OVERVIEW OF THE RIO GRANDE COMPACT

COLORADO PERSPECTIVES

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by
Hal D. Simpson, P.E.
Colorado State Engineer

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History and Purpose

The Rio Grande Compact was signed on March 18, 1938, by the three Commissioners representing each of the signatory states Colorado, New Mexico, and Texas, and by the Federal Commissioner on behalf of the United States. This Compact brought to end the long and contentious period of disagreement over the use of the water supplies of the Rio Grande basin in the three states above Ft. Quitman, Texas. These disagreements date back to the 1890's when Texas and Mexico claimed that upstream development had reduced their water supply.

In response to these claims, the United States in 1896 placed an embargo (removed in 1925) on any water development projects on federal lands in New Mexico and Colorado. This action was followed by the signing of the Mexican Treaty in 1906, which provides Mexico with 60,000 acre-feet of water per year. Following this act, Elephant Butte Reservoir was constructed in 1916 as part of the Rio Grande Project with a capacity of 2,638,860 acre-feet. The Rio Grande Project would irrigate 155,000 acres of land below the reservoir in Texas (43 percent of lands) and New Mexico (57 percent of lands).

Negotiations between the three states began in 1924 with the intended settlement of the claims for water from this basin. A temporary compact was signed in 1929 to preserve the status quo while the states negotiated a permanent compact to "equitably apportion the waters of the Rio Grande based on conditions obtaining on the river and within the Rio Grande basin at the time of signing of this Compact."

To assist the negotiations, the National Resources Committee and three states agreed to conduct a Joint Investigation to determine the present and future water uses of the basin based on current and anticipated irrigation requirements. The Joint Investigation was conducted in 1936 and 1937 with the final report

submitted to the Commissioners of the three states in June, 1937. The Joint Investigation Report is a very impressive study containing much useful information on streamflow, depletions, and uses from 1892 to 1935. This document and data contained therein was used by the Engineer Advisers to the Commissioners who prepared a proposal for a compact and submitted it in December, 1937. The basic principles followed by the Engineer Advisers were that water uses in each section of the river as of 1929 must be protected and that inflow-outflow relationships should be used to determine interstate delivery obligations.

M.C. Hinderlider, State Engineer and Colorado Commissioner, provided the following analysis of the Compact when it was submitted to the Colorado Legislature for ratification. "The terms of the Rio Grande Compact accomplish two major purposes: First, they protect the present use of water in the various sections of the basin by setting up schedules of delivery of water at the Colorado-New Mexico stateline and at San Marcial, which is on the head of Elephant Butte Reservoir, and by fixing the average annual releases from Elephant Butte Reservoir. Second, the terms of the Compact permit the construction and operation of additional reservoirs above Elephant Butte Reservoir to regulate the water that is being used at the present time, and to capture and make usable, for beneficial use in the Upper Rio Grande basin, water which otherwise would spill from Elephant Butte Reservoir and be lost." (Emphasis added).

Important Provisions to Colorado

In addition to protecting the 1928 to 1937 level of uses in Colorado, the Compact allowed the construction of post-compact reservoirs to regulate the highly uneven flows of the Rio Grande and Conejos River in the San Luis Valley. The runoff is such that two-thirds of the runoff occurs in one-fourth of the year and this runoff does not meet the seasonal irrigation demands in the San Luis Valley. The negotiators of the Compact expected Elephant Butte Reservoir to spill frequently and, therefore, under the terms of the Compact, post-1929 reservoirs would operate freely with little restriction. As we

have since learned by historic conditions, Elephant Butte Reservoir did not spill between 1942 and 1985. Only one post-compact reservoir of any size has been constructed in the San Luis Valley and it was Platoro Reservoir completed in 1950 with a capacity of 52,000 acre-feet on the Conejos River.

Colorado water users in the Closed Basin area north of the Rio Grande have developed water management practices to maximize the highly variable flows of the river by using large canals such as the Rio Grande Canal to recharge the shallow unconfined aquifer. Nearly all irrigation is accomplished through the use of wells to supply center pivot sprinkler systems that are much more efficient and less labor intensive. Thus, these water users divert the waters of the Rio Grande twice and use the unconfined aquifer as a reservoir to store water from wet years for dry year production.

The Compact in Article III contains the schedule of deliveries for the Rio Grande and Conejos River and it allows Colorado to increase its consumptive uses of water from the Rio Grande and Conejos River to the extent that water of suitable quality is delivered to the stateline from the Closed Basin. The Closed Basin Project was completed in 1988 and delivers water to the Rio Grande below Alamosa. The Closed Basin Project removes water from the shallow aquifer in the sump area via 170 wells that lower the water table to prevent the loss of water from non-beneficial evapotranspiration by native vegetation. The project has provided about 30,000 acre- feet of suitable quality water per year and has been limited by biofouling of some production well screens. The Bureau of Reclamation is currently attempting to resolve this problem.

Article VI contains some very important provisions that are vital to both Colorado and New Mexico. Paragraph 1 requires that credits and debits will be computed for each calendar year unless there is an actual spill of water from Elephant Butte Reservoir. This means that both states do not have a delivery obligation in a year of spill.

Paragraph 2 allows Colorado to depart from the schedule of deliveries by allowing an annual debit or the accrued debit to be up to 100,000 acre–feet. This provision allows for the natural variation in runoff within the San Luis Valley. Article VI also allows for an amount greater than 100,000 acre-feet if the water is stored in reservoirs constructed after 1937. This water would then become available to Colorado users if Elephant Butte Reservoir spills.

Paragraph 6 states that in any year in which actual spill occurs, the accrued credits of either state would be proportionally reduced by the amount of spill and the amount of spill must be increased by the gain in storage prior to the time of spill in post-1929 reservoirs. Thus, the states lose some credit water but do not have a delivery obligation for the year in which a spill occurs.

Paragraph 7 states that in a year of spill of usable water or at the time of hypothetical spill, as defined in the Compact, all accrued debits of either or both states are cancelled. This, in fact, did occur in 1985 and wiped out a large accrued debt for Colorado (512,000 acre-feet). Elephant Butte Reservoir spilled again in 1986, 1987, 1988, 1994 and 1995.

Since 1985, Colorado has operated without any accrued debits. This is due to the manner of river administration in Colorado using real-time streamflow information along with accurate projections of runoff and return flows. This administration is described in the paper prepared by Steve Vandiver and is included in these proceedings. A careful review of the Vandiver report will show the importance of real-time information for river administration and for management to maximize beneficial use.

Paragraph 8 allows the reduction of accrued debits of either state if the unfilled capacity of project storage is less than the accrued debit. The debits would be reduced proportionally for each state to a total equal to the amount of unfilled capacity. This paragraph also provides for the reduction of credit water in

Elephant Butte Reservoir for evaporation and, likewise, the reduction of debit water for evaporation held in post-1929 reservoirs in both states.

Article VII provides protection to water users below Elephant Butte Reservoir from the storage of water in post-1929 reservoirs if project storage is less than 400,000 acre-feet of usable water.

Article VIII permits the Commissioners of Texas and/or New Mexico to demand the release of water stored in post-1929 reservoirs limited by the accrued debits of New Mexico and/or Colorado necessary to bring the quantity of usable water in project storage to 600,000 acre-feet by March 1 and maintain it until April 30 of a Compact year with the intent that a normal release of 790,000 acre-feet may be made from project storage in that year.

Current Issues of Importance to Colorado

Colorado believes that all three states must comply with the provisions and intent of the Rio Grande Compact. One issue is the increasing pressure to release usable water year-round for municipal demand. This is not in accordance with Article I (l) where usable water is to be released from project storage in accordance with irrigation demands. Irrigation demands in 1929 was nearly zero in January and February. Because of the rapidly expanding population in the El Paso area, project water is being converted to municipal use and the El Paso Water Department would prefer to have releases throughout the year. Colorado cannot accept or agree to this proposed operation unless an accounting procedure is adopted that adjusts the content of project storage so that the potential for spill in May or June is not reduced or lost.

A second looming issue is the endangered Silvery Minnows which was listed by the U.S. Fish and Wildlife Service (FWS) in 1993 along with its proposed critical habitat which covers the Rio Grande from

Cochiti to San Marcial. There are several aspects of this issue that remain to be clarified including litigation over the critical habitat designation, the status and implementation of a recovery plan for the species, and the operation of federal projects subject to consultation with the FWS and possible changes to the operation of the federal projects as a result of the consultation.

Finally, the 1997 complaint filed by the United States in Federal Court requesting the court to enter a declaratory judgment quieting the title of the United States to the right to the waters of the Rio Grande and its tributaries for the purposes of the project and its treaty obligation to Mexico must be resolved. The issue is still under litigation after efforts to mediate the issue appears to have failed. It is Colorado's position that the Bureau of Reclamation must operate the reservoir and the project as intended by the authorizing legislation and the Compact. The Bureau of Reclamation, acting as an independent entity, can assure that water is delivered and accounted for without waste to the project beneficiaries, Mexico, and Hudspeth County Irrigation District.

As Colorado and New Mexico have learned in interstate compact litigation over the waters of the Arkansas River and the Pecos River, respectively, it is important to comply with the obligations of the specific Compact. Likewise, it is just as important to protect our Compact entitlements that were so carefully negotiated by our Compact Commissioners.

A SUMMARY OF COMPACTS AND LITIGATION GOVERNING COLORADO'S USE OF INTERSTATE STREAMS

COLORADO DIVISION OF WATER RESOURCES

1995

Any evaluation of the supply of water available for use to the citizens of Colorado must, of necessity, include a study of the laws which govern the topic. This evaluation must concern itself not only with state law, which tells the water administrator how to distribute water as between citizens of the state, but must also consider the ramifications of constitutional law and international law, for Colorado is so situated that the streams arising within her borders are vital to the economics of eighteen other states and the Republic of Mexico.

The consideration of geography alone is enough to make Colorado a prospective defendant in any interstate water case, but consideration of economics appears to be even more important. One-twentieth of the land in Colorado is under irrigation, a proportion which exceeds any other state. Considering irrigation by surface water only, Colorado has half again as much land under irrigation as any other state. The ability to protect and defend this huge portion of the state's economy is of major importance to Colorado.

Colorado is directly involved in one international treaty, nine interstate compacts, two U. S. Supreme Court decrees, and one interstate agreement, but before a discussion of the treaty, compacts, and decrees, it would seem appropriate to discuss the mechanisms available for the solution of controversies between states.

Three methods are available in the United States for this purpose:

1. Direct legislation by Congress,
2. A suit by one state against another in the United States Supreme Court,
3. A compact between states approved, where necessary, by Congress.

The first of these methods is very limited in scope, for while Congress has absolute power in administration of territories, its ability to interfere between states is permitted only within its constitutional powers, which in themselves are very limited.

The second method is granted by Article III, Section 2 of the U.S. Constitution, wherein it grants each state the right to seek redress from legal wrongs before the Supreme Court. This method is a civilized substitution for war between the states, and often the results are as unpredictable. Two major drawbacks can result from this course. The first is the difficulty in securing execution of a judgment against a state since each is a sovereign body not subject to the laws and actions of the other, necessitating some kind of Federal intervention for enforcement. The second drawback, and perhaps the most insurmountable, is that not all matters in dispute between states are capable of judicial determination.

The third method of resolution of interstate controversies is provided for in the U.S. Constitution in Article I, Section 10, Clause 3, whereby it is stated that, ". . . no state shall, without the consent of Congress, . . . enter into any agreement or compact with another state, or with a foreign power". This method provides the advantage of lengthy discussion of the controversy outside of a formal court environment by individuals who are knowledgeable on the topic, leading to a mutual understanding of problems, and hopefully, a mutually beneficial solution in the form of a compact.

Often, great criticism is levelled against the Colorado representatives who were instrumental in the framing of the several compacts to which the state is party. These criticisms range from the accusation that they "gave our water away" to the charge that they were "short-sighted" and should have been more cognizant of Colorado's tremendous natural resources and its consequent potential for future growth and need for water. Certainly, the Compact negotiators were not blessed with superhuman abilities and did, in fact, make some questionable decisions, but before judging them too harshly it is imperative that the situation, as it existed at the time of negotiation, be understood.

The first area to examine is that of the prevailing legal mood in the U.S. Supreme Court with respect to the equitable settlement of water controversies. The Supreme Court had decided many interstate controversies, but only two cases pertained to the question of water and irrigation in the arid and relatively unpopulated West. Colorado was a defendant in both of these cases.

The first case was Kansas v. Colorado, 185 U.S. 208; 206 U.S. 46; (1901, 1907). This case concerned the Arkansas River and its depletion by irrigation. From this case, the principle of "equitable apportionment" was evolved, which could be construed to allow one state all or substantially all of the waters of a stream in order to offset other advantages the other state may have. This principle relied heavily on preserving existing developed uses, and the ramifications of this kind of thinking were apparent when considering the state of development of Colorado as opposed to California on the Colorado River.

The second landmark case which had great bearing on Colorado's negotiators was Wyoming v. Colorado, 259 U.S. 419, 496; 260 U.S. 1; (1922). This case concerned the waters of the Laramie River, and the Supreme Court upheld the theory that when two contesting states both operate under the doctrine of prior appropriation, then that doctrine can be applied on an interstate basis. Having been severely limited in these two cases, Colorado's negotiators began to search for a more viable way to protect Colorado's waters for future use.

The second constraint placed on the negotiators was the lack of good hydrologic data. For example, in 1922 the historic records indicated a mean annual flow in the Colorado River at Lee Ferry of 15,000,000 acre feet. We now know that the period of record available was a wet one and that the long-term mean flow at Lee Ferry was approximately 13,000,000 acre feet per year. In another instance, the streams in the Republican River Compact were allocated, in some instances, on the basis of less than ten years of record. History shows some of these to have been underestimated by as much as 80%.

We see, then, that while the Compacts to which Colorado is a signatory state are restrictive, the potential for much more damaging Court decisions existed.

With this brief background, the following summaries are presented. These summaries in no way are conclusive or all-encompassing, as each Compact is a very complicated and difficult document. Any decisions concerning any Compact should be made only after a thorough evaluation of the full document.

INTERNATIONAL AND INTERSTATE DOCUMENTS AFFECTING COLORADO'S USE OF WATER

International Treaties

Mexican Treaty on Rio Grande, Tijuana, and Colorado Rivers - 1945

Interstate Compacts

Colorado River Compact	1922
La Plata River Compact	1922
South Platte River Compact	1923
Rio Grande River Compact	1938
Republican River Compact	1942
Costilla Creek Compact	1944 (Rev. 1963)
Upper Colorado River Compact	1948
Arkansas River Compact	1948
Animas-La Plata Project Compact	1969

U. S. Supreme Court Cases

Nebraska v. Wyoming	325 U.S. 589 (1945)
Wyoming v. Colorado	353 U.S. 953 (1957)
Tex.& New Mex. v. Colorado	391 U.S. 901 (1968)

Agreements

Pot Creek Memorandum of Understanding -- 1958

COLORADO RIVER COMPACT
November 24, 1922

Signatory States: Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming

Major Purposes:

1. Equitable division of the waters of the Colorado River (Art. I)
2. Establish relative importance of different uses (Art. II)
3. Promote interstate comity (Art. I)
4. Remove causes of present and future controversies (Art. I)
5. Secure expeditious agricultural and industrial development of the basin (Art. I)

Salient Provisions:

1. Divides Colorado River Basin into the Lower Basin (California, Arizona, Nevada) and the Upper Basin (Colorado, Utah, New Mexico, Wyoming) at Lee Ferry, Arizona. (Art. I and II)
2. Allocates 7,500,000 acre-feet of consumptive use to each basin per annum. (Art. III)
3. Allows Lower Basin to increase its consumptive use by 1,000,000 acre feet per year. (Art. III)
4. Provides for Mexican allocation, first from surplus waters above the 15,000,000 acre feet per year, and secondly splits obligation equally between the basins. (Art. III)
5. Provides that Upper Basin shall deliver 75,000,000 acre feet in each consecutive 10-year period to the Lower Basin. (Art. III)
6. Subordinates navigation use to domestic, agriculture, and power purposes. (Art. IV)
7. Subordinates power use to domestic and agricultural purposes. (Art. IV)
8. Termination of compact by unanimous agreement of all signatory states. (Art. X)

LA PLATA RIVER COMPACT
November 27, 1922

Signatory States: Colorado and New Mexico

Colorado Commissioner: State Engineer

Major Purposes:

1. Equitable distribution of the waters of the La Plata River (Preamble)
2. Remove causes of present and future controversy (Preamble)
3. Promote interstate comity (Preamble)

Salient Provisions:

1. State of Colorado shall at her own expense operate two gaging stations on the La Plata River--one being the Hesperus station and one being the interstate station at or near the state line. (Art. I)
2. Flow at the Hesperus station means the river flow at that station plus the amount of concurrent diversions above that station. (Art. I)
3. Flow at the interstate station means the river flow at that station plus one-half of the concurrent diversions of the Enterprise and Pioneer Canals, plus any other diversion in Colorado for use in New Mexico. (Art. I)
4. Both gages will be operated between February 15th and December 1st. (Art. I)
5. Between December 1st and February 15th each state has unrestricted use of all water within its boundaries. (Art. II)
6. Between February 15th and December 1st the water shall be apportioned as follows:
   a. Each state has unrestricted use on those days where the interstate station has a mean daily flow of 100 cfs or more. (Art. II)
   b. On all other days, Colorado must deliver to the interstate station half of the mean flow at Hesperus for the preceding day, but not more than 100 cfs. (Art. II)
7. Whenever the flow is so low that the state engineers of each state agree that greater beneficial use can be obtained, the water can be distributed to each state successively in alternate periods in lieu of the schedule set in (6) above. (Art. II)
8. Substantial delivery of water in accordance with the Compact is deemed a compliance, and minor irregularities shall be disregarded. (Art. II)
9. Compact can be modified or terminated by mutual consent of the signatory states.

SOUTH PLATTE RIVER COMPACT
April 27, 1923

Signatory States: Colorado and Nebraska

Colorado Commissioner: State Engineer

Major Purposes:

1. Remove all causes of present and future controversy between the states and its citizens with respect to the South Platte River (Preamble)

2. Promote interstate comity (Preamble)

Salient Provisions:

1. "Upper Section" means that portion of the South Platte in Colorado upstream of the west boundary of Washington County. (Art. I)

2. "Lower Section" means that portion of the South Platte between the west boundary of Washington County and the stateline. (Art. I)

3. "Flow of the river" means the measured flow at Julesburg plus the inflow below that station and above the diversion works of the Western Irrigation District in Nebraska. (Art. I)

4. The waters of Lodgepole Creek are divided at a point two miles north of the stateline. Nebraska is entitled to exclusive use above the division point, and Colorado has exclusive use of all waters below the division point. (Art. III)

5. Colorado has the right to full and uninterrupted use of all the waters in the "Lower Section" during the period of October 15th to April 1st, except that should Nebraska construct the South Divide Canal with a heading near Ovid, Colorado, then that canal will bear an appropriation date of December 17, 1921, and Colorado shall have full use of the waters in the "Lower Section" plus 35,000 acre-feet less the amount diverted by the South Divide Canal under its appropriation date during the period October 15th to April 1st. (Art. IV and VI)

6. Between April 1st and October 15th, Colorado shall not permit diversions from the "Lower Section" by Colorado appropriators whose decrees are junior to June 14, 1897, on any day when the interstate station shows a mean flow less than 120 cfs. (Art. IV)

7. Because of climatic conditions, minor irregularities in the delivery of water shall be disregarded. However, if a deficiency in delivery should result from neglect on the part of Colorado, the deficiency shall be made up within 72 hours. (Art. IV)

8. Colorado waives any objection it may have to the diversion of waters in Colorado for use in Nebraska through the Peterson Canal or other canals in the Julesburg Irrigation District. (Art. V)

9. The Compact may be modified or terminated by mutual consent of the signatory states. (Art. X)

RIO GRANDE COMPACT
March 18, 1938

Signatory States: Colorado, New Mexico, and Texas

Colorado Commissioner: State Engineer

Major Purposes:

1. To remove all cause of present and future controversy between the states concerning the waters of the Rio Grande above Ft. Quitman, Texas (Preamble)

2. To promote interstate comity (Preamble)

3. To effect an equitable apportionment of the waters of the Rio Grande above Ft. Quitman, Texas (Preamble)

Salient Provisions:

1. Rio Grande Basin means all of the territory drained by the Rio Grande and its tributaries in Colorado, New Mexico and Texas.

2. The Commission shall cause to be maintained and operated, among others, the following stream gaging stations: (Art. II)

    a. Rio Grande near Del Norte above the principal points of diversion to the San Luis Valley
    b. Conejos River near Mogote
    c. Los Pinos River near Ortiz
    d. San Antonio River at Ortiz
    e. Conejos River at its mouth near Las Sauses
    f. Rio Grande near Lobatos
    g. Automatic water stage recorders on all reservoirs constructed after 1929, as well as stream gaging stations below such reservoirs.

3. Colorado is obliged to deliver at Lobatos the sum of the amounts set forth in the delivery schedules for the Conejos River and the Rio Grande less 10,000 acre-feet. The Conejos Index Supply includes the San Antonio River and Los Pinos River flows for the months April through October. These schedules require zero delivery for an index of 100,000 acre-feet, up to 68% delivery for an index of 700,000 acre-feet on the Conejos, and 30% delivery for an index of 200,000 acre-feet, and up to 60% delivery for an index of 1,400,000 acre-feet on the Rio Grande (see attached graph). (Art. III)

4. If the Closed Basin is used for delivery of water to the Rio Grande, the water must contain no more than 45% sodium ions in the total positive ion count when total dissolved solids exceed 350 ppm. (Art. III)

RIO GRANDE COMPACT (cont.)

5. Delivery credits and debits shall be computed on the basis of each calendar year, and Colorado's annual or accrued debit shall not exceed 100,000 acre-feet except as either or both may be caused by holdover storage in reservoirs constructed after 1937. (Art. VI)

6. Colorado shall retain, insofar as possible, water in storage at all times to the extent of her accrued debit. (Art. VI)

7. In any year in which actual spill occurs, accrued credits are reduced in proportion to the amount of credit held by Colorado and New Mexico, and in any year in which there is actual spill of usable water, all accrued debits are canceled. (Art. VI)

8. In any year that accrued debits exceed the minimum unfilled capacity of project storage, such debits shall be reduced proportionally to an aggregate amount equal to the minimum unfilled capacity. (Art. VI)

9. No increase in storage in reservoirs constructed after 1929 is permitted whenever there is less than 400,000 acre-feet of usable water in project storage. (Art. VII)

10. During January of any year, the Commissioner for Texas or New Mexico may demand the release of water from reservoirs constructed after 1929 to the amount of the accrued debit of Colorado and/or New Mexico. (Art. VIII)

11. Review of nonsubstantive changes in the Compact can be considered every fifth year. (Art. XIII)

12. The schedules of delivery in the Compact shall never be changed as a result of an increase or diminution in the delivery of water to Mexico. (Art. XIV)

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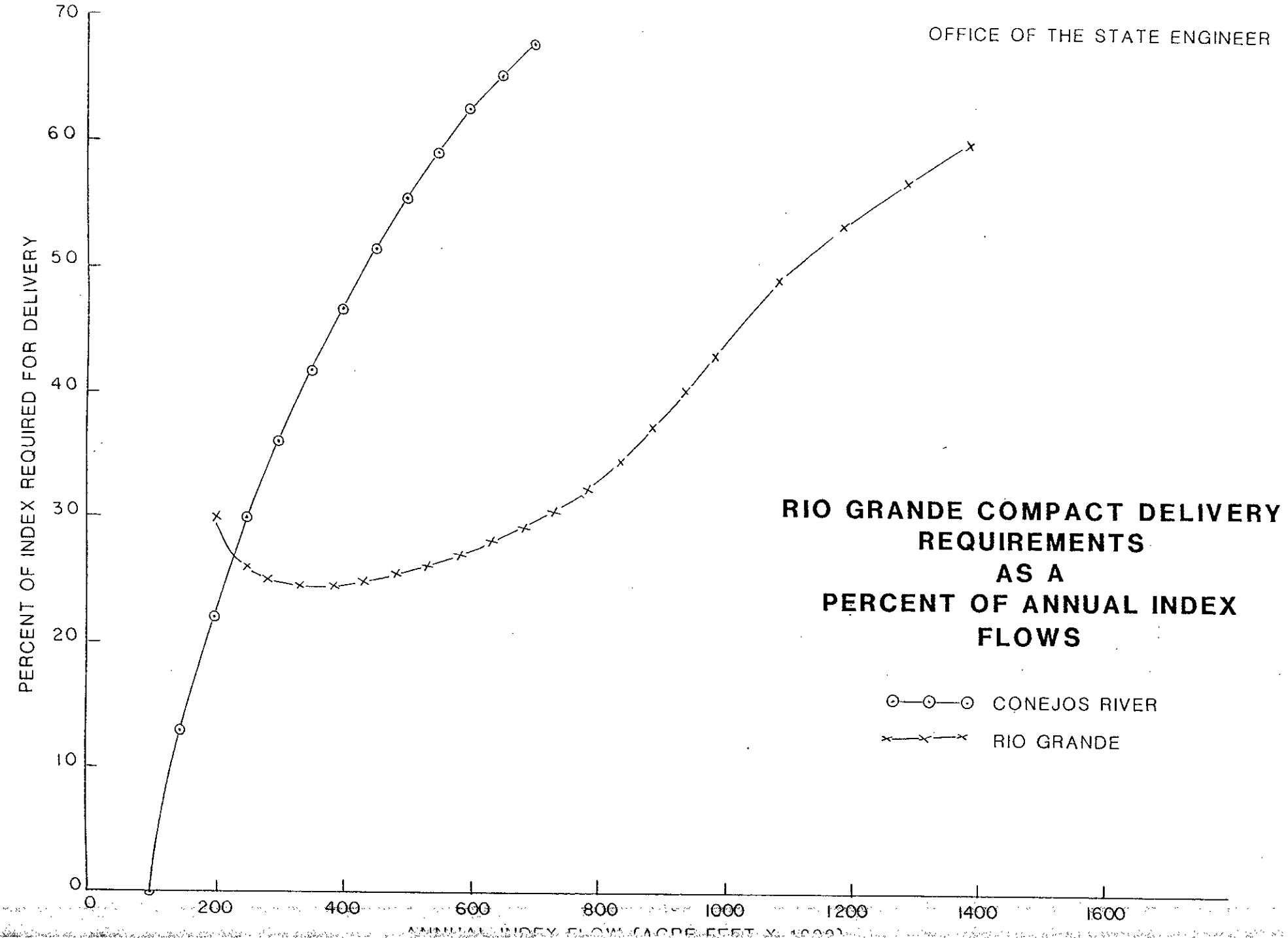

RIO GRANDE COMPACT DELIVERY REQUIREMENTS AS A PERCENT OF ANNUAL INDEX FLOWS

⊙—⊙—⊙ CONEJOS RIVER

×—×—× RIO GRANDE

REPUBLICAN RIVER COMPACT
December 31, 1942

Signatory States: Colorado, Kansas and Nebraska

Colorado Commissioner: State Engineer

Major Purposes:

1. Provide for most efficient use of water for multiple purposes (Art. I)

2. Remove all present and future controversy (Art. I)

3. Promote interstate comity (Art. I)

4. Recognize that the most efficient utilization of waters in the basin is for beneficial consumptive use (Art. I)

5. Promote joint action between the U.S. and the states in the efficient use of water and in the control of floods (Art. I)

Salient Provisions:

1. Allocation of waters are based on a computation of average, annual virgin water supply in the respective streams. (Art. III)

2. Colorado is allocated the beneficial use of the following waters on an annual basis:

North Fork of the Republican	10,000 acre-feet
Arikaree River	15,400 acre-feet
South Fork of the Republican	25,400 acre-feet
Beaver Creek	3,300 acre-feet
Total	54,100 acre-feet

plus the entire supply of Frenchman Creek and Red Willow Creek in Colorado. (Art. IV)

3. Kansas is allocated on an annual basis 190,300 acre-feet of beneficial consumptive use and Nebraska 234,500 acre-feet. (Art. IV)

4. No provision is made for any debit or credit system, but provisions are made for readjustment of historical, annual virgin flows should they vary more than 10% from those set forth in the Compact. Reallocations can be made on these readjusted flows. (Art. III)

COSTILLA CREEK COMPACT

September 30, 1944
(Amended February 7, 1963)

Signatory States: Colorado and New Mexico

Colorado Commissioner: State Engineer

Major Purposes:

1. Equitable division of the waters of Costilla Creek (Art. I)
2. Remove present and future causes of interstate controversy (Art. I)
3. Assure the most efficient utilization of water (Art. I)
4. Provide for integrated operation of existing and prospective irrigation facilities in the two states (Art. I)
5. Adjust conflicting jurisdictions of the two states over irrigation works diverting and storing water in one state for use in both states (Art. I)
6. Equalize benefits of water from Costilla Creek (Art. I)
7. Place the beneficial application of water on an equal basis in both states (Art. I)

Salient Provisions:

1. Provides for the calculation of a safe yield prior to delivery of water each year. (Art. II)
2. Defines an irrigation season (May 16 - Sept. 30) and a storage season (Oct. 1 - May 15). (Art. II)
3. Establishes a duty of water of one cubic-foot per second for each 80 acres of land irrigated. (Art. III)
4. Involves the relinquishment of Colorado water rights and the change of decreed amounts. (Art. III)
5. Establishes schedules of delivery to each state based on water available. (Art. V)
6. Prohibits direct flow diversions during the storage season. (Art. V)

UPPER COLORADO RIVER COMPACT
October 11, 1948

Signatory States: Arizona, Colorado, New Mexico, Utah and Wyoming

Colorado Commissioner: Appointed by the Governor

Major Purposes:

1. Provide for the equitable division of the waters of the Upper Basin allocated by the terms of the Colorado River Compact (Art. I)

2. Establish the obligations of each state of the Upper Basin with respect to required deliveries at Lee Ferry, as set forth in the Colorado River Compact (Art. I)

3. Promote interstate comity (Art. I)

4. Remove causes of present and future controversies (Art. I)

5. Secure the expeditious agricultural and industrial development of the Upper Basin (Art. I)

Salient Provisions:

1. Apportionment of waters of the Upper Basin as follows:

Arizona	50,000 acre-feet/yr.

Of the total beneficial consumptive use allocated to the Upper Basin less the 50,000 acre-feet per year to Arizona, the apportionment is (Art. III):

Colorado	51.75%
New Mexico	11.25%
Utah	23.00%
Wyoming	14.00%

2. The apportionment is based upon the allocation of man-made depletions, and beneficial use is the basis, the measure, and the limit of the right to use. (Art. III)

3. No state shall exceed its apportioned use in any water year when the effect of such use is to deprive another signatory state of its apportioned use. (Art. III)

UPPER COLORADO RIVER COMPACT (cont.)

4. If a call should be placed at Lee Ferry by the Lower Basin, the extent of curtailment by each state of the Upper Basin shall be determined by the following:

   a. The extent and times of curtailment shall assure full compliance with Article III of the Colorado River Compact. (Art. III)
   b. If any state shall have in the ten-year period preceding the call exceeded its allocation, it shall make up that overdraft before demand is placed on any other state. (Art. IV)
   c. Curtailment shall be proportioned among the states in the same ratio as beneficial use of waters occurred during the preceding year, provided that use by rights which predate November 24, 1922, shall be excluded. (Art. IV)

5. The Compact recognizes the provisions of the La Plata River Compact, and consumptive use of water under it shall be charged to the respective states under Article III of this Compact. (Art. X)

6. Apportions the waters of the Little Snake River between Colorado and Wyoming differentially between rights perfected before the Compact and those perfected after its signing. (Art. XI)

7. Apportions the waters of Henry's Fork, a tributary of the Green River between Utah and Wyoming. (Art. XII)

8. Apportions the waters of the Yampa River between Colorado and Utah such that Colorado must ensure that the flow of the Yampa at Maybell must not fall below 5,000,000 acre-feet for any consecutive 10-year period. (Art. XIII)

9. Apportions the waters of the San Juan River system between Colorado and New Mexico in such a way that Colorado agrees to deliver in the San Juan and its tributaries enough water to meet New Mexico's entitlement under Article III considering the water which originates within New Mexico proper. (Art. XIV)

ARKANSAS RIVER COMPACT
December 14, 1948

Signatory States: Colorado and Kansas

Colorado Commissioners: One resident from former Water District 14 or 17, one resident from former Water District 67, and the Director of the Colorado Water Conservation Board

Major Purposes:

1. Settle existing and future controversy between the states concerning the utilization of the waters of the Arkansas River (Art. I)

2. Equitably divide and apportion the waters of the Arkansas River between Colorado and Kansas as well as the benefits which arise from the construction of John Martin Reservoir (Art. I)

Salient Provisions:

1. The conservation pool at John Martin Reservoir will be operated for the benefit of water users in Colorado and Kansas, both upstream and downstream from the dam. (Art. IV)

2. The Compact is not intended to impede development of the Arkansas Basin in either state provided that the waters of the Arkansas River shall not be materially depleted in usable quantity or availability. (Art. IV)

3. From November 1st to March 31st (winter storage) of each year, all water entering John Martin Reservoir shall be stored up to the limit of the conservation pool, except that Colorado can demand release of the river inflow up to 100 cfs as long as no waste occurs. (Art. V)

4. Summer storage in John Martin Reservoir shall commence on April 1st and continue to October 31st of each year. All water entering the reservoir during this period shall be stored except:
   a. When Colorado water users are operating under decreed priorities.
   b. Colorado may demand releases of river inflow up to 500 cfs and Kansas may demand releases of water equivalent to that portion of river inflow between 500 cfs and 750 cfs regardless of Colorado releases. (Art. V)

5. Releases of stored water shall be made upon concurrent or separate demands by Colorado or Kansas at any time during the summer storage period. Limitations imposed are:
   a. Unless specifically authorized by the Compact Administration, separate releases by Colorado shall not exceed 750 cfs and separate releases by Kansas shall not exceed 500 cfs.
   b. Concurrent releases shall not exceed 1250 cfs.
   c. When water stored in the conservation pool is less than 20,000 acre-feet, releases to Kansas shall not exceed 400 cfs and concurrent releases shall not exceed 1000 cfs. (Art. V)

6. When the supply in the conservation pool falls below a 14-day supply level, the Compact Administration will notify the State Engineer of Colorado of the date when the supply will be exhausted, and at that time, Colorado priorities above and below the dam will be administered together. (Art. V)

7. When water is available in the conservation pool at John Martin Reservoir, Colorado users above the dam shall not be effected by priorities located below John Martin Reservoir. (Art. V)

8. When Colorado reverts to administration of decreed priorities, Kansas shall not be entitled to any river flow entering John Martin Reservoir. (Art. V)

ANIMAS-LA PLATA PROJECT COMPACT
June 7, 1969

Signatory States: Colorado and New Mexico

Colorado Commissioner: Not Specified

Major Purposes:

1. Implement the operation of the Animas-La Plata Reclamation Project
2. Consideration of interstate comity

Salient Provision:

Provides New Mexico with the right to divert and store water from the La Plata and Animas River systems under the Project with the same validity and equal priority as those rights granted by Colorado courts for Colorado users of Project water, providing such uses are within New Mexico's allocation in the Upper Colorado River Compact.

NEBRASKA v. WYOMING
325 U.S. 589 (1945)

Salient Provisions:

1. Colorado is prohibited from diverting water from the North Platte River and its tributaries for irrigation of more than 135,000 acres in Jackson County during one irrigation season. (This value was changed to 145,000 acres by the Court on June 14, 1953).

2. Colorado is prohibited from storing more than 17,000 acre-feet of water for irrigation purposes from the North Platte River and its tributaries in Jackson County between October 1st of any year and September 30th of the following year.

3. Colorado is prohibited from exporting out of the basin of the North Platte River and its tributaries in Jackson County more than 60,000 acre-feet in any consecutive 10-year period.

4. Colorado and Wyoming are required to maintain accurate records of irrigated acreage, volumes of water stored, and volumes of water exported for inspection at all times.

5. This decree does not affect or restrict the use or diversion of water from the North Platte River and its tributaries for ordinary and usual domestic, municipal, and stock watering purposes.

WYOMING v. COLORADO
353 U.S. 953 (1957)

Salient Provisions:

1. Permits Colorado to divert from the Laramie River and its tributaries 49,375 acre-feet per year, subject to the following limitations:

   a. No more than 19,875 acre-feet per year may be diverted by Colorado for use outside the basin.
   b. No more than 29,500 acre-feet per year may be diverted by Colorado for use within the basin, of which not more than 1,800 acre-feet can be diverted after July 31st of each year.
   c. Any portion of the 19,875 acre-feet per year not diverted by Colorado for use outside the basin can be added to the 29,500 acre-feet per year permitted for use within the basin.
   d. All waters diverted by Colorado for use within the basin are restricted to irrigation use on those lands designated by the court at the time of the decree.

2. This decree does not prejudice the right of either state to exercise the use of the waters of Sand Creek.

TEXAS AND NEW MEXICO v. COLORADO
391 U.S. 901 (1968)

Salient Provisions:

1. Based upon stipulation the Court granted a motion for continuance provided that:

   a. Colorado delivers at the state line every year the obligation established by the schedules of Article III of the Rio Grande Compact.
   b. Colorado shall use all available administrative and legal powers including curtailment of diversions to meet the schedule.
   c. Colorado makes frequent and regular reports to the plaintiffs of all measures taken to effect compliance.

POT CREEK MEMORANDUM OF UNDERSTANDING

April 1, 1958

Signatory States: Colorado and Utah

Major Purpose:

Develop a workable and equitable division of the waters of Pot Creek between the signatory states.

Salient Provisions:

1. Both states agree that a compact is necessary, but that prior to its formulation, a workable system must be developed.

2. The states agree to the appointment of a water commissioner with authority to administer in both states with Colorado bearing 20% of his expenses.

3. Establishes a schedule of priorities for use in both states and defines a period before which direct flow diversions cannot be exercised, namely May 1st of each year.

The Administration of the Rio Grande Compact in Colorado

Steven E. Vandiver, PE
Division Engineer
Colorado Division of Water Resources

44th Annual New Mexico Water Conference
December 2, 1999

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EXECUTIVE SUMMARY

The administration of the Rio Grande Compact in Colorado has evolved from the signing of the document in 1939 until the present time. Interstate and intrastate litigation has driven that evolution. Once the issues were defined, Colorado had to determine an administrative scheme that would allow her to fully utilize the entitlements provided in the Compact, and still meet the obligation to the downstream states. Fortunately Colorado had the infrastructure in place to move forward and resolve how it could be accomplished in a practical and reasonable manner. Since 1968 Colorado has met or exceeded her obligation under the Compact and has developed the ability to accurately deliver the amount of water annually required.

The process of accomplishing both of these demands has required considerable effort, time and resources. It takes the full cooperation of the water users on the Rio Grande and Conejos River, the State of Colorado and the various agencies involved with water administration to accomplish these tasks. The process of administrating the Rio Grande Compact is discussed in this paper.

THE ADMINISTRATION OF THE RIO GRANDE COMPACT IN COLORADO

Introduction

The Rio Grande Compact requires Colorado to annually deliver certain amounts of water to the Stateline according to the delivery schedules in Article III. On any given year this can require from 25 to 50 percent of the water generated in the Rio Grande and Conejos River basins to arrive at the Lobatos gage just above the border with New Mexico. Since the diverters have the capability of diverting and using most of the water generated in both basins, it is necessary that a process be in place that enables the State to ensure that her obligation is met. One can imagine the turmoil that can be generated when water is bypassed to the Stateline when there is a significant demand for that water in Colorado from the water rights owners on the rivers. A great amount of work was required by the State and the water users in the San Luis Valley to reach an administrative scheme that allowed Colorado to use her entitlements under the Compact and still meet her obligations to the downstream states.

Since 1939, the administration of the Rio Grande Compact in Colorado has been an evolutionary process marked by three distinct periods. The first period from 1939-1967 was a time when the Colorado officials made the decision to continue with the administration of water rights as they had during the study period of 1927 to 1936. This action worked well until 1952 when Colorado under delivered approximately 154,000 acre-feet. The reasons for this under-delivery are largely unknown, but it began a period of under deliveries and accrued debit that continued until 1967 when that accrued debit reached approximately 940,000 acre-feet. The year before that, in 1966, the States of Texas and New Mexico had brought an action against Colorado in the U.S. Supreme Court to force Colorado to comply with the provisions of the Compact. In May of 1968, the Court granted the three states and the U.S. a stipulation for continuance of the case as long as Colorado met her Compact obligation until she was once again in compliance.

The second period, from 1968 to 1985, Colorado administered the Compact pursuant to the stipulation and was forced to determine a way to curtail water rights in a manner that would allow the appropriate delivery of water to the Lobatos gage near the Stateline. Since this administrative scenario had never been attempted, the State Engineer entered a very difficult time of working with the water users on both the Conejos River and the Rio Grande to determine how this issue might be resolved. In 1975, after several years of negotiated informal annual operative criteria, the State Engineer promulgated rules and regulations for the intrastate administration of the Compact on each river and as between the two rivers. In 1979, the numerous protests to the proposed rules were heard in the local District Court in an eleven-week trial. The decision rendered by the Court upheld the State Engineer's Compact rules but the ruling was appealed to the Colorado Supreme Court. The Supreme Court decision upholding the State Engineer's rules was made in 1983. Therefore, from approximately 1968 to present, the State Engineer has directed that the Compact be administered as a two-river system with each river responsible for its own delivery obligation dictated by Article III. The rules also provided that any curtailment of diversions would come from the junior water rights which would have otherwise been in priority on any given day of administration. During this period of litigation over the rules, Colorado met or exceeded its obligation each year from 1968 through 1984 because of the incentive provided by the U.S. Supreme Court stipulation. In fact, because of the hydrologic and climatologic vagaries of the Upper Rio Grande Basin, coupled with the negative consequences of noncompliance with the stipulation, Colorado was forced to over-deliver to ensure that she met the obligation. This very conservative administration resulted in a reduction in the accrued debit of approximately 430,000 acre-feet in 17 years.

The third and current period began in June of 1985, when the Rio Grande Project in Southern New Mexico spilled and eliminated the debt of Colorado and New Mexico. This gave cause for the three states to recommend to the U.S. Supreme Court that the 1966 case be dismissed, which it was on December 9, 1985. Since 1985, Colorado has operated under the Compact as it was written and has met or exceeded

their obligation since that time. What is required to accomplish this administration is the topic of this paper and will be described in detail below.

Pertinent Colorado Water Law

When the State of Colorado achieved statehood in 1876, her corresponding constitution included and adopted the Doctrine of Prior Appropriation as the basis for the appropriation of the water. This was a matter of necessity due to the water-short characteristics of many of the streams in the State. It was recognized early on that because of the large numbers of competing appropriations that some judicial confirmation would be required to allow for the orderly distribution of the State's water. It was also authorized by the legislature in 1883 that a State Engineer would be given the responsibility to administer the water rights of the State.

As early as 1883, general adjudications were held on the Conejos River which confirmed and decreed water rights in relative priority based on the date of appropriation and the amount required to satisfy the irrigation requirements under each ditch. The first general adjudication that occurred on the Rio Grande mainstem was signed on May 1, 1896. These adjudicatory processes were widely noticed and all individuals that had completed their appropriations were allowed to come forward and provide proof of their claims. The date of appropriation, the legal description of the point of diversion, the flow rate of the appropriation and the use to which the water right was to be placed was determined by the court and confirmed. The court referee investigated each claim for accuracy, ranked the water rights according to the appropriation dates and recommended the court decree them accordingly. The State Engineer, through water commissioners, used these decrees to administer and deliver the available water to those who were entitled to it. Subsequent supplemental adjudications would include all new or existing claims not previously decreed and create additions to the water rights administrative list. All water rights in these subsequent adjudications were "junior" to all previously adjudicated rights regardless of their appropriation date. Therefore, a water right may have a very early appropriation date, but having failed to participate in the original adjudication, would end up junior to all others in the original adjudication.

The following table describes the adjudication dates and the amounts decreed in each on the two Compact streams in Colorado. The Conejos adjudications include the Los Pinos and the San Antonio rivers because they are tributaries. It is readily apparent that the vast majority of the water available in both systems was decreed by around the turn of the century. The hydrology of the two basins described later in the text will show the grossly over-appropriated nature of the two streams.

Rio Grande and tributaries	Conejos River and tributaries
1896 – 3209 cfs	1883 – 1459 cfs
1903 – 2501	1890 – 1312
1916 - 678	1914 - 502
1934 - 353	1915 to present – 375
1959 - 765	
1960 to present – 140	
Total including instream flow – 9139 cfs	Total including instream flow – 4104 cfs

These adjudications established early on the system of administration that has followed for more than 100 years. Gaging stations were established on all streams that had become fully appropriated that allow the water commissioners to determine the amount of water that was available for distribution. Recognition of return flows and tributary inflow to the stream make the task even more interesting. On the Rio Grande mainstem, gages were established routinely along the course of the river to help recognize the changes in the flow throughout the system. Through the years, the State Engineer has hired a staff of hydrographers

to operate and maintain the gaging stations and to rate the measuring flumes on the ditches. The State Engineer is responsible for the distribution of water in the system to ensure the water is available at the time and place of demand by water right owners who are in priority. His staff is also responsible for ensuring that the ratings on the ditches are kept current to ensure the proper amount of water is delivered to each ditch. Headgates and measuring flumes are required by statute on each diversion and the State Engineer has the authority to refuse water to the owners who fail to maintain these structures in proper order. In recent developments, most of the larger diversions have installed satellite-monitoring equipment, which allows the user as well as the State to acquire real-time data in order to ensure better administration.

Hydrology of the Rio Grande and Conejos River

The headwaters of the Rio Grande mainstem and the Conejos River are ringed by the Continental Divide. This area of southwestern Colorado normally receives a significant snowpack that provides the majority of the water that arrives at the upper index gages on the two rivers. These headwater areas are in relatively close proximity to the index gaging stations near Del Norte, Mogote, and Ortiz. Normally, the day's snowmelt or rain event runoff arrives at the gages during the next 12 to 24 hours, depending on what location in the basin one might consider. Since the operating reservoirs on both systems control only a fraction of the flow, the flows at the index gages are primarily a reflection of snowmelt or rainfall events. All these reservoirs hold relatively junior priorities and during the runoff, store under those decrees on a very limited basis when the flows at the index gages are very large. Therefore, during the irrigation season, the reservoirs bypass the inflow to them except for the highest portion of the runoff, if at all. Three ditches own the three irrigation reservoirs on the Rio Grande and the water from their decrees is not available to any other ditches on the river. The Conejos Water Conservancy District, on the other hand, operates Platoro Reservoir and the water from it is available to the member ditches. It is a commonly held belief that all the irrigation reservoirs on the Rio Grande are available to all the ditches, or to store water for other purposes. This is obviously not the case and only the owners of the reservoirs can use the water available to them. Since Platoro is a post-compact reservoir, any water stored under its decree is accounted for as if it had passed the Mogote gage on a monthly basis. This stored water is then subtracted when it is released to ensure that the native water in the basin is properly accounted for and that the index supply and the corresponding obligation is not altered because of storage. The annual volumes of flow at the index stations are therefore relatively unaffected by the reservoirs on either of the Compact streams except on the occasion of a very wet year when some carryover can result.

The hourly, daily, seasonal and annual flows at the index stations are extremely variable. The daily diurnal effect during the runoff season as well as the variability of high altitude snowmelt can cause large changes within the day as well as from day to day. As is the situation with most western streams, the seasonal and annual flows are also highly variable. The past 25 years are a wonderful case study on variability of the water supply for the Rio Grande Basin. On the Rio Grande mainstem in Colorado, we have seen the historic low year in 1977 of 215,000 acre-feet and just a few years later saw three consecutive annual flows of over 1,000,000 acre-feet, a volume which has been exceeded only in seven of the 110 years of recorded history. The graph "Rio Grande River near Del Norte, CO – Annual Calendar Year Flows" shows the annual variability of streamflow at the Rio Grande near Del Norte gage. This gage is the upper index gage for the Rio Grande and is used to determine the amount of water owed to the downstream states, as well as the water available for distribution in priority to water rights owners.

Peak flows on both systems are also reflective of the large variability of the low from year to year. On the Rio Grande near Del Norte gage, the peak averages around 5,400 cfs and varies over the history of the record from 1,730 cfs in 1977 to 18,000 cfs in 1912. The Conejos near Mogote gage shows a similar pattern with peak flows from 882 cfs in 1972 to 9,000 cfs in 1912 with the average around 2,000 cfs.

Average flows for the two rivers reflect that the historic mean flow is demonstrative of the fact that neither carries large flows on the average and that the large majority of the flows occur in the spring months of May through July. The rest of the year the flows are near base flow conditions except for the runoff from the occasional rainfall event during the summer and fall. The mean flow for the Rio Grande near Del Norte gage is 907 cfs, for the Conejos near Mogote is 331 cfs, for the Los Pinos near Ortiz is 121 cfs, and for the San Antonio near Ortiz is 26 cfs. Base flows on the four rivers would be approximately 400 cfs, 150 cfs, 40 cfs, and 10 cfs respectively.

These statistics and the graphs "Rio Grande River near Del Norte, CO – CY=1996" and "Rio Grande River near Del Norte, CO – CY=1997" are provided to illustrate the large variability in the hydrology of the Upper Rio Grande Basin in Colorado and provide the setting in which the Compact in Colorado has to be administered. This variability creates a difficult challenge to the managers of the diversion systems and especially to those responsible for ensuring that Colorado meets her Compact obligation to deliver water to the downstream States. The constantly moving target therefore demands that the Compact be administered on a daily basis. The staff involved in this effort must be able to readily analyze the past, current, and future conditions of stream flows of the calendar year. Real-time data, calendar year flows to date and good historic streamflow data are all required to calculate what must be done to stay current with deliveries. The challenge then is to use that knowledge to administer the priority system on both river systems while concurrently bypassing the proper amount of flow to the Stateline to meet the required delivery for Compact purposes. It is imperative to water right owners as well as the water managers to ensure that Colorado is able to utilize her full entitlement allowed under the Compact while meeting her obligation. As conditions change during the year, they must be recognized in a timely manner and adjustments made to the administration of the river to accomplish those two goals.

Tools

There are a number of tools that the State of Colorado uses to effectively administer the Rio Grande Compact. These include legal, physical and political tools that are used to determine the necessary actions that need to take place to meet Colorado's obligation to the Lobatos gage.

Legal Tools:

- Doctrine of Prior appropriation system contemplated by the Constitution
- Case Law that reinforces and refines the Doctrine
- Historic and current adjudication process
- 1969 Water Right Determination and Administration Act
- Rules and Regulations governing Rio Grande Compact Administration

Physical Tools:

- Extensive stream gage network
- State Hydrographic Program
- Satellite Monitoring System on stream gages and major diversions
- Spreadsheets for water accounting
- 10-Day reporting
- NRCS monthly forecasts
- Communication protocol with National Weather Service
- Closed Basin Project

Political Tools:

- Active Water User Associations
- Water Conservation and Water Conservancy Districts
- Continuing education programs to inform users and public

Media relationship to inform public of significant events
Strong relationship between the State Engineer staff and water user community

Current Administration

Since 1968, the Rio Grande Compact has had a significant impact on water rights administration in the Upper Rio Grande in Colorado. The State Engineer has administered the Compact on a two-river system since that time: both the Rio Grande and the Conejos are administered independently per their respective delivery obligations. Therefore, two separate accountings and administration schemes are used for the day-to-day administration. The following administration process is used for both rivers and is linked only by certain adjustments to the deliveries that are explained later in this document.

Article III of the Rio Grande Compact is the pertinent section that determines what administration of water rights is required to provide the appropriate flow to the Stateline to meet Colorado's annual obligation. That article sets the annual delivery obligation for each river based upon the native water that flows past the index stations. The combination of the two separate delivery schedules determines Colorado's total obligation less the 10,000 acre-feet credit provided by the Compact. The delivery schedules are reflective of the inflow-outflow relationships developed during the Rio Grande Joint Investigation Study from 1927 to 1936. The delivery schedules set in place the amount of consumptive use that is allowed in each basin for given flows into that basin. The consumptive use that is allowed in each basin is reflected in their delivery schedules by subtracting the delivery obligation from the index flow. For each given annual flow there is a theoretical consumptive use for each river and all additional flows must be passed through the system. The maximum consumptive uses are 570,000 acre-feet on the Rio Grande and 224,000 acre-feet on the Conejos system. These peak consumptive use amounts occur when the annual flow is quite large and considerably above the average flow. The graphs "Rio Grande Compact Delivery Requirements Verses Annual Index Flows" and "Rio Grande Compact Delivery Requirements As Percent of Annual Index Flows" graphically demonstrate the delivery schedules in Article III. They represent both the percentage of the index required as well as the numeric value of the obligation for the corresponding index supply.

Deliveries to the Stateline are not required to strictly adhere to the Compact's delivery schedules on an annual basis. The Compact in Article VI allows for the accrual of Compact credits and debits. Colorado may under deliver by as much as 100,000 acre-feet in any one year, and may accrue up to 100,000 acre-feet of annual debit over multiple years. Colorado may also receive up to 150,000 acre-feet of annual credit in any given year and may accrue an unlimited credit over multiple years. This credit and debit accounting provision of the Compact provides Colorado with some flexibility in managing water use from year to year and allows the state to utilize the credit to enhance water supply in years when it will provide relief to a shortage in the system. The only downside to having credit water stored in Elephant Butte is that approximately 10 percent of the water is lost to evaporation each year. Current administration practices are to make deliveries that approximate the obligation on an annual basis. Because of the vagaries of the climate and hydrology, it is very difficult to forecast accurately enough during the runoff to exactly meet the delivery requirements.

Seasonal Administration

Since 1968, Colorado has attempted several different scenarios to ensure that Colorado would meet her obligation. What has evolved over time is a very successful routine that guides the administrators through the year. It provides a reasonably accurate method for meeting the obligation within a few percentage points, thus allowing Colorado to fully utilize her entitlements and at the same time meet her obligation to the downstream states. It requires recognizing the indexes and deliveries from the first of the year to the present, assuming deliveries for the early winter months and adjusting the forecast for the irrigation

season as it progresses. After the annual index supply forecasts for both rivers are established, then water rights are curtailed as is necessary to ensure that the Compact delivery requirement is met. If the actual runoff and summer thunderstorm activity change the forecasted index supply then adjustments are made to deliveries to account for those changes. Large late season increases in the indexes require significant changes in administration that can cause considerable hardship to very senior pre-Compact water rights.

As described above, day-to-day administration of the Rio Grande Compact for inter- and intrastate purposes involves a series of detailed calculations using historical, real-time, and forecasted stream flow information at all seven of the Compact gages as well as the intermediate gages in between them.

The upper index gages are:

Rio Grande near Del Norte
Conejos River near Mogote
Los Pinos River near Ortiz (April – October)
San Antonio River at Ortiz (April – October)

The lower index gages are:

Rio Grande near Lobatos
Conejos near La Sauses (two stations)

Flows at these locations are used to determine the total annual delivery obligation, to determine deliveries to date, and to establish a "curtailment" of water use if needed to meet the delivery obligation of the year. The State Engineer, through the Engineer Adviser and the staff in the Division of Water Resources office in Alamosa, make these calculations every 10 days when diversions are being made, and monthly during the remainder of the year for both river systems. It is critical to remember that each river is analyzed separately and that each river has its own delivery obligation.

The general methodology for making these calculations is described in the four following steps. The dates are for illustrative purposes only and vary depending on the forecast and Compact status of the State of Colorado. Examples of the 10-day analysis sheets and report are attached.

January 1st through March 31st

Both the Rio Grande and the Conejos River diversions are curtailed 100 percent, that is no diversions are allowed except for storage in pre-Compact reservoirs. Any storage in post-Compact reservoirs is accounted for and subject to Compact rules. Exception to the100 percent curtailment can occur if Colorado has a large accrued credit, a spill of Elephant Butte has or will occur or if drought conditions prevail and thus the anticipated obligation is very low. This action will maximize deliveries to the Stateline during this period and will allow for lower curtailment during the irrigation season. The Closed Basin Project is pumped at a prudent level considering the limitations of winter operations and well production. The March 1 forecast is used to make some of the initial analyses for how the Compact will be administered for the early part of the irrigation season. The Rio Grande headwater areas typically receive large accumulations of snow during this month and therefore it is normally assumed that significant changes will be made to the projected index supply when the April forecast is received.

April 1st through October 31st

Diversions are normally allowed to commence around April 1 but because of the normally cold springs and low demand, Compact obligations are usually made without any curtailment. As soon as the April forecast is received from the Natural Resources Conservation Service (NRCS) on or

about the 7th of the month, the first comprehensive analysis is done to determine what the projected index supply for the year will be. Upper index flows that have occurred through the end of March are added to the forecast (April – September) and to average flows for October through December. This will provide the first estimate of the annual index supply for each river.

From that estimate of the annual index, the obligation for each river is determined using the delivery schedules in Article III. Deliveries through the end of March are added to the normal (average) deliveries for November and December, the anticipated Closed Basin Project deliveries and the appropriate portion of the 10,000 acre-foot credit. The sum of those deliveries, subtracted from the projected obligation determines the amount of water needed at the Stateline during the irrigation season (April – October). Adjustments to the amount needed are made for variables which include Colorado's accrued credits or debits, return flows, tributary inflows or accretions to the rivers.

Once the amount to be delivered during the irrigation season is determined then it is necessary to determine how much of the available index supply must be delivered on a daily basis to achieve the desired delivery. This is accomplished by dividing the amount of delivery required by the amount of index supply available during the irrigation season. This quotient then represents the percentage of the daily available index supply that must bypass the Colorado diverters and be delivered to the Stateline. Again, return flows, tributary inflows and groundwater accretions must be taken into consideration and the curtailment reduced accordingly or substantial over deliveries can result. One of the greatest challenges for the administrators is weather conditions that cause substantial changes to the index supply and the forecast which add greatly to the delivery obligation. Late summer or early fall rainfall events can have very dramatic effects on administration and must be handled in a timely manner to prevent large under deliveries. A study of the delivery schedules show that in higher years like 1999, that the incremental amount of water that has to be delivered when an unexpected event occurs can reach as high as 90 percent of the increased amount of water indexed. Therefore, during the entire irrigation season it is imperative that a continual monitoring of daily administration occurs to ensure that the forecast is indeed tracking as was expected and that deliveries are being made accordingly.

November 1st through December 31st

Diversions on both the Rio Grande and the Conejos River are curtailed 100 percent if necessary to deliver water to the Stateline to complete the remaining deliveries. Reservoirs are typically allowed to go into storage on November 1. Consultation with the water users on both rivers can result in some diversions extending into November if the Compact will be met with the remaining deliveries. In fact, six large ditches on the Rio Grande have obtained decrees to divert water to recharge the aquifers in the San Luis Valley to the extent the water is not needed to meet the Compact obligation. Typically, by no later than Thanksgiving, the winter weather has made diversion of water impossible and all diversions are concluded. Closed Basin Project deliveries are made to the river at the sustainable level necessary and in accordance with winter operations.

Because the Compact is river specific in Colorado, the process for determining curtailment percentages occurs independently for both the Rio Grande and the Conejos River and different curtailment percentages are applied to the two systems pursuant to the analysis described above. It is important to note this process relies heavily on forecasted inflows at least through the end of June. As the snowmelt runoff recedes, the summer thunderstorm activity or lack thereof begins to control the index supply for the remainder of the summer and fall seasons. The actual flows are not, and cannot be, known until very late in the calendar year. While Colorado attempts to match the delivery requirement on an annual basis, over and under deliveries can and do result from inaccuracies associated with inflow forecasts and

uncertainties associated with natural stream systems. These over and under deliveries are added or subtracted from the accrued debit or credit carried forward from previous years and the resulting status as of January 1 of each year is considered in the following year's curtailment calculations.

The State of Colorado relies heavily on the coordinated forecast inflows to the basin that are developed and provided by the Natural Resources Conservation Service in cooperation with the National Weather Service. These forecasts are published monthly, typically beginning in January and ending in May or June. Since Colorado analyzes her Compact status and considers adjustments to the curtailment every 10 days, there is often a need for more up-to-date information, especially during the higher portions of the runoff. Colorado has routine discussions with the Natural Resources Conservation Service and the National Weather Service concerning trends and intermediate forecasts prior to the release of updated monthly forecasts.

As previously discussed, the effect of applying a curtailment to the Rio Grande and the Conejos River is to make a percentage of the water flowing past the index gages unavailable for diversions such that it can be delivered at the Stateline. As curtailment information is developed during the irrigation season, the calculated percentages are communicated to the appropriate water commissioners, who use this data in their water rights administration.

Reservoir Storage, Trans-Basin Diversions, and Compact Accounting

Most reservoirs within the Rio Grande Basin in Colorado were constructed prior to signing and ratification of the Rio Grande Compact. As such, storage and releases by these reservoirs are not reflected in the Compact accounting performed by the State of Colorado. By contrast, reservoirs constructed after 1939 ("post-Compact" reservoirs) are subject to special Compact restrictions concerning how and when they can store water and require adjustments to observed flows at index gages during the accounting procedures. For example, operations at Platoro Reservoir, which is the largest post-Compact reservoir in the Basin, affect the flows in the Conejos River at the Mogote Index Gage. Observed flows at the Mogote Gage must therefore be adjusted (upward when the reservoir is storing water, and downward when it is releasing) in order to accurately calculate the Compact delivery obligation for the Conejos River.

Similar adjustments are made to stream flow gages affected by trans-basin diversions into the Rio Grande Basin. Annual storage, releases and evaporative losses by post-Compact reservoirs and Basin inflows from trans-basin diversions are explicitly accounted for in the administration of the Compact.

Daily Administration

Once the water commissioners for each river have received the curtailment percentage for the next period of the season, they incorporate that requirement into the delivery of water to ditches. After determining the amount of native flow at the upper index station each morning they apply the curtailment percentage to that flow and thereby establish what water has to bypass the ditches and flow to the lower index delivery points. The remainder of the water is distributed to the ditches on their river in accordance with their relative priorities. Because of the distance involved between the index gages and the ditches and delivery points, the delivery to them is time-lagged. The intermediate gaging stations on the rivers help the water commissioners track the Compact water through the system. These gages also help establish return flows and tributary inflow that is available to help the State meet the deliveries on both rivers.

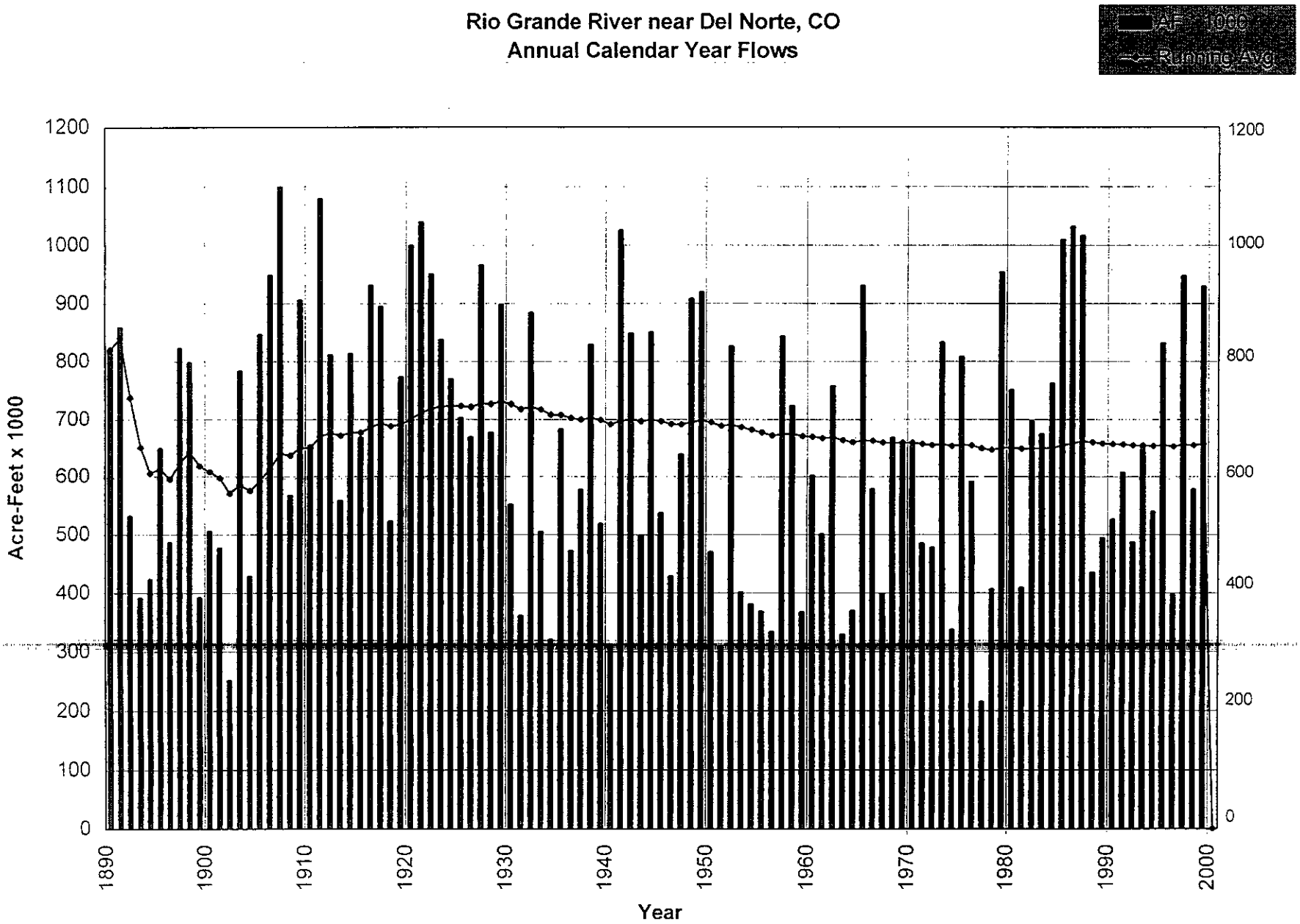
Depending on the actual deliveries that are made during a 10-day period and considering what water is in transit, adjustments may be made to the curtailment. Monthly analysis of how the actual runoff compares to the forecast or how rainfall events may be effecting the annual index supply are also made. This continual updating and reevaluation provide Colorado administrators and water users the information to

make informed decisions on if or how adjustments to the curtailment should be made. It also provides a process to assess the current conditions and if there have been changes from the assumptions used to establish the forecast. Extreme drought or flood conditions that change those assumptions are recognized and the administration varies accordingly. If normal summer and fall rainfall does not occur and lower than normal flows result, then the curtailment may be reduced. If the summer monsoon season provides vastly increased flows, then large increases in the curtailment may have to be made to remain current on deliveries. The 1999 season is a perfect example of how the curtailment must be increased due to significant changes in the river hydrology during the latter half of the year. As is very evident to the observer, the flows in the later summer months on the Upper Rio Grande were well above normal because of an unusual "monsoon" flow. This rainfall dramatically increased the index supply on the river and caused Colorado to increase the curtailment from 12 percent to over 40 percent as the summer proceeded. The only way to compensate for the increased obligation from the increased index supply was to increase the curtailment. These types of unforeseen events show that without regular and routine monitoring and adjustment in operation Colorado cannot expect to meet her obligation within reasonable tolerances. The vagaries in the hydrology and climate and the inability of man to predict weather in advance makes the administration of the Compact a dynamic and challenging process.

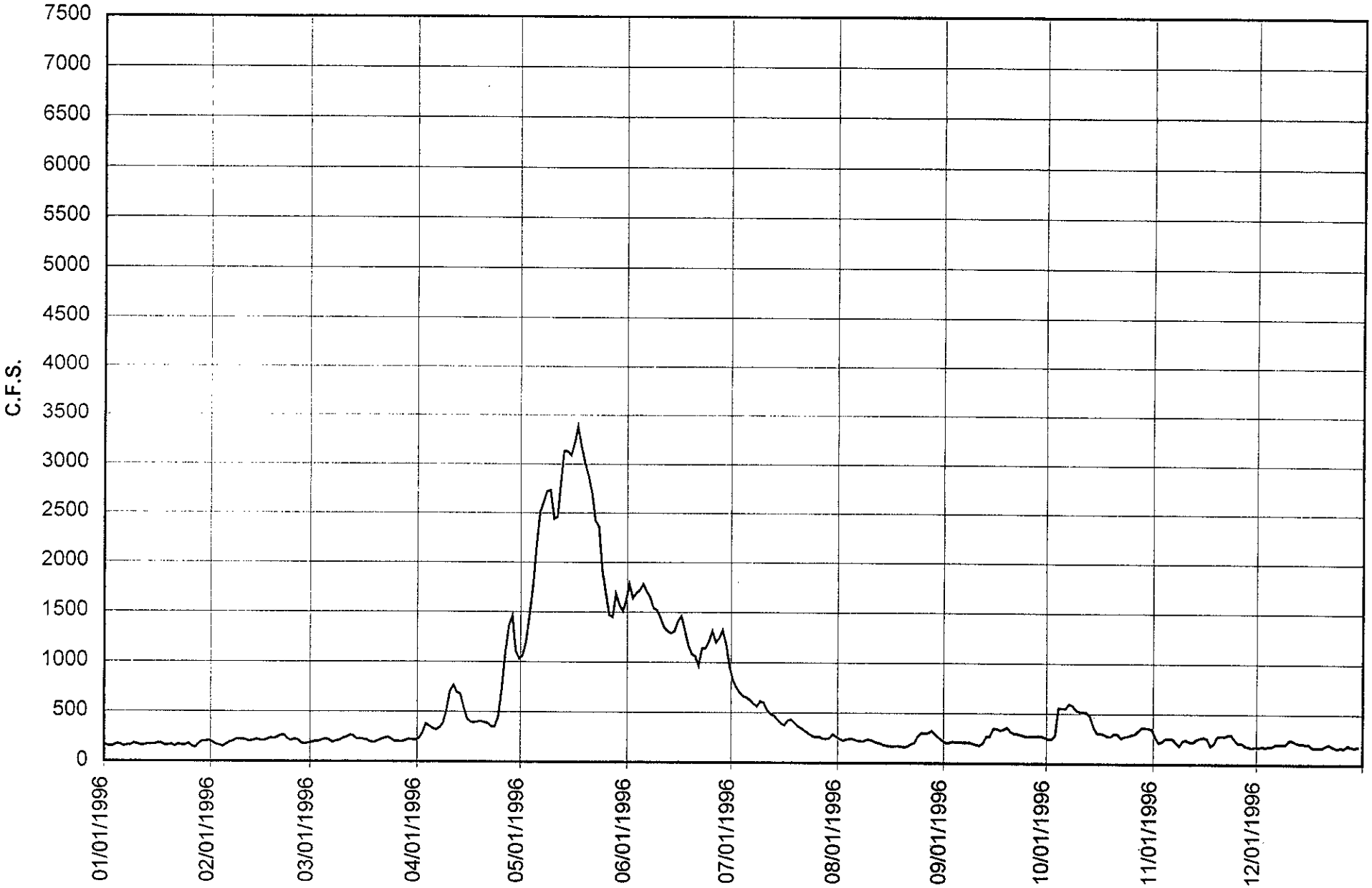
One of the goals of the State of Colorado is to try to determine the curtailment percentage that can be applied throughout the irrigation season so that the resulting effect of that curtailment is applied evenly across the priorities as the hydrograph rises and recedes. Large changes in the curtailment within the season can transfer the effect of the Compact and disproportionately effect the water rights in the system. This issue is extremely important to the water users on both rivers who decided long ago that the impact of the Compact should be shared as uniformly as possible by the water rights that were in priority in any given year.

Remarks

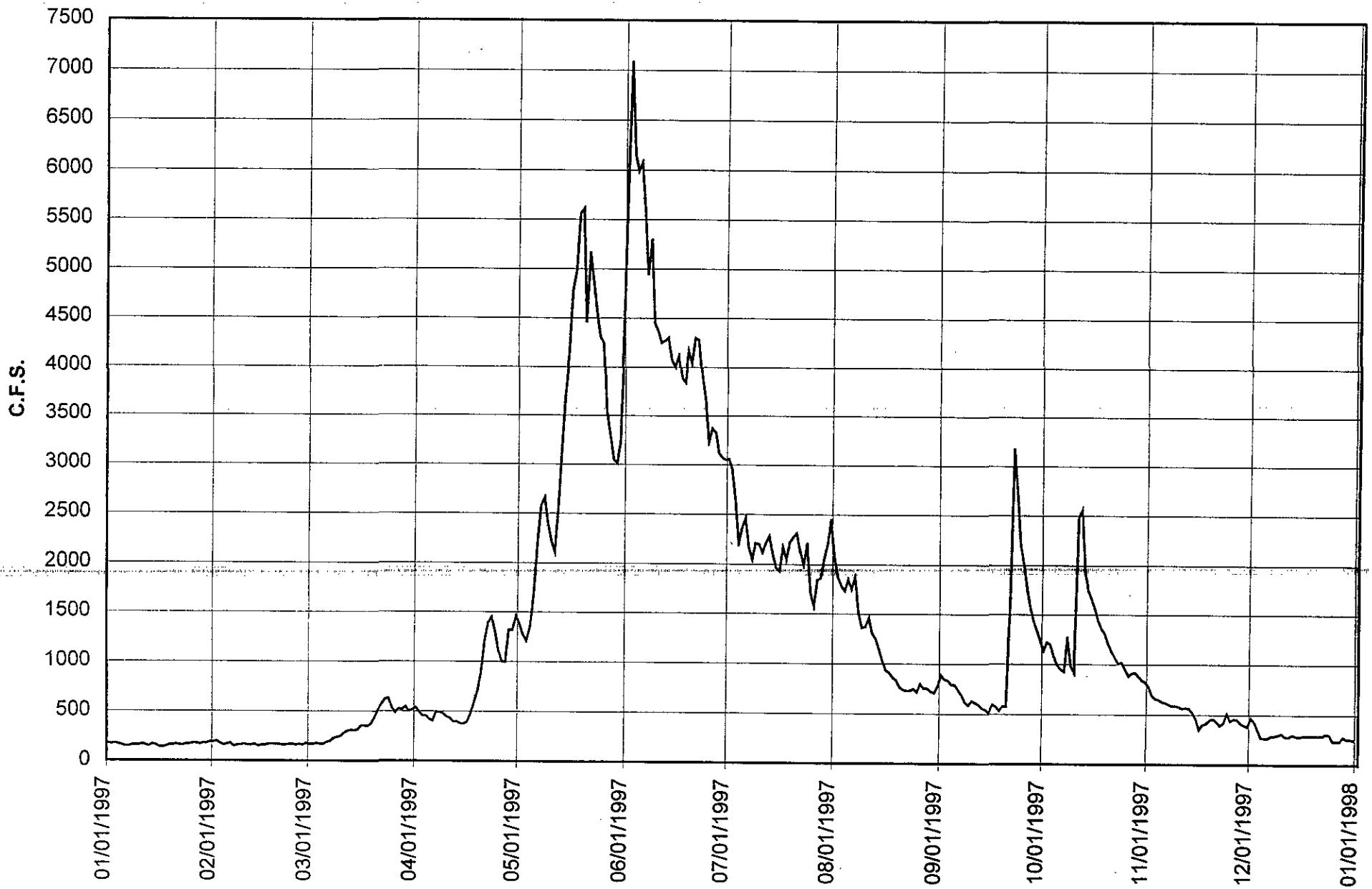
Since 1968, the State of Colorado has worked diligently to develop a methodology that allows her to meet her Compact obligation. The ability to do so is hampered by a number of variables that are either unknown or subject to change without notice. This has demanded a system be developed which recognizes and accounts for these variables and which is flexible enough that changes can be made to maintain deliveries that are required. The original curtailment and changes to it during the year directly effect the water supply for many water right owners on the Conejos River and the Rio Grande. It is extremely important to Colorado to fully utilize the entitlements allowed to the State under the Compact. Colorado's entitlements provide water to over one-half of the irrigated land on the Rio Grande above Fort Quitman, Texas. That system has to be run without large reservoirs and is primarily a run of the river operation. This is the reason it is critical for Colorado to continuously analyze and improve her methodology of Compact administration. Improved snowmelt runoff forecasting, as well as improved weather forecasting would greatly enhance the ability of Colorado to meet her obligation correctly and reduce the impact of it on the water users. It is, and always will be, the variability and the unknowns of the hydrologic system that provides the challenge to administrators and users on the system.


Rio Grande River near Del Norte, CO
Annual Calendar Year Flows
AF - 1000
Running Avg
Acre-Feet x 1000
Year
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000

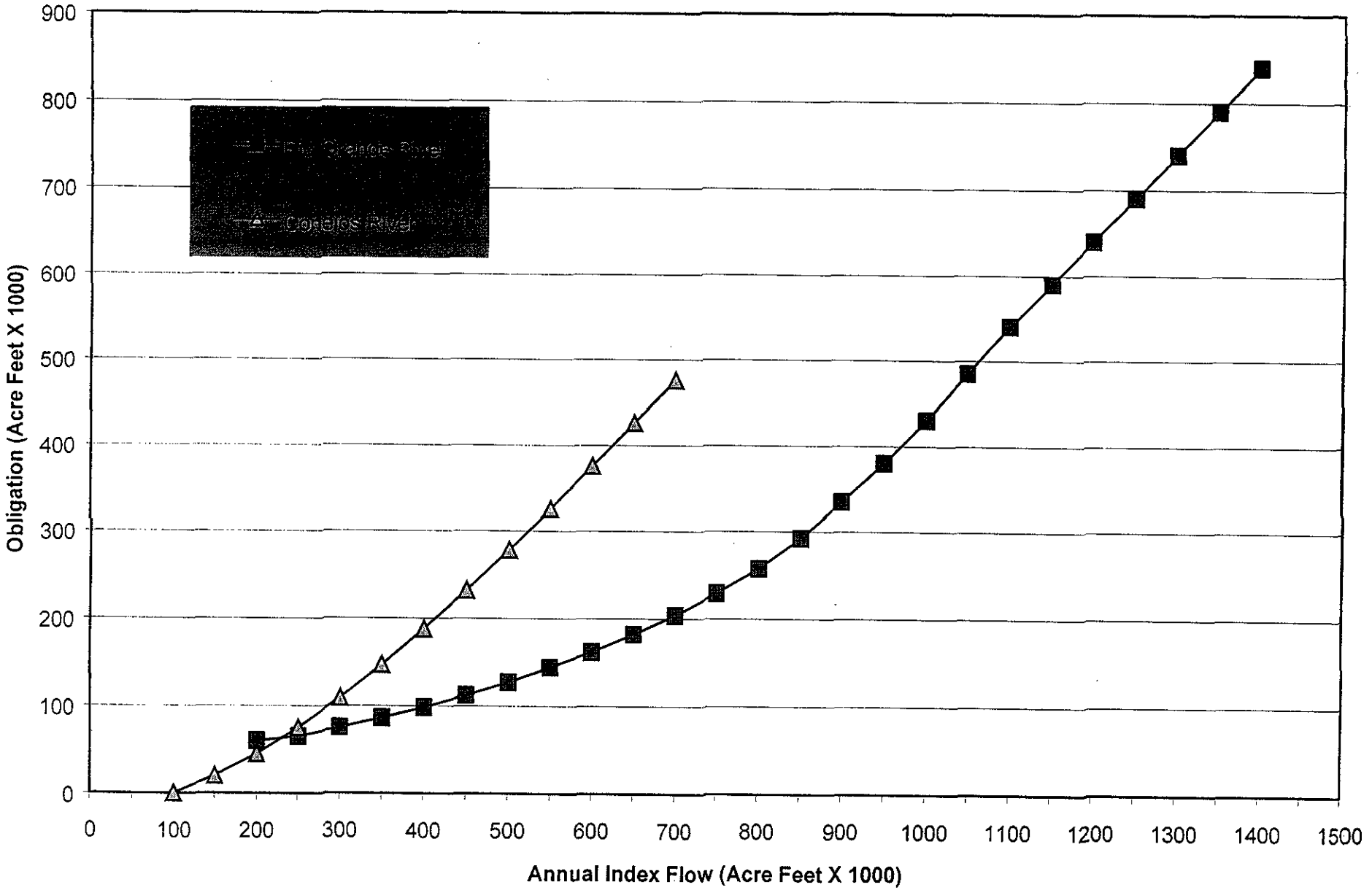
Rio Grande River near Del Norte, CO. CY = 1996



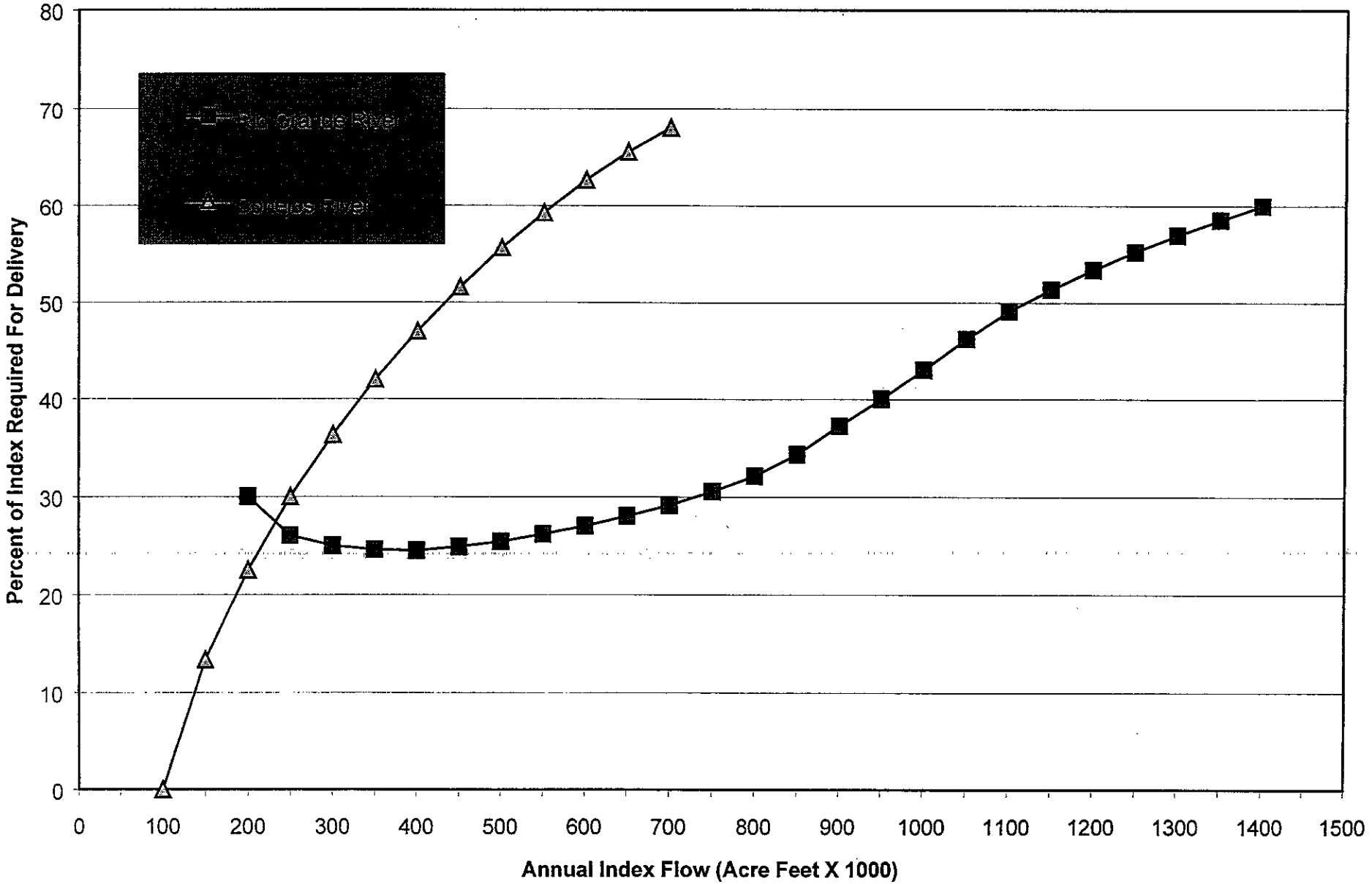
Rio Grande River near Del Norte, CO. CY = 1997



Rio Grande Compact Delivery Requirements Verses Annual Index Flows



Rio Grande Compact Delivery Requirements As Percent of Annual Index Flows



RIO GRANDE COMPACT TEN DAY REPORT

PRELIMINARY DATA

DATE: November 22, 1999 Period Ending: November 20, 1999

CBP Allocation: 40% as of 1/1/99

CONEJOS RIVER

(Units in Thousands of Acre-Feet)

Projected Annual Index: 313,000 Obligation: 118,900 % of Index: 38%

CONEJOS INDEX SUPPLY								ADJUSTED DELIVERIES	
MONTH	MEASURED FLOW			PLATORO SUPPLY					
	Conejos at Mogote	Los Pinos near Ortiz	San Antonio at Ortiz	Storage End of Month	Change in Storage	Supply in Month	Accum. Total	Conejos River at Mouths near La Sauses *	Accum. Total
JAN	2.7	—	—	21.7	0.2	2.9	2.9	5.6	5.6
FEB	3.1	—	—	21.9	0.2	3.3	6.2	5.5	11.1
MAR	5.9	—	—	22.8	0.9	6.8	13.0	7.2	18.3
APR	11.0	9.5	3.8	23.3	0.5	24.8	37.8	2.8	21.1
MAY	42.4	30.7	7.6	28.9	5.6	86.3	124.1	21.8	42.9
JUN	80.5	16.4	0.8	40.0	11.1	108.8	232.9	27.9	70.8
JUL	32.9	3.7	0.2	35.4	-4.6	32.2	265.1	8.9	79.7
AUG	18.7	4.6	0.4	38.1	2.7	26.4	291.5	12.6	92.3
SEP	13.7	1.9	0.1	33.5	-4.6	11.1	302.6	3.1	95.4
OCT	7.7	1.2	0.1	29.7	-3.8	5.2	307.8	2.1	97.5
NOV 1-10	1.0	—	—	29.7	0.0	1.0	308.8	0.7	98.2
NOV 11-20	0.9	—	—	29.6	-0.1	0.8	309.6	0.8	99.0
Annual Credit									
APR-SEP	199.2	66.8	12.9						
TOTAL	220.5	68.0	13.0		8.1	309.6		99.0	

* Deliveries Include: Conejos Portion of Adjusted Closed Basin Project Production to Date 7,277 Acre-Feet

Delivery Target	(% of Index)	Estimated Compact Curtailment	(% of Index)
January 1 - March 8	100%	January 1 - March 8	100%
March 9 - April 6	0%	March 9 - May 7	0%
April 7 - May 7	10%	May 8 - June 15	20%
May 8 - August 25	20%	June 16 - 30	0%
August 26 - October 4	28%	July 1 - August 5	35%
October 5 -	0%	August 6 - 25	0%
		August 26 - 31	30%
		September 1 -	0%

RIO GRANDE COMPACT TEN DAY REPORT

PRELIMINARY DATA

DATE: November 22, 1999 Period Ending: November 20, 1999

CBP Allocation: 60% as of 1/1/99

RIO GRANDE

(Units in Thousands of Acre-Feet)

Projected Annual Index: 918,000 Obligation: 351,200 % of Index: 38%

	RIO GRANDE INDEX SUPPLY			ADJUSTED DELIVERIES	
MONTH	Recorded Flow near Del Norte	Accumulated Total		Rio Grande Lobatos less Conejos-La Sauses *	Accumulated Total
JAN	13.3	13.3		17.6	17.6
FEB	11.3	24.6		17.1	34.7
MAR	22.5	47.1		12.8	47.5
APR	41.9	89.0		4.2	51.7
MAY	170.0	259.0		27.2	78.9
JUN	245.3	504.3		63.3	142.2
JUL	147.1	651.4		34.4	176.6
AUG	110.7	762.1		66.2	242.8
SEP	84.9	847.0		52.7	295.5
OCT	39.0	886.0		26.0	321.5
NOV 1-10	8.4	894.4		6.6	328.1
NOV 11-20	5.7	900.1		8.1	336.2
Annual Credit					
APR-SEP	799.9				
TOTAL	900.1			336.2	

* Deliveries Include: Rio Grande Portion of Adjusted Closed Basin Project Production to Date 10,913 Acre-Feet.

Delivery Target	(% of Index)	Estimated Curtailment of Ditches	(% of Index)
January 1 - March 14	100%	January 1 - March 14	100%
March 15 - May 7	10%	March 15 - May 7	0%
May 8 - July 13	17%	May 8 - July 13	12%
July 14 - July 21	20%	July 14 - July 21	17%
July 22 - August 5	33%	July 22 - August 5	30%
August 6 - September 2	40%	August 6 - August 23	Vol. Bypass
September 3 - October 18	50%	August 24 -September 2	30%
October 19 -	40%	September 3 - October 18	40%
		October 19 - 31	30%
		November 1 -	0% (recharge)

Respectfully submitted,

Steven E. Vandiver, Division Engineer, Division III

cc: Hal Simpson(3), Steve Baer, Dale Pizel, Paul Clark, Ralph Curtis, Roy Helms, Dennis Felmlee, Bob Robins, John Allen Davey, Jim Horton, David Harrison, Mike Gabaldon, Bill Paddock, David Robbins, George Whitten

RIO GRANDE COMPACT
July 20, 1999 Analysis (Modified for Estimated Index)
Closed Basin Project Split: 60/40

RIO GRANDE BASIN

April - September Index

NRCS Forecast =		568,000
DWR Forecast =		668,000

Index

In the bank:	Apr - pres	554,500
	YTD	601,600

Obligation = 243,000

Delivery

In the bank:	Apr - pres	113,600
	YTD	161,300

Curtailment

Req Deliv	41,600	29.0%
Native Index	143,400	

Index Supply

January - February	24,600	*
March	22,500	*
April	41,900	*
May	170,000	*
June	245,300	*
July 1 - 20	97,300	*
July 21 - September	113,400	estimate
October	30,000	estimate
November - December	30,000	estimate
Total	775,000	

Deliveries

January - February	34,800	*
March native	12,900	*
April	4,500	*
May	26,700	*
June	63,000	*
July 1 - 20	19,400	*
July 21 - Oct native	41,600	needed
Nov - Dec native	34,000	estimate
Total	236,900	
Paper Credit	5,000	
SC Norton Drain Flow	-5,500	estimate
Remaining CBP Share	6,600	estimate
Total Required Delivery	243,000	
Expected Overdelivery	0	

* = Actual measured flows (Deliveries include Closed Basin Project share)

- All values in acre-feet
- Assumes 60% of the Closed Basin Project flows are creditable to the Rio Grande (Projected delivery of creditable CBP production to the Rio Grande is 24,000 acre-feet)
- Asssumes no recharge diversions after November 1, 1999
- Trinchera Creek flow [illegible]

RIO GRANDE COMPACT
July 20, 1999 Analysis (Modified for Estimated Index)
Closed Basin Project Split: 60/40

CONEJOS RIVER BASIN

DWR Estimated
April - September Index
Flows = 287,000

Conejos = 209,000
Los Pinos = 65,000
San Ant. = 13,000

Index
In the bank: Apr - pres 243,800
YTD 256,800

Obligation = 116,600

Delivery
In the bank: Apr - pres 58,700
YTD 76,800

Curtailment

Req Deliv 7,400 17.1%
Native Index 43,200

Index Supply		
January - February	6,200	*
March	6,800	*
April	24,800	*
May	86,300	*
June	108,800	*
July 1 - 20	23,900	*
July 21 - September	33,200	estimate
October	10,000	estimate
November - December	10,000	estimate
Total	310,000	

Deliveries		
January - February	11,000	*
March native	7,100	*
April	2,500	*
May	22,300	*
June	27,900	*
July 1 - 20	6,000	*
July 21 - Oct native	7,400	needed
Nov - Dec native	6,000	estimate
Total	90,200	
Paper Credit	5,000	
SC Norton Drain Flow	5,500	estimate
Carryover Credit in E.B.	11,500	
Remaining CBP Share	4,400	estimate
Total Expected Delivery	116,600	
Expected Overdelivery	0	

* = Actual measured flows (Deliveries include Closed Basin Project share)
- All values in acre-feet
- Assumes 40% of the Closed Basin Project flows are creditable to the Conejos (Projected delivery of creditable CBP production to the Rio Grande is 24,000 acre-feet)