users may face limits experienced only in the driest of years. Those limits will come in the form of the first ever regulations that limit the use of groundwater. And, if predictions regarding climate change come to pass, another set may be imposed by Mother Nature.

While there is argument over how climate change will impact water supplies, Valley water users have already seen reduced flows in the years covered by this study. Stream flows on the Rio Grande, which are listed on Table F-6, have been below the historic average in four of the five years covered in this study. Likewise, reservoir levels and flows on other streams have also dropped as shown on Table F-7.

Those conditions have meant less water at ditch headgates, forcing irrigators to lean more heavily on the nearly 4,800 irrigation wells in the valley. See Table F-8 for a breakdown of wells by county.

The unconfined aquifer, which is the shallower of the valley's two major groundwater formations, also lost recharge, in part, because of the lack of surface water. The aquifer is typically replenished in spring and summer by return flows from the diversions made by irrigators from the Rio Grande. From 2007 to 2012, the unconfined aquifer declined by 226,300 acre-feet, according to monitoring wells administered by the Rio Grande Water Conservation District in the north end of the valley. (Table F-9)

Irrigators and water managers have also faced an earlier runoff in three of the last five years. Above normal temperatures and dust storms prompted early flows in 2009, 2010 and 2012. Dust from the Colorado Plateau is blamed for reducing the snow's albedo, or its ability to reflect the sun, which in turn accelerates the rate of snowmelt. The Center for Snow and Avalanche Studies tracks dust events in the Rio Grande basin via monitoring sites at Spring Creek and Wolf Creek passes. Partial data from those sites can be seen on tables F-10 and F-11.

Climate change may also impact the snowpack over the rest of the century, according to the 2011 Secure Water Act Report by the U.S. Bureau of Reclamation. The report said temperatures throughout the Rio Grande Basin are likely to increase by five to six degrees Fahrenheit by the end of the 21st Century. Temperatures in the headwaters of the basin increased by 1.8 degrees from 1895 to 2005 with most of the warming happening after 1990. By 2050 the report suggested that annual precipitation may decrease from 2.3 percent to 2.5 percent. Moreover, that moisture is more likely to fall as rain instead of snow at lower elevations, which will increase wintertime runoff.

2. Local Water Management

In 2012, Subdistrict No. 1 went into operation, marking the first regulatory effort to reduce groundwater pumping in the San Luis Valley.

The Subdistrict, which takes in 149,749 acres of irrigated land in Alamosa, Rio Grande and Saguache counties and is shown in Map F-1, seeks to mitigate the impact of well pumping on senior surface water rights holders and restore the unconfined aquifer through the fallowing of up to 40,000 acres of farm ground.

Subdistrict members pumped 216,676-acre-feet of groundwater with a net consumptive use of 144,470

acre-feet, according to the 2012 annual report. Both those figures represented a decline from 2011, although the net consumptive use remained higher than 2010's 95,505 acre-feet.

Calculations made through the Rio Grande Decision Support System, a state-run computer model administered by the Office of the State Engineer, determined wells in the subdistrict were required to replace 4,724 acre-feet to the river to mitigate for the pumping.

The subdistrict also contracted with 37 farmers to temporarily fallow 9,023 acres of irrigated ground. Despite those efforts, the unconfined aquifer continued to decline and has lost more than 1.2 million acre-feet since monitoring was initiated in 1976. Subdistrict members were also offered the chance in 2013 to enroll in the Conservation Reserve Enhancement Program, which would pay to fallow ground with a combination of federal and subdistrct money for periods of up to 15 years. No enrollment figures for that program were available at the time of this report.

As many as five other subdistricts could be initiated in the San Luis Valley.

A second effort to regulate groundwater wells is expected from the State Engineer, who has issued draft rules and regulations. The draft rules call for well owners outside of a subdistrict to get an augmentation plan if the state's computer model determines their wells are responsible to depletions from area streams and rivers.

That effort is pending the completion of the computer model calculations and the approval of the rules by the Water Court for Water Division Three.

3. Rio Grande Compact

Colorado's use of the Rio Grande is determined through an interstate compact signed with New Mexico and Texas in 1938. Colorado's delivery requirements vary depending on the quantity of streamflows in the Rio Grande and the Conejos River with wetter years increasing the state's delivery obligation as outlined in Table F-3.

In the last five years, Colorado's deliveries have ranged from a high of 393,900 acre-feet in 2008 to a low of 126,500 acre-feet in 2012 as shown on F-13.

Following a 1966 suit filed with the U.S. Supreme Court for Colorado's lack of compliance with the compact, the State Engineer began curtailing surface water use in the valley, including water for rights whose priority predated the compact. That practice continues today.

In 2012, Texas brought suit against New Mexico and Colorado in the U.S. Supreme Court centered mainly on claims of illegal groundwater pumping in southern New Mexico. Although Texas made no allegations against Colorado, the latter was named as a defendant since it is a party to the compact.

4. Water Budget (Table F-2)

The water budget from 1997 is based on a model from the Rio Grande Decision Support System using a 27-year average, and represents what could be expected in a normal year – not like the situation we are facing now. Estimates of water quantities and use are subject to complex variables and measurements, and vary from source to source. Persons interested in more detailed information on water are encouraged to contact sources cited in the various tables and footnotes.

An average of over 2.8 million acre-feet entering and leaving the Valley each year are estimated by the model, enough to fill the 37-mile long Elephant Butte and Caballo reservoirs in central New Mexico which are the two largest on the Upper Rio Grande system.

Surface water, estimated at a little under 1.2 million acre-feet, originates from 4,700 square miles of watershed and mountain snowmelt. Surface water inputs are delivered to the Valley floor by approximately 7,000 miles of stream channels tributary to the Rio Grande and irrigation canals or ditches. Surface water provides, directly or indirectly, nearly all the water used for irrigation, and also supplies a major portion of the recharge to the Valley's aquifers.

A slightly larger portion of the total budget in this model is contributed by mountain precipitation (1.3 million acre-feet). Ungauged surface water and ground water inflow add smaller amounts.

On the outflow side, about 1.4 million acre-feet (50.3 percent) entering the Valley is consumed by evapotranspiration (evaporation and plant transpiration) on non-irrigated native lands. Irrigated agriculture consumes 967,000 acre-feet; and about 12,000 acre-feet (5.0 percent) is consumed by a combination of reservoir evaporation, city and industrial use, and livestock.

The balance of 305,000 acre-feet (10.7 percent) entering the Valley in normal years leaves as surface water outflow, a portion of which must be delivered to downstream states under the Rio Grande Compact. Some also leaves as ground water outflow (4.4 percent).

5. Agricultural Water Use (Table F-4, F-5)

Examples of typical farm and home water uses and volumes in Table F-4 are intended to provide some basic understanding of the parameters involved, and are subject to further study and refinement. While food production requires vastly greater quantities of the precious water resource, it also provides the major export base for the regional economy, and the continued practice of agriculture preserves the Valley's rural lifestyles and land use patterns.

The table shows the consumptive use required to grow a particular crop is the same regardless of center pivot or flood irrigation. Using potatoes as an example, the sprinkler system on a 125-acre circle applies 210 acre-feet in a 100-day growing season, 146 acre-feet are consumed in growing the crop, and an estimated 64-acre-feet are returned to the aquifer by soil absorption.

Flood irrigation (uncommon for potatoes), would draw 290 acre-feet but return 144 for aquifer replacement. From the standpoint of cost and amount of water accessed to produce a crop, the center pivot method is considered to have an irrigation application efficiency of 70 percent or more, compared with only 50 percent for flood irrigation.

A typical potato and barley rotation farm in the Valley would consist of six 125-acre center pivot circles with a consumptive use of 945 acre-feet/yr. The same six circles for alfalfa would require 1,500 acre-feet/yr, which causes some concern due to higher prices for the crop and expanded acreage.

Table F-5 provides data from another source comparing water use per day in millions of gallons. Water consumption in the Valley is highest in Rio Grande County, which accounts for over a third of all water consumption in the area.. Groundwater withdrawals are greatest in Saguache, Alamosa, and Rio Grande, and lowest in Mineral, Conejos, and Costilla.

6. Home and City Water Use (Table F-4, F-5)

In contrast to agricultural use, Table F-4 shows .14 acre-feet per year for personal use, equivalent to only 6,467 acre-feet per year for the entire Valley population. While residential use is dwarfed by the quantities needed for agriculture, water conservation is being taken very seriously in many Southwestern cities such as noted by the examples from Tucson.

Alamosa acquired land north of the city with substantial surface water rights some years ago to increase its capacity for growth, but we are not aware of actions taken by other towns along these lines. Most of the cities (with the exception of Del Norte and Antonito) draw potable water from deep wells in the confined aquifer. Confined aquifer water is also available for irrigation purposes, but may require greater pumping costs to lift water depending on location of the well. Since 1972, the State Engineer has not allowed the construction of any new high capacity wells (300+GPM) in the confined aquifer.

7. Rio Grande Basin Roundtable

State legislators created the Rio Grande Basin Roundtable and eight others across the state in 2005 as a means of solving local and statewide water problems.

The 30-member panel has funded 32 projects since its inception. Those projects, when combined with allocations from the Colorado Water Conservation Board, have tallied $8.1 million in funding – the highest sum of any roundtable in the state. See Table F-15.

The funding has gone toward an array of projects including planning studies, river restoration, ditch rehabilitation, dam improvements and conservation easements, among others.

The roundtable also offers a forum for interests from across the basin to learn about emerging issues.

8. Closed Basin Project

Authorized by Congress in 1972, the Closed Basin Project was designed with the aim of withdrawing up to 100,000 acre-feet of groundwater annually from the northeastern corner of the valley for delivery primarily to the Rio Grande to assist with compact delivery requirements.

The U.S. Bureau of Reclamation built and maintains the project, although the Rio Grande Water Conservation District contributes civil maintenance on the project.

But the project has delivered only a fraction of the water originally envisioned by the project's designers. Declining aquifer levels, poor water quality and iron bacteria that hamper well performance, have combined to idle 50 to 60 of the project's 170 wells in recent years.

Total deliveries of project water have suffered accordingly. Deliveries from 2008 to 2012 averaged just under 16,000 acre-feet per year, as shown in Table F-16.

The project also delivers water to the Alamosa National Wildlife Refuge and the Blanca Wetlands, which is managed by the U.S. Bureau of Land Management.

Table F-1

Water Supply and Use Terminology

Absolute water right: A property right to put water to beneficial use with a specified priority date.
Acre-foot: A volume of water equal to one foot in depth covering an area of one acre. Also 43,560 cubic feet, or 325,829 gallons. Used to measure stored water quantities.
Adjudication: Judicial decree defining and dating a water right.
Alluvial water: Ground water that is hydrologically part of a surface stream that is present in permeable soil material, usually small rock and gravel.
Appropriate: (verb) To take the legal actions necessary to create a right to take water from a stream, tributary or aquifer for application to beneficial use.
Appropriation: The right to take water from a stream, tributary or aquifer for beneficial use at a specified rate of flow, either for immediate use or to store for later use. Usually evidenced by a water court decree.
Aquifer: A water saturated underground layer of rock or unconsolidated material that can transmit an economic quantity of water. In an unconfined aquifer the upper surface of the saturated aquifer is a changing water table under atmospheric pressure. In a confined (artesian) aquifer the water is maintained under pressure by low porosity rocks surrounding it.
Augmentation plan: A court-approved plan that allows a water user to divert water out of priority so long as adequate replacement is made to the affected stream system preventing injury to the water rights of senior users.
Augmentation source: The supply of water used to replace out-of-priority depletions.
Beneficial use: Application of water without waste for human or natural benefit.
Call: The exercise of a senior water right holder of a "calling" for his or her water rights, requiring upstream junior water rights holders to allow water to flow to the senior water right.
Compact: A contract between states that is ratified by state legislatures and by the U.S. Congress. The contract controls the division of water in a river system that flows across state boundaries.
Conditional water right: The legal preservation of a priority date that provides a water user time to develop his or her water right, but reserves a more senior date. A conditional right becomes an absolute right when water is actually put to beneficial use.
Consumptive use: Any use of water that permanently removes water from the natural stream use.
Cubic feet per second (cfs): A rate of water flow at a given point, amounting to a volume of one cubic foot for each second of time. Equal to 7.48 gallons per second, 448.8 gallons per minute, or 1.9835 acre feet per day.
Decree: A court decision about a water right that is then administered by Colorado's Water Resources Department.
Direct flow (also direct right): Water diverted from a river or stream for use without interruption between diversion and use except for incidental purposes, such as settling or filtration.
Diversion: The removal of water from its natural course or location, or controlling water in its natural course or location, by means of a ditch, canal, flume, reservoir, bypass, pipeline, conduit, well, pump, or other device.
Doctrine of prior appropriation: A legal concept in which the first person to appropriate water and apply it to a beneficial use has the first right to use that amount of water from that source. Each successive appropriator may only take a share of the water remaining after all senior water rights are satisfied. This is the historical basis for Colorado water law and is sometimes known as the Colorado Doctrine or the principle of "first in time, first in right."
Due diligence: The efforts necessary to complete a water appropriation action that demonstrates a good faith action to complete a diversion of water within a reasonable time period.
Exchange: A process by which water, under certain conditions, may be diverted out of priority at one point by replacing it with a like amount of water at another point.
Evapotranspiration (ET): Total moisture loss from an area controlled by climatic conditions and plant processes.
Futile call: A situation in which a junior (more recent) priority is allowed to continue to divert in spite of a downstream senior call because curtailing the junior would not reasonably produce any additional water for the senior.
Ground water: Water found below the earth's surface.
Historic use: The documented diversion and consumptive use of water over a period of years. Determines true value of a right.
Hydrologic cycle: The movement of water from the atmosphere to the earth and back again to the atmosphere. The three stages are precipitation, runoff or infiltration and evaporation.
Instream flows: Water flowing in its natural streambed, such as water required for maintaining flowing streams, or for fish.
Instream use: Any use of water that does not require a diversion.
Junior rights: Water rights that are more recent than older or more senior rights.
Non-consumptive use: Water drawn for use that is not consumed, for example, water withdrawn for purposes such as hydropower generation. It also includes uses such as boating or fishing where the water is still available for other uses at the same time.

Table F-1 continued on next page

Table F-1 continued

Non-tributary ground water: Underground water that meets certain legislative criteria as to its affect on a stream system.
Point of diversion: A specifically named place where water is removed from a body of water.
Priority: The right of an earlier appropriator to divert from a natural stream in preference to a later appropriator.
Priority date: The date of establishment of a water right. The rights established by application have the application date as the date of priority.
Recharge: The addition of water to groundwater.
Return flow: Unconsumed water that returns to its source, surface or ground water after use.
Reuse: To use again; to intercept for subsequent beneficial use – either directly or by exchange – water that would otherwise return to the stream system
Senior rights: Water rights that are staked the earliest with the water court.
System loss: An amount of water, expressed as a percentage, lost from a water storage or distribution system due to leaks, evaporation, seepage and unauthorized use.
Transbasin diversion: The conveyance of water from its natural drainage basin into another basin for beneficial use.
Transmountain diversion: The conveyance of water from one drainage basin to another across the Continental Divide.
Transpiration: The process by which plants remove soil moisture by losing water vapor through their leaves.
Tributary: A stream or river that flows into a larger one.
Tributary drainage: The area from which water naturally drains by gravity into a watercourse.
Tributary ground water: Water present below the earth's surface that is hydrologically connected to a natural surface stream.
Water right: A property right to make beneficial use of a particular amount of water with a specified priority date.
Watershed: An area from which water drains to a given stream or river or river system.
Source: Metro Water Construction, Inc., *Water – Colorado's Precious Resource*, 1998; League of Women Voters of Colorado, *Colorado Water*, 1992; and *Saguache County Resource Guide & Business Directory, 2001.*

Water Equivalents

Cubic feet	Gallons	Acre-feet
1 cubic foot	7.48 gal	
43,560 cubic feet	325,851 gal	1 acre-foot
1 cubic foot per second (cfs)	448.4 gal/minute (gpm)	
1 cfs (for 24 hours)	646,000 gal/day (gpd)	1.9835 acre-feet/day
1 cfs (for 30 days)		59.5 acre-feet
1 cfs (for 1 year)		724 acre-feet

Table F-2

Annual Average Water Budget, 1950-1997

San Luis Valley

Inflow Components	Acre-feet/yr	Percent
Gauged surface water inflow	1,184,702	41.7
Ungauged surface water inflow	237,461	8.4
Ground water inflow	132,294	4.7
Precipitation	1,284,382	45.2
	2,838,839	100.0
Outflow Components		
Irrigated agriculture CU	967,031	34.1
Non-irrigated native lands CU	1,429,139	50.3
Reservoir/pond evaporation	5,063	0.2
Municipal/industrial CU	5,159	0.2
Livestock CU	1,609	0.1
Surface water outflow	305,146	10.7
Ground water outflow	125,692	4.4
Storage	0	0.0
	2,838,839	100.0

Source: Approximation from the water budget model developed by Leonard Rice Consulting Water Engineers (LRCWE) under contract with the Colorado Water Conservation Board (CWCB). Reported in Colorado's Decision Support Systems (CDSS) website, April 2001. Local assistance in obtaining information provided by AgroEngineering, Inc., 5/15/02. CU= Consumptive use.

* Less than 0.1%.

Table F-3

Rio Grande Compact Delivery Requirements

Acre-Feet x 1,000

Supply	Delivery req Los Sauces	Compact %	Valley balance	Delivery req Lobatos	Compact %	Valley balance
100	0		100			
150	20	13.3	130			
200	45	22.5	155	60	30.0	140
250	75	30.0	175	65	26.0	185
300	109	36.3	191	75	25.0	225
350	147	42.0	203	86	24.6	264
400	188	47.0	212	98	24.5	302
450	232	51.6	218	112	24.9	338
500	278	55.6	222	127	25.4	373
550				144	26.2	406
600				162	27.0	438
650				182	28.0	468
700				204	29.1	496
750				229	30.5	521
800				257	21.1	543
850				292	34.4	558
900				335	37.2	565
950				380	40.0	570
1,000				430	43.0	570

Source: Rio Grande Compact Commission Report, 2000.

[1]Supply for the Conejos is measured at gauging stations in Mogote and Ortiz; supply for the Rio Grande is measured at Del Norte.

[2]Rio Grande at Lobatos less the Conejos flows.

Table F-4

Water Quantity Approximations for Farm and Home Use

Selected Farm Uses	**Total** (acre-feet per year)[7]	**Consumptive** (acre-feet per year)[8]	**Irrigation application efficiency** (percent)[9]	**Estimated aquifer replacement** (acre-feet per year)[10]
Crops - 125 acres, 100-day growing season[1]				
Potatoes, center pivot irrigation	210	146	70%	64
flood irrigation	290	146	50%	144
Barley, center pivot irrigation	240	167	70%	73
flood irrigation	335	167	50%	168
Alfalfa, center pivot irrigation	358	250	70%	108
flood irrigation	500	250	30%	250
Typical farm, potato & barley rotation[1]				
6 125-acre center pivot circles	1,350	945	70%	405
Livestock, 90,000 head		365 million gal/yr		
Over 1 million gal/day (3.068 af)[2]		1,120		

Selected Home Uses	Total
Average home residence	
Family of four[3]	0.4 a.f./yr
Basis for residential water sales[4]	0.3 a.f./yr
Per person, 50-200 gal/day[5]	45,625 gal/yr
(125 gal/day avg.)	0.14 a.f./yr
Total estimate for San Luis Valley	
.14 af/yr x 46,027 (2010 Census total pop)	6,444 a.f./yr
Home - Indoor (typically 50%, 37.5% in bathroom)[6]	
Brushing teeth (water running)	2 gal/day
Showering	12.5 - 50 gal/day
Tub bath	18 - 36 gal/day
Toilet flushing (5 flushes per day per person)	8 - 17.5 gal/day
Washing dishes - by hand	5 - 35 gal/day
- dishwasher	9 - 16 gal/load
Washing machine	24 - 45 gal/load
Home - Outdoor (typically 50%)[6]	
Lawn (100 sq/ft)	3,100 gal/yr
Lawn(400 sq/ft)	12,400 gal/yr
Trees (10)	10,500 - 30,000 gal/yr
Shrubs (20)	2,400 - 6,700 gal/yr

Sources: [1]Agro Engineering, Inc, June 2002.

[2]San Luis Valley Water Quality Demonstration Project, *San Luis Valley Water Resources* poster, 1991.

[3]Rio Grande Water Conservation District, June 2002.

[4]San Luis Valley Water Conservation District, June 2002.

[5]*Saguache County Resource Guide & Business Directory, 2001.*

[6]Tucson Audubon Society, *Vermillion Flycatcher*, November 1998.

[7]Amount of water diverted for use in order to grow the crop.

[8]Water permanently removed from the system by the crops and evaporation.

[9]Efficiency of the irrigation method from the standpoint of pumping and labor cost.

[10]Estimated amount not used by crops or evaporation and absorbed into the ground or returned to the system.

Table F-5

San Luis Valley Daily Water Use, 2005

County	Population served by public water systems	Population served by domestic self-supplied systems	Total domestic use (Mgal/day)	Irrigation			
				Groundwater (Mgal/day)	Surface (Mgal/day)	Total irrigation use (Mgal/day)	Total acres irrigated (thousands)
Alamosa	11,383	3,899	2.07	228.49	39.27	267.76	112.57
Conejos	4,854	3,658	1.33	6.88	338.35	345.23	99.33
Costilla	2,546	878	0.48	42.56	129.78	172.34	45.18
Mineral	472	460	0.37	0.61	20.71	21.32	2.06
Rio Grande	7,026	5,201	1.93	196.44	530.82	727.26	135.84
Saguache	4,085	2,946	1.07	350.52	157.05	507.57	118.65
San Luis Valley	30,366	17,042	7.25	825.5	1,215.98	2,041.48	513.63

County	Total livestock use (Mgal/day)	Total aquaculture use (Mgal/day)	Total mining use (Mgal/day)	Total groundwater use (Mgal/day)	Total surface use (Mgal/day)	Total water use (Mgal/day)
Alamosa	0.13	1.69	0.01	232.83	39.29	272.12
Conejos	0.29	12.26	0.03	20.69	338.56	359.25
Costilla	0.09	0	0.03	43.19	129.82	173.01
Mineral	0.01	0	0.01	1.07	20.72	21.79
Rio Grande	0.15	0.16	0.06	198.95	530.9	729.85
Saguache	0.29	0	0.06	351.76	157.39	509.15
San Luis Valley	0.96	14.11	0.20	848.49	1,216.68	2,065.17

Source: U.S. Geological Survey, *Estimated Use of Water in United States County-Level Data for 2005*.
http://water.usgs.gov/watuse/

Table F-6
Annual Calendar Year Flows - Rio Grande at Del Norte, 1890-2011

Acre-Feet x 1,000

Year	Annual water flow	Running average	Annual % of running average
1890	**820**	**820**	**100**
1900	506	608	83
1902	**252**	**570**	**44**
1910	655	650	101
1920	**1,000**	**700**	**143**
1930	552	726	76
1940	312	691	45
1950	470	695	68
1960	602	669	90
1970	656	659	100
1977	215	649	33
1980	751	651	115
1990	526	656	80
2000	391	655	60
2001	725	655	111
2002	**154**	**651**	**24**
2003	319	648	49
2004	528	647	82
2005	794	648	123
2006	570	647	88
2007	710	648	110
2008	710	648	110
2009	593	647	92
2010	527	647	81
2011	503	646	78

Source: Colorado Division of Water Resources, Division 3 Engineer, September 2012.
Lowest and highest water years in bold.

Table F-7

Rio Grande Basin Streamflows, Total Precipitation, and Water Storage

Streamflows, April - September (Acre-feet)

Selected Stream Segment	30-year average	2009 forecast	% of average	2012 forecast	% of average	2013 forecast	% of average
Rio Grande at 30-mile bridge	129,000	127,000	93%	76,000	56%	61,000	47%
Rio Grande at Wagon Wheel Gap	340,000	310,000	90%	200,000	58%	160,000	47%
Rio Grande at South Fork	127,000	127,000	96%	70,000	53%	55,000	43%
Rio Grande near Del Norte	515,000	485,000	91%	290,000	55%	225,000	44%
Saguache Creek near Saguache	32,000	27,000	82%	16,000	49%	16,000	50%
Alamosa Creek above Terrace Reservoir	68,000	67,000	96%	36,000	51%	30,000	44%
La Jara Creek near Capulin	8,900	8,200	92%	4,200	48%	3,300	37%
Trinchera Creek above Turner's Ranch	33,000	10,100	84%	5,600	47%	5,000	40%
Platoro Reservoir inflow	62,000	61,000	95%	35,000	55%	33,000	53%
Conejos River near Mogote	194,000	205,000	103%	110,000	55%	87,000	45%
San Antonio River at Ortiz	15,600	17,000	104%	5,500	34%	2,200	14%
Los Pinos River near Ortiz	73,000	77,000	104%	35,000	47%	24,000	33%
Culebra Creek at San Luis	23,000	21,000	91%	10,500	46%	7,300	32%
Costilla Reservoir inflow	11,100	10,000	94%	5,000	47%	4,500	41%
Total selected stream segments	**1,631,600**	**1,552,300**	**95.1**	**898,800**	**55.1**	**713,300**	**43.7**

Selected SNOTEL sites

Snow/Precipitation, January 2014 Forecast (in)

Basin Site Name / Elev. (ft.)	Snow Water Equivalent: Current (in)	Snow Water Equivalent: Median (in)	Snow Water Equivalent: Pct of Median	YTD Precipitation: Current (in)	YTD Precipitation: Average (in)	YTD Precipitation: Pct of Avg
Upper Rio Grande Basin						
Upper San Juan / 10,200	13.3	19.4	69.0	*	21.6	*
Wolf Creek Summit / 11,000	9.90	20.5	48.0	13.1	20.2	65.0
Rio Chama River Basin						
Cumbres Trestle / 10,040	10.90	15.3	71.0	10	16.10	62.0
Sangre De Cristo Mountain Range Basins						
Culebra #2 / 10,500	7.2	7.4	97.0	6.6	7.8	85.0
Santa Fe / 11,445	4.9	9.5	52.0	8.3	11.6	72.0

Water Storage (Acre-feet)

Selected Reservoirs	Capacity	May Average	May 2009	May 2012	May 2013
Sanchez	103,000	26,900	25,300	6,800	6,200
Platoro	60,000	24,500	21,900	15,200	8,900
Rio Grande	51,000	24,000	19,500	21,000	6,600
Santa Maria	45,000	11,400	4,400	7,500	6,800
San Luis Lake	21,300	*	*	*	*
Mountain Home	17,300	*	*	*	*
Continental	27,000	8,200	6,300	6,800	8,400
La Jara	14,000	*	*	*	*
Terrace	18,000	8,000	9,100	7,800	4,300
Smith	5,800	*	*	*	*
Beaver Park	4,700	*	*	*	*
Big Meadows	2,400	*	*	*	*
	369,500	*	*	*	*

*Data not available

Source: USDA, Natural Resources Conservation Service, *State Basin Outlook Reports.*
http://www.nrcs.usda.gov

Table F-8

Number and Type of Wells by County

Type	Alamosa	Conejos	Costilla	Mineral	Rio Grande	Saguache	Total by Type
Residential	2,033	1,629	618	280	2,440	1,513	8,513
Household	456	411	530	456	716	399	2,968
Livestock	236	230	30	-	150	379	1,025
Irrigation	1,454	336	253	6	1,446	1,297	4,792
Commercial	94	50	15	26	152	63	400
Municipal	11	15	8	9	14	19	76
Geothermal	11	-	1	-	3	2	17
Industrial	10	6	2	1	19	9	47
Monitoring	297	15	96	14	48	350	820
All Uses	12	-	-	1	-	-	13
Other	830	65	5	55	310	480	1,745
Total	**5,444**	**2,757**	**1,558**	**848**	**5,298**	**4,511**	**20,416**

Source: Colorado Division of Water Resources, 2012 Cumulative Yearly Statistics

Table F-9

Change in Unconfined Aquifer Storage

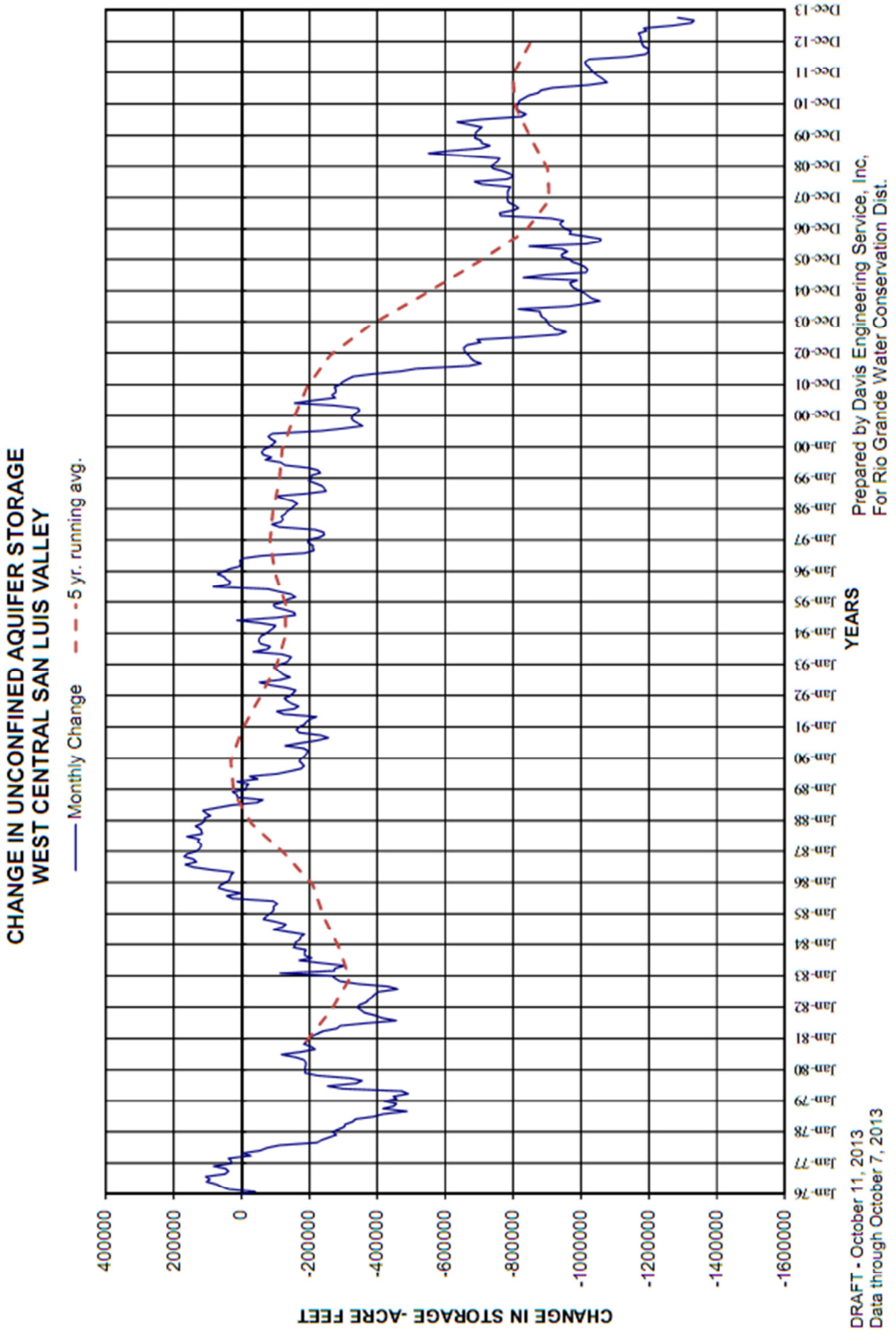
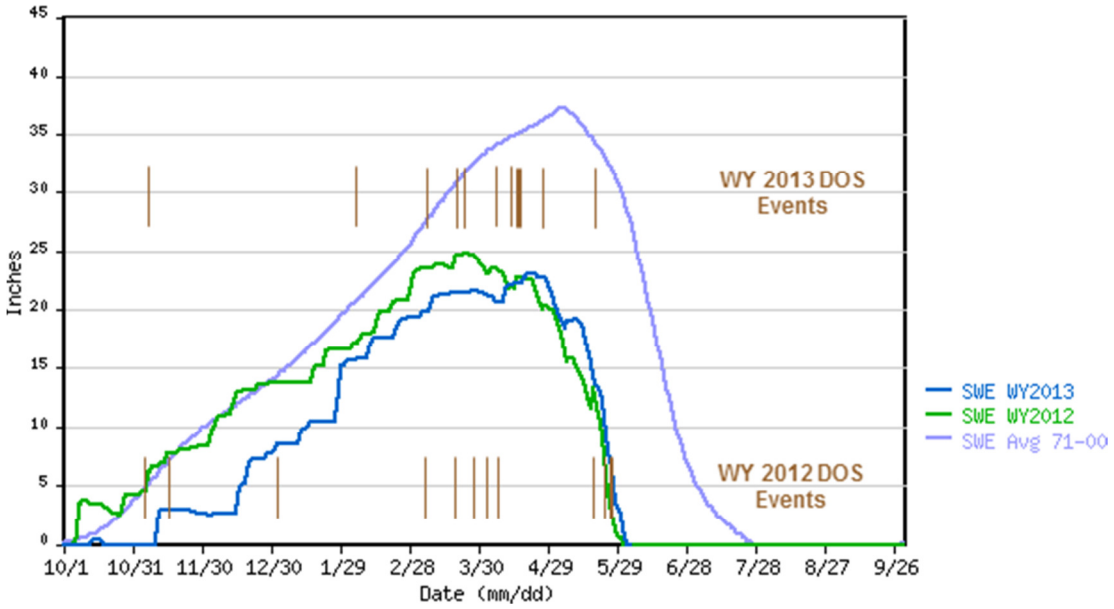
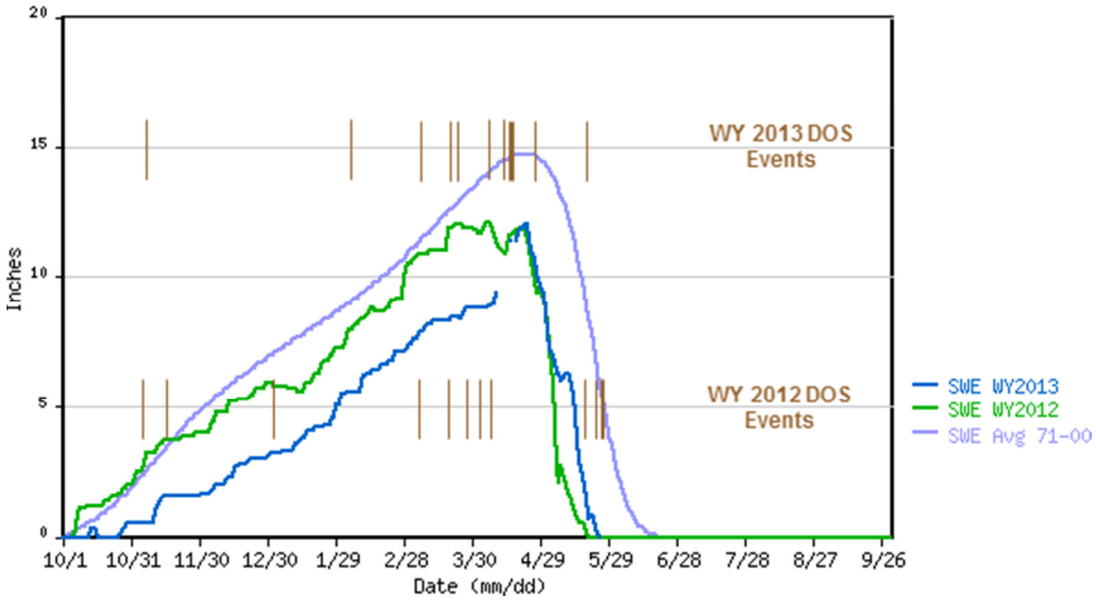


Table F-10
Dust on Snow Events and Snowpack, Wolf Creek Pass



WY – Water year
DOS – Dust on snow
SWE – Snow water equivalent
Source: Center for Snow and Avalanche Studies.
http://www.snowstudies.org/dust/index.html

Table F-11
Dust on Snow Events and Snowpack, Slumgullion Pass



WY – Water year
DOS – Dust on snow
SWE – Snow water equivalent
Source: Center for Snow and Avalanche Studies.
http://www.snowstudies.org/dust/index.html

Map F-1

Subdistrict No. 1

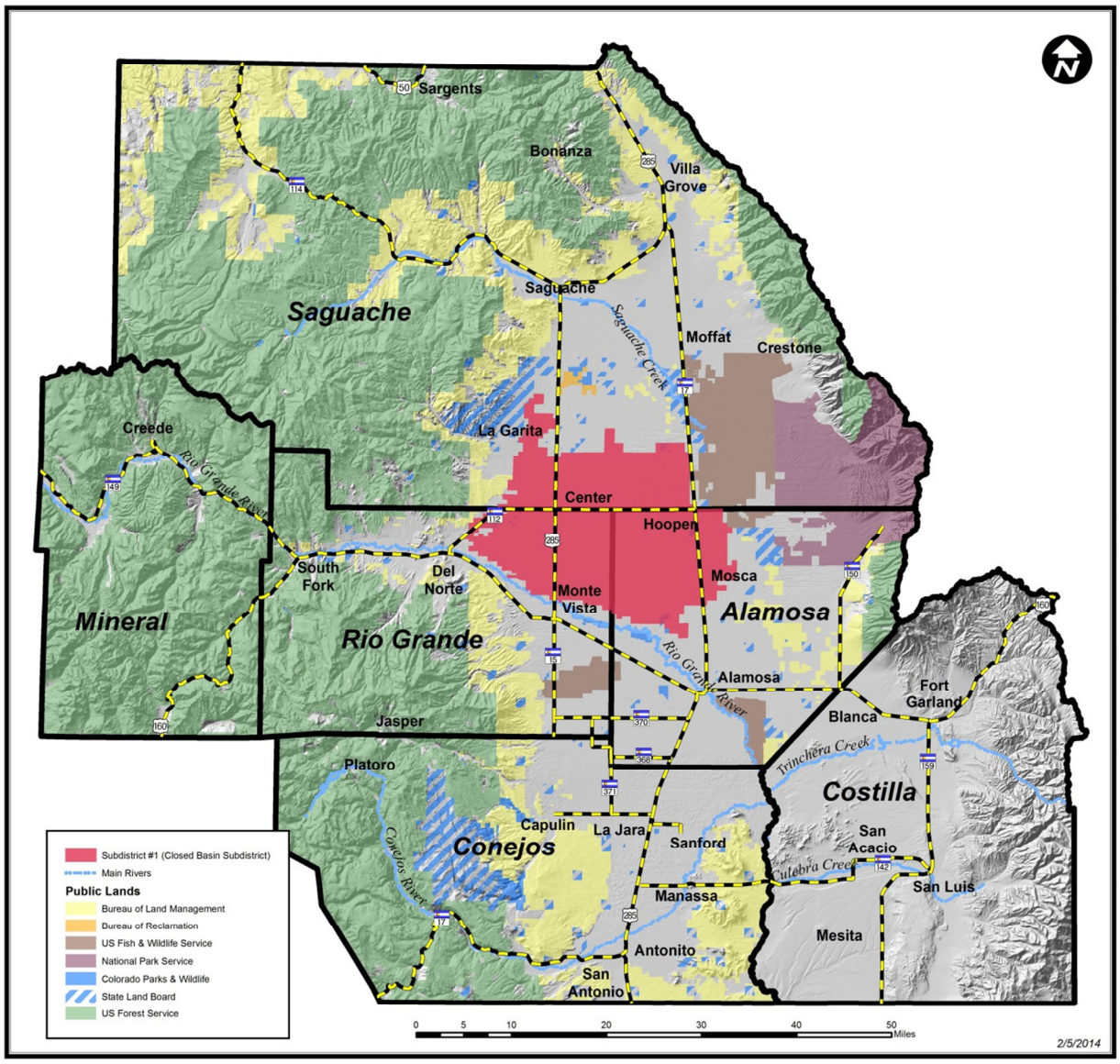


Table F-12
Rio Grande Compact Deliveries

(acre feet)

Year	Conejos River at Los Sauces	State Line
2008	177,000	393,900
2009	134,500	299,300
2010	87,000	229,500
2011	89,200	200,000
2012 [1]	31,200	126,500

Source: Colorado Division of Water Resources

[1] The figures for 2012 have not been approved by the compact commission.

Table F-13

Rio Grande Basin Roundtable Funded Projects

Projects	Basin Account	Statewide Account	Total
Alamosa River in-stream flow	$64,500	$0	$64,500
Prelminary design, Rio Grande Reservoir rehabilitation and enlargement	$0	$288,000	$288,000
Rio Grande Basin Conservation Reserve Enhancement Program	$36,750	$0	$36,750
Romer-Guadalupe channel rectification	$83,700	$0	$83,700
Santa Maria and Continental reservoirs rehabilitation and multiple use studies	$50,000	$141,700	$191,700
2008 Rio Grande riparian stabilization	$35,000	$250,000	$285,000
Platoro Reservoir restoration	$50,000	$200,000	$250,000
Conejos River and North Branch diversion and stabilization	$50,000	$333,700	$383,700
Rio Grande Reservoir refinement and enhancement of reservoir reoperation and op	$100,000	$0	$100,000
El Codo Ditch diversion and rehabilitation	$65,000	$0	$65,000
Lower Willow Creek Restoration Project	$50,000	$200,000	$250,000
Sangre de Cristo Trinchera diversion canal restoration	$48,315	$150,000	$198,315
Rio Grande conservation Reserve Enhancement Program - Phase 2	$31,500	$0	$31,500
Sangre de Cristo Trinchera diversion canal restoration - shortfall request	$54,000	$0	$54,000
2009 Rio Grande riparian stabilization - Phase 4	$50,000	$98,000	$148,000
Educating Today to Balance tomorrow's Water Supplies and Needs	$25,000	$0	$25,000
San Luis People's Ditch upgrade and rehabilitation - Phase 1	$40,000	$0	$40,000
Conejos north branch water conservation and management	$75,000	$0	$75,000
McDonald Ditch and Plaza Project - Phase 1	$40,000	$0	$40,000
Rio Grande Initiative - North Rio Grande Ranch conservation easement	$15,000	$55,000	$70,000
Santa Maria and Continental reservoirs priority studies to restore capacity	$22,000	$0	$22,000
Flaming Gorge Project Committee	$1,000	$7,143	$8,143
Platoro Reservoir crest of dam repair	$15,000	$135,000	$150,000
Sanchez Reservoir - Phase 1	$10,000	$85,000	$95,000
McDonald Ditch and Plaza Project - Phase 2	$20,000	$275,000	$295,000
Water 2012: Partnering for Colorado's Water Future	$15,600	$0	$15,600
Terrace Reservoir spillway improvements	$75,000	$1,425,000	$1,500,000
Conejos River system guaging stations	$20,000	$387,280	$407,280
Rio Grande County hydrogeologic study	$99,564	$0	$99,564
Rio Grande Initiative - Haywood Ranch conservation easement	$25,000	$400,000	$425,000
Sanchez Reservoir - Phase 2	$55,000	$859,400	$914,400
Rio Grande edition of Headwaters magazine	$0	$33,237	$33,237
Santa Maria Reservoir siphon and canal rehabilitation	$23,000	$440,750	$463,750
Quantifying Mogote/romero flows and effects on Conejos system	$16,700	$268,300	$285,000
Vallejos Ditch headgate replacement	$10,000	$90,000	$100,000
"Narrowing the Gap for Colorado's Water Future"	$23,500	$0	$23,500
Drip irrigation field trial for potato cropping	$40,000	$0	$40,000
Kerber Creek Restoration Project	$34,871	$0	$34,871
Rio Grande Basin Implementation Plan	$211,000	$100,000	$311,000
Lower Willow Creek Restoration Project - Phase 2	$55,000	$0	$55,000
McDonald Ditch and Plaza Project - Phase 2 Implementation	$22,000	$409,000	$431,000
Lone Cabin Dam repair and rehabilitation	$38,000	$232,688	$270,688
Radar monitoring and hydrogeologic modeling in the Upper Rio Grande	$37,000	$200,000	$237,000
Santa Maria Reservoir - Phase 2 Continental Dam and spillway restoration	$51,000	$962,750	$1,013,750
Total	**$1,884,000**	**$8,026,948**	**$9,910,948**

Source: Colorado Water Conservation Board, *Water Supply Reserve Account 2013 Annual Report.*
http://cwcb.state.co.us/PUBLIC-INFORMATION/PUBLICATIONS/Pages/AgencyReports.aspx

Table F-14

Closed Basin Project Deliveries

(acre-feet)

Year	Rio Grande	Blanca Wildlife Area	Other	Alamosa National Wildlife Refuge	Total
2008	13,044	1,300	1,000	2,735	17,079
2009	13,741	1,050	226	2,569	17,360
2010	12,849	800	628	2,713	17,098
2011	11,579	800	404	2,700	15,167
2012	9,409	800	406	2,660	13,283
Annual Avg.	**12,124**	**950**	**533**	**2,675**	**15,997**

Source: U.S. Bureau of Reclamation, *Report to the Rio Grande Compact Commission,* 2008, 2009, 2010, 2011, 2012.