KANSAS
DEPARTMENT OF AGRICULTURE

Kathleen Sebelius, Governor
Adrian J. Polansky, Secretary

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December 19, 2007

Ann Bleed, P.E.
Nebraska Commissioner,
Republican River Compact Administration
Director, Nebraska Department of Natural Resources
P.O. Box 94676
Lincoln, NE 68509-4676

Subject: Remedy for Nebraska's violation of the Decree in *Kansas v. Nebraska & Colorado*, No. 126, Original, U.S. Supreme Court

Dear Commissioner Bleed:

The State of Nebraska is in violation of the May 19, 2003 Supreme Court Decree in *Kansas v. Nebraska & Colorado,* 538 U.S. 720 (2003). The Decree approved the Final Settlement Stipulation ("FSS"), which had been filed with the Special Master on December 16, 2002. The FSS requires compliance on a five-year running average, and, when Water-Short Year Administration is in effect, compliance is also calculated on a two-year running average unless Nebraska submits an Alternative Water-Short Year Administration plan to the Republican River Compact Administration ("RRCA"). Appendix B to the FSS provides the FSS Implementation Schedule, which sets the first normal compliance year as 2007 (5-year running average for 2003-2007) and the first Water-Short Year Administration compliance year as 2006 (2-year running average for 2005-2006) if water supply conditions for Water-Short Year Administration are present.

Pursuant to the Implementation Schedule and water supply conditions, Water-Short Year Administration began in 2006. Data for the year 2006 was received in 2007. Analysis of that data and data for 2005 shows the 2-year running average of Nebraska's Computed Beneficial Consumptive Use above Guide Rock for 2005-2006 to be 41,430 acre-feet per year in excess of Nebraska's allocations above Guide Rock, contrary to Subsection V.B.2 (a) of the FSS. For the two years, Nebraska's total overuse of water in violation of the FSS amounts to 82,870 acre-feet. See Attachment 1 hereto. For comparison, this amount is more than a city in Kansas of 100,000 population consumes in 10 years. It is also more than twice the amount of water that would be consumed per year under full supply conditions on all the acreage authorized to be irrigated in the Kansas Bostwick Irrigation District in the Republican Basin.

Kansas began to express its concerns in the 1980s that Nebraska was violating the Compact. Despite continued complaints by Kansas and attempts at mediation, Nebraska allowed further significant increases in water development and use by its water users. Consequently, Kansas was forced to file *Kansas v. Nebraska & Colorado,* No.126, Orig., in 1998. After rulings by the Special Master and the Supreme Court, the States agreed to the FSS in December 2002 as noted above. Since then Kansas has complied with all of its obligations under the FSS in good

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faith. The State of Nebraska, on the other hand, has seriously neglected its obligations under the FSS. Actions by the State of Nebraska have been grossly insufficient and unrealistic, resulting in injury to Kansas and its water users. As was the case when David Pope wrote his letter of January 24, 2007, actions apparently being discussed by the State of Nebraska will continue to be insufficient and ignore growing river depletions due to past groundwater pumping.

It is now five years since the FSS was agreed to by Nebraska. But again, the State of Nebraska has failed to meet its obligations to the State of Kansas under the Republican River Compact, and Kansas' water users have continued to suffer as a result. Although there are disagreements between Kansas and Nebraska on certain portions of the final accounting for 2005 and 2006, Nebraska is significantly out of compliance for this first period of Water-Short Year Administration regardless of which State's methodology is used. Further, although the accounting for 2007 is not yet available, it is clear that Nebraska will not be in compliance for the statewide five-year accounting period 2003 through 2007. The cumulative Nebraska overuse for 2003 through 2006 is 143,840 acre-feet. See Attachment 2 hereto. This is the amount that Nebraska needed to make up in 2007 in order to be in compliance for 2003-2007, an unlikely event. In addition, 2007 was also a Water-Short Year Administration year, and it is highly unlikely, as well, that Nebraska will meet the Water-Short Year Administration requirements for that year.

In light of the foregoing, Kansas proposes the remedy set out in Attachment 3 to this letter. The remedy includes: (1) entry of an order by the Supreme Court finding Nebraska in violation of the Court's Decree; (2) Kansas' damages for the years 2005-2006 or Nebraska's gains, whichever are greater, plus compounded interest and attorneys fees and costs, together with any additional relief that may be considered appropriate by the Court; and (3) (a) shutdown of wells and groundwater irrigation in Nebraska within 2 ½ miles of the Republican River and its tributaries, (b) shutdown of groundwater irrigation of acreage added after the year 2000 throughout the Republican River Basin in Nebraska and (c) such further reductions of net consumptive use in the Basin in Nebraska necessary to maintain yearly compliance, or the hydrologic equivalent of the foregoing. In addition, if Nebraska continues to be unable or unwilling to control its water users, further relief, including a Court-appointed River Master, may be necessary.

Supporting Materials

Although the most urgent need is to bring Nebraska into compliance, sanctions for the 2005-2006 violations are also appropriate. Kansas' preference is for repayment in water, but repayment in water by Nebraska appears to be impractical, given the overwhelming deficit that has been accumulated by Nebraska. Therefore, monetary payment is proposed, equal to the gains reaped by Nebraska as a direct result of violating the Court's decree, or Kansas' damages, whichever are greater. This should reduce Nebraska's incentive to violate the Court's Decree in the future.

During recent years, Nebraska's groundwater consumptive beneficial use has been approximately 200,000 acre-feet per year. Even with purchase of surface water and other actions by Nebraska, however, Nebraska has been significantly short of Compact compliance. Kansas' attached analysis demonstrates that Nebraska must reduce its annual groundwater consumptive use (depletions of the surface waters of the Republican River Basin in Nebraska) to 175,000 acre-feet per year, or otherwise achieve the hydrologic equivalent, to dependably meet its 5-year compliance test. See Attachment 4 hereto.

The stipulated RRCA Ground Water Model has been used to determine the extent to which ground water pumping must be curtailed in order to reduce and maintain river depletions caused by groundwater pumping in Nebraska down to 175,000 acre-feet per year. See Attachment 5 hereto. That analysis indicates that a reduction in groundwater irrigated acreage of approximately 515,000 acres is required of 1,201,000 irrigated acres assumed in the future case. As is demonstrated in Figure 4 of Attachment 5, failure to address groundwater depletions in a substantive way will result in continued loss of streamflow. Without this reduction in groundwater pumping, significantly less surface water will be available for existing irrigation projects and/or to assist in achieving Compact compliance. Immediate additional actions by Nebraska are also necessary to achieve near-term compliance. In the long term, further actions will likely be needed, especially in Water-Short Year Administration years.

Designated Schedule for Resolution

Kansas is proposing the foregoing remedies to address the past and continuing violations of the Supreme Court Decree in order that you may consider whether you can agree to these remedies. This situation comes as no surprise to you. Nebraska has been aware that its consumptive use has exceeded allocation every year since 2003. At the 2006 and 2007 Republican River Compact Administration meetings, for instance, Kansas pointed to the increasing likelihood that Nebraska would be out of compliance as soon as the data became available. In addition, by letter of January 24, 2007, Kansas specifically addressed the inadequacy of actions then being proposed in Nebraska as a means of bringing Nebraska into compliance.

Please review this proposal and respond to me within 45 days with regard to whether Nebraska is willing to agree to the proposed remedy. If we do not reach an agreement within that time period, Kansas will submit the dispute to the RRCA. If the dispute is not resolved by the RRCA, we will submit the dispute to the RRCA as a "fast track" issue and will proceed pursuant to the FSS Dispute Resolution procedure according to the schedule set out in Attachment 6 hereto, unless otherwise agreed.

Very truly yours,

David W. Barfield

David W. Barfield, P.E
Kansas Chief Engineer
Kansas RRCA Commissioner

cc: (w/encl.) (Via Email & U.S. Mail)
Kansas Attorney General Paul Morrison
Dick Wolfe, Colorado RRCA Commissioner
Aaron M. Thompson, U.S. Bureau of Reclamation
Col. Roger Wilson, Jr., U.S. Army Corps of Engineers
James J. DuBois, U.S. Department of Justice

Attachments:

Attachment 1 – Nebraska's Violations of the Final Settlement Stipulation: 2005-2006

Attachment 2 – Nebraska's Statewide Allocation and Computed Beneficial Consumptive Use: 2003-2006

Attachment 3 – Proposed Remedy for Violations of the Court's Decree

Attachment 4 – Engineering Report: Requirements for Nebraska's Compliance with the Republican

Attachment 5 – Report: RRCA Groundwater Model Analysis

Attachment 6 – Designated Schedule for Resolution

Attachment 1

Nebraska's Violation of Water-Short Year Administration Requirement 2005 and 2006

Table 5C Nebraska's Compliance During Water-Short Year Administration (from App. C of the FSS p. C65)*								
Year	Allocations			Computed Beneficial Consumptive Use (CBCU)			Credits from Imported Water	Difference Between Allocation and Consumptive Use Minus Imported Water Supply above Guide Rock
Column	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8
	State Wide Allocation	Allocation below Guide Rock	State Wide Allocation above Guide Rock	State Wide CBCU	CBCU Below Guide Rock	State Wide CBCU Above Guide Rock	Credits above Guide Rock	Col 3 – (Col 6 – Col 7)
2005	199,450	4,586	194,864	253,740	4,052	249,689	11,965	(42,860)
2006	189,180	3,615	185,565	240,850	3,064	237,786	12,214	(40,010)
Average	194,320	4,100	190,210	247,300	3,560	243,740	12,090	(41,430)

*All average and total values are rounded to the nearest 10.

For 2005, two accountings were approved by the RRCA. The difference was caused by dispute over the inclusion or exclusion of evaporation from non-federal reservoirs in Nebraska below Harlan County Reservoir. The values displayed are from the accounting includes all non-federal reservoir evaporation in Nebraska, as proposed by Kansas.

For 2006, no accounting was approved by the RRCA. Only input data for the accounting was approved. The values displayed are from an accounting consistent with Kansas position on accounting inclusive of (1) all non-federal reservoir evaporation in Nebraska and (2) a Harlan County Reservoir evaporation assignment method that assigns evaporation to both Kansas and Nebraska when only one State takes water from Harlan County Storage.

The totals for 2005 and 2006 from table 5C are below:

Year	Allocations			Computed Beneficial Consumptive Use (CBCU)			Credits from Imported Water	Difference Between Allocation and Consumptive Use Minus Imported Water Supply above Guide Rock
Column	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8
	State Wide Allocation	Allocation below Guide Rock	State Wide Allocation above Guide Rock	State Wide CBCU	CBCU Below Guide Rock	State Wide CBCU Above Guide Rock	Credits above Guide Rock	Col 3 – (Col 6 – Col 7)
Totals	388,630	8,200	380,430	494,590	7,120	487,470	24,180	(82,870)

Attachment 2

Nebraska's Five-Year Running Average Allocation and Computed Beneficial Consumptive Use for Determining Compact Compliance 2003 through 2006

Table 3C: Nebraska's Five-Year Average Allocation and CBCU (from App. C of the FSS p. 62)*				
	Col. 1	Col. 2	Col. 3	Col. 4
Year	Allocation	Computed Beneficial Consumptive Use	Credits from Imported Water Supply	Difference between Allocation and Computed Beneficial Consumptive Use minus Imported Water Supply
2003	227,580	262,780	9,782	(25,418)
2004	205,630	252,650	10,386	(36,640)
2005	199,450	253,740	11,965	(42,325)
2006	189,180	240,850	12,214	(39,456)
2007				
Average	205,460	252,510	11,090	(35,960)

*All average and total values are rounded to the nearest 10.

The values for years 2003 and 2004 were approved by the Republican River Compact Administration.

For 2005, two accountings were approved by the RRCA. The difference was caused by dispute over the inclusion or exclusion of evaporation from non-federal reservoirs in Nebraska below Harlan County Reservoir. The values displayed are from the accounting includes all non-federal reservoir evaporation in Nebraska, as proposed by Kansas.

For 2006, no accounting was approved by the RRCA. Only input data for the accounting was approved. The values displayed are from an accounting consistent with Kansas position on accounting inclusive of (1) all non-federal reservoir evaporation in Nebraska and (2) a Harlan County Reservoir evaporation assignment method that assigns evaporation to both Kansas and Nebraska when only one State takes water from Harlan County Storage.

The totals of table 3 C are below:

Year	Allocation	Computed Beneficial Consumptive Use	Credits from Imported Water Supply	Difference between Allocation and Computed Beneficial Consumptive Use minus Imported Water Supply
Totals for 2003 to 2006	821,840	1,010,020	44,350	(143,840)

Attachment 3

Proposed Remedy for Violation of the Court's Decree
in
Kansas v. Nebraska and Colorado,
No. 126, Orig., U.S. Supreme Court
Decree of May 29, 2003, 538 U.S. 720

1. Order of Supreme Court finding Nebraska in violation of the Court's Decree and imposing the following remedy.

2. For 2005-2006 violation of the Final Settlement Stipulation (FSS), Nebraska shall pay to Kansas the following:

   A. Kansas' damages or Nebraska's gains, whichever are greater;

   B. Prejudgment interest compounded from the date of Nebraska's overuse;

   C. Attorneys fees and costs; and

   D. Such further relief as may be considered appropriate by the Court to address fully the Decree violation by Nebraska.

3. To achieve compliance with the FSS in the future, Nebraska shall:

   A. Immediately (a) shut down wells and groundwater irrigation in Nebraska within 2 ½ miles of the Republican River and its tributaries, (b) shut down groundwater irrigation of acreage added after the year 2000 throughout the Republican River Basin in Nebraska and (c) such further reductions of net consumptive use in the Basin in Nebraska necessary to maintain yearly compliance. This will reduce groundwater consumptive use to approximately 175,000 acre-feet per year. Nebraska is invited to submit an alternative remedy that is the hydrologic equivalent in quantity and timing;

   B. Further reduce Nebraska's Computed Beneficial Consumptive Use to the extent necessary to keep Nebraska (1) within its Compact allocation until the effects of the reduction of groundwater pumping brings Nebraska into compliance with the Compact and the FSS, and (2) in compliance when the actions listed above in are insufficient, especially in Water-Short Year Administration years;

   C. Be subject to preset damages, costs, attorneys' fees, and additional sanctions for any failure to comply with the Court's order in the future.

Attachment 4

Requirements for Nebraska's Compliance with the Republican River Compact

Report to

David Barfield

Kansas Department of Agriculture, Division of Water Resources

from

Spronk Water Engineers, Inc.

Dale E. Book, P.E.

December 18, 2007

Introduction

This report describes the analysis made to determine the reductions in Groundwater Computed Beneficial Consumptive Use (CBCU) necessary in Nebraska to achieve compliance with the Republican River Compact as implemented by the Final Settlement Stipulation (FSS). Nebraska's CBCU exceeded the allocation above Guide Rock for the two-year water short year test applied to 2005 and 2006. The expected result for the five-year period of 2003 through 2007 is that Nebraska's statewide CBCU will exceed its corresponding allocation. For the four years of 2003 through 2006, Nebraska's statewide CBCU has exceeded allocations by a total of 143,840 acre-feet using the Kansas methodology.

The analysis described in this report is intended to estimate the level of Groundwater CBCU that could occur within Nebraska's allocation to achieve compliance with the five-year test. Compliance with the Water Short year standard would require that additional reduction of surface water CBCU or equivalent offset be supplied. This analysis was intended to quantify the level of groundwater CBCU that could occur within Nebraska's allocation. The RRCA Groundwater model was used to determine reductions in pumping that would be necessary to achieve this level of CBCU (see Attachment 5).

This analysis relies on the data for the period of 2002 - 2006 to compare CBCU with the allocation under the Republican River Compact. This comparison provides the amount of groundwater CBCU that can occur, in combination with the limited surface water CBCU of this period, to achieve compliance with the FSS for this period. The amount of groundwater CBCU that can occur is a reduction from recent levels of groundwater CBCU of approximately 200,000 acre-feet/year. The RRCA groundwater model was used to quantify the projected groundwater depletions in Nebraska resulting from reductions in pumping as well as changes to Imported Water Supply Credits that would occur with the reduced groundwater pumping. The projected effects of these reductions on surface water CBCU and compliance with the FSS over this period were estimated.

Criteria and Assumptions

The level of groundwater CBCU that would allow the total CBCU to be within the allocation over the five-year period of 2002 through 2006 was determined as follows. The increased streamflow caused by a proposed level of pumping reduction would increase the supply available for surface water use in Nebraska and increase supply available to Kansas. The net change of Nebraska use was estimated assuming that additional water would be consumed by the surface water users as a result of the increased supply.

The level of groundwater depletion that would provide compliance with the five-year statewide standard in Nebraska was determined by estimating the change in groundwater CBCU, surface water CBCU, and Imported Water Supply Credits and then comparing the resulting net total CBCU to the allocation for the five-year period. The analysis is based on the following criteria and assumptions:

- CBCU should not exceed the statewide allocation, over a five-year period.
- The Imported Water Supply Credit was estimated from analysis with the RRCA Groundwater Model
- Reductions in CBCU necessary to achieve compliance are assumed to be accomplished from reductions in groundwater irrigation pumping, as represented in the groundwater model simulation.
- Surface water CBCU in Nebraska would be increased due to increased streamflow.
- Compliance with the two-year standard for water short conditions may require reduction in surface water use, in addition to the pumping reductions.
- The time required for groundwater CBCU, as predicted with the RRCA Groundwater model, to decline to the necessary level will be several years. Until CBCU is reduced to that level, other reductions will be needed to achieve compliance.

Description of Analysis

The analysis computes the change in statewide CBCU corresponding to a reduced level of groundwater depletions. It is necessary to reduce the groundwater depletions by more than the actual deficit, since additional surface water consumptive use would be expected to occur, as a result of the increased streamflow resulting from less depletion to streamflow from groundwater pumping.

Using available compact data, the five-year average statewide allocation over the period of 2002 - 2006 was 212,000 acre-feet/year. Table 1 shows the actual FSS accounting for this period. The overuse averaged 32,000 acre-feet/year for this period.

The amount of increased surface water consumptive use in Nebraska was estimated, based on the location of the changes in groundwater depletions. For the storage conditions in effect during these years, it was assumed that the increased flows would be largely diverted for irrigation, with some additional reservoir evaporation. The amount of additional streamflow that would be consumed by surface water uses in Nebraska was estimated to be 45%. Table 1 shows the adjusted CBCU and the comparison with the allocation.

The Imported Water Supply Credit was estimated using the RRCA Groundwater Model, with the projected future level of pumping determined from this analysis. The credit was estimated to be approximately 30,000 acre-feet/year. Actual credit would of course depend on the amounts of continued importation of Platte River water into the basin.

Results of Analysis

1. The average annual allocation for Nebraska for 2002 - 2006 was 212,000 acre-feet/year. The actual use, including both surface and groundwater, averaged 254,000 acre-feet/year. After adjusting for the Imported Water Supply Credit, the Computed Beneficial Consumptive Use exceeded the allocation by 32,000 acre-feet/year.

2. When the groundwater CBCU is reduced to 175,000 acre-feet/yr, average surface water CBCU is estimated to increase from 55,000 to 67,000 acre-feet/year. Imported Water Supply Credits increase to approximately 30,000 acre-feet/year.

3. The total CBCU that could occur within the Nebraska's allocation is 242,000 acre-feet/yr, after applying the estimated Imported Water Supply Credit.

4. The Groundwater CBCU must be reduced to 175,000 acre-feet/yr to achieve a balance with the statewide allocation over the five year period.

Conclusions

The Nebraska beneficial consumptive use has exceeded the statewide allocation for each of the years 2002 - 2006. The five-year total for the period of 2003 - 2007 is expected to exceed the allocation over that period, given the status of the accounting through 2006. Based on the five-year allocation through 2006, it would be necessary to reduce the total CBCU to approximately 242,000 acre-feet/year for Nebraska to be in compliance with the FSS.

A reduction of stream depletions due to groundwater pumping in Nebraska from 200,000 to 175,000 acre-feet was estimated to be necessary to provide compliance with the five-year test of the FSS over a period of similar water supply conditions. This would result in a balance between CBCU and allocation. This level of groundwater depletions corresponds to the pumping reductions described in Attachment 5.

To achieve compliance with the Water-short year periods, additional reductions to CBCU beyond those described above will be necessary. It would be necessary to limit surface water consumptive use or provide equivalent offsets from alternate sources.

Table 1

Estimated Effect on Compliance from a Reduction in Nebraska's Pumping: 2002 - 2006

(1000 acre-ft)

Table 3C: Nebraska's Five-Year Average Allocation and CBCU					
	Actual				
Year	Statewide Allocation	Ground Water CBCU	Surface Water CBCU	Imported Water Supply Credit	Allocation - (CBCU - IWS Credit)
2002	237	180	85	14	-15
2003	228	204	59	10	-25
2004	206	213	40	10	-37
2005	199	203	51	12	-42
2006	189	198	42	12	-39
Average	212	200	55	12	-32

	Adjusted				
Year	Ground Water [1] CBCU	Effect on [2] Nebraska's Surface Water CBCU	Surface Water [3] CBCU	Imported Water [4] Supply Credit	Allocation - [5] (Adjusted CBCU - IWS Credit)
2002	175	2	88	30	4
2003	175	13	72	30	11
2004	175	17	57	30	4
2005	175	13	63	30	-9
2006	175	11	53	30	-9
Average	175	11	67	30	0

[1] Nebraska's projected amount of Ground Water CBCU

[2] 45% of the difference between the actual Ground Water CBCU and adjusted Ground Water CBCU

[3] Adjusted Surface Water CBCU = the actual surface water CBCU plus the Effect on Nebraska's Surface Water CBCU

[4] Nebraska's projected Imported Water Supply Credit

[5] Adjusted compliance = Nebraska's allocation - (the adjusted Ground Water CBCU + the adjusted Surface Water CBCU - the adjusted imported water supply credit)

Attachment 5: RRCA groundwater model analysis
Impact of Nebraska pumping and proposed remedy

Samuel P. Perkins[1] and Steven P. Larson[2]
December 18, 2007

[1]Civil Engineer, Interstate Water Issues, Kansas Dept. Of Agriculture, Div. of Water Resources;
[2]S. S. Papadopulos & Associates, Inc., Bethesda, MD.

Introduction

The analysis described in Attachment 4 has shown that annual groundwater consumptive use in Nebraska must be reduced to 175,000 acre-feet in order to achieve sustained compliance with the compact. The approved RRCA groundwater model was used to determine the reduction in pumping necessary for Nebraska to meet this requirement and thereby achieve sustained compliance with the Republican River Compact. This memo describes the basis for the projected depletions computed by the groundwater model under the base case and reduced pumping scenarios.

In order to reach and then sustain a groundwater consumptive use of 175,000 acre-feet (AF) needed to comply with the Compact over the next 50 years, the proposed remedy case imposes the following conditions on future groundwater pumping for irrigation within the Republican River basin in Nebraska: first, a no-pumping zone for irrigation is imposed within 2.5 miles of RRCA groundwater model stream cells; second, groundwater irrigation area is held at 2000 levels at distances greater than 2.5 miles from stream cells; third, commingled irrigation area is held at 2000 levels at all distances from stream cells within the Republican River basin in Nebraska. Under this scenario, future groundwater irrigation area in Nebraska is reduced by 514,610 acres: 350,970 acres within the no-pumping zone, and 163,640 acres outside the no-pumping zone. For comparison, Nebraska's reported groundwater irrigated acreage within the Republican River basin has increased by 211,000 acres since 2000 and by 309,900 acres since 1990.

The proposed remedy is intended to allow recovery of streamflow as quickly as groundwater response will allow by focusing on groundwater pumping near the Republican River and its tributaries. The groundwater model was used to represent impacts of Nebraska groundwater pumping on Republican river streamflow and of imported water supply from the Platte River. Model scenarios were run to represent both status quo conditions and the proposed remedy. Projected Nebraska impacts for a 51-year future time period, as well as computed Republican River streamflow, are presented here under both scenarios.

Projected average annual impacts over 51 years (2007-2057) on Republican River streamflow under base case, or status quo, conditions are 259,900 acre-feet per year (afy) for Nebraska groundwater pumping, reduced by 13,300 afy for imported water supply credit from Platte River imports, for a net impact of 246,600 afy. The corresponding impacts under the reduced pumping scenario are 163,500 afy for Nebraska pumping, reduced by 27,700 afy for imported water supply credits, for a net impact of 135,800 afy. However, the net impact under the proposed remedy shows an initial decline followed by an upward trend for years 2015-2057, indicating a possibly larger net impact beyond the simulated time period. Compared with the base case scenario, the proposed remedy scenario shows an average decrease in pumping impact of 96,400 afy and increase in imported water supply credit of 14,400 afy, for a reduction in Nebraska's net impact of 110,800 afy.

Using a sequence of historical years to represent futures

Model datasets for historical years 1990-2006 were used to construct future scenarios. These years were chosen initially because of the higher quality of Kansas water use reporting data beginning in 1990. The sequence of historical years 1990-2006, beginning with year 1990, was repeated three times to represent future scenarios for years 2007-2057. Median annual precipitation for years 1990-2006, spatially averaged over the groundwater model domain, is 19.58 inches/year. Compared

against the model's years of record 1918-2006, this corresponds to a probability of 54.5 percentile, which is slightly above median rainfall of 19.28 in/yr for years 1918-2006. This indicates that the sequence is a reasonable projection, at least with respect to the historical record. Additionally, the sequence consists of a relatively wet period (1990-1999) followed by a relatively dry period (2000-2006).

Hydrologic conditions for future years were represented by the conditions of the historical sequence of years. These conditions include mean monthly streamflow and reservoir elevations at the end of each month, both of which are specified for the stream (STR) package, and evapotranspiration (for the EVT package) as input to Modflow (mf2k). Groundwater recharge, pumping and irrigated area are also based on conditions of the historical sequence of years, but with adjustments to specify conditions for the specific cases as input files to the pumping (WEL) and recharge (RCH) packages. Irrigated area is a consideration due to the dependence of precipitation recharge on whether or not the land is irrigated. Input files to Modflow were assembled by the preprocessor programs mketff (EVT package), mkstrff (STR package) and rrppf (RCH and WEL packages).

Base case: status quo scenario

Recharge and pumping conditions for the status quo, or base case, scenario were represented by historical conditions with adjustments as follows.

Kansas data for irrigated area, groundwater pumping and return flow in future years were based on corresponding historical years' data, but with adjustments to reflect 2006 conditions with respect to return flow (based on improvements in irrigation systems), metering and development.

Data for irrigated area served by groundwater and commingled pumping as reported in 2006 by Colorado and Nebraska were used to represent all future years under base case conditions. Irrigated area served by surface water pumping in future years was represented by data for the corresponding historical years. For Colorado, 2006 groundwater irrigated area was substituted for the corresponding historical years' area as a correction to the Colorado dataset from authorized area, as specified in years 1990-2000, to reported area used for irrigation, as specified in years 2001-2006. No corresponding adjustment was made to groundwater pumping for Colorado.

In the case of Nebraska, 2006 groundwater and commingled irrigated area were substituted for corresponding historical years' data in order to represent continued development through 2006. Groundwater pumping by Nebraska in future years was represented by reported pumping in the corresponding historical years to reflect hydrological conditions. To reflect the change in development associated with irrigation from a given historical year to the year 2006, historical pumping corresponding to each grid cell was multiplied by the ratio of total groundwater and commingled irrigated area in 2006 to the total area for the corresponding historical year. In order to reflect differences in development across Natural Resource Districts in Nebraska, this ratio was calculated for each NRD within the groundwater model domain, and applied to total reported pumping and groundwater return flow for each model grid cell within the corresponding District. NRD boundaries are shown in Figure 1.

The assumptions of historical conditions for the Nebraska dataset that are projected into the future include return flow from groundwater pumping for irrigation, which is assumed to be 20 percent. This is considered to be a generous assumption, even for recent historical years, and may warrant revision for scenario refinements, especially if allocations imposed by Natural Resource Districts are to be incorporated.

Proposed remedy case: reduced Nebraska pumping scenario

Conditions for the reduced Nebraska pumping scenario are summarized above in the Introduction. The conditions are explained in greater detail as follows.

No-pumping zone

The no-pumping zone was specified in terms of model grid cells as an approximation of an actual zone, which would likely be independent of the model grid; for example, it might reference a boundary based on the Public Land Survey System. The grid-based approximation has the advantage of allowing the affected pumping in Nebraska to be selected from datasets previously prepared by Nebraska for the model, including groundwater pumping, recharge and irrigated area. Additionally, defining the no-pumping zone with reference to model stream cell centers is intended to be consistent with prior decisions made during model development to represent the stream network.

Figure 1 shows the extent of the proposed no-pumping zone on Nebraska groundwater pumping for irrigation within the Republican River basin as gray-shaded grid cells. Model cells representing streams and federal reservoirs (turquoise) are included in the no-pumping zone. By selecting model grid cells whose centers lie within two miles of stream cell centers, the resulting no-pumping zone applies to groundwater diversions within 2.5 miles of the stream. The model grid cells corresponding to the no-pumping zone were selected in GIS and converted into a "mask", i.e., an array of 1's and 0's that was written to a text file for input to a preprocessor to identify grid cells for which pumping is to be excluded.

2000 irrigated area

Outside the no-pumping zone, groundwater and commingled irrigation area for the year 2000 were substituted for corresponding historical years' data to hold development at 2000 levels. Groundwater pumping by Nebraska in future years was represented by reported pumping in the corresponding historical years to reflect hydrological conditions, multiplied by a factor to reflect the change in irrigated area, given by the ratio of total groundwater and commingled irrigated area in 2000 to the total area for the corresponding historical year.

An implicit assumption of the above conditions for the proposed remedy scenario is that pumping within the no-pumping zone cannot be transferred outside the zone.

Commingled irrigated area

Future scenario years are represented by both groundwater and commingled irrigated area datasets for a specified historical year outside the no-pumping zone—i.e., by Nebraska's 2000 dataset within the Republican River Basin and Nebraska's 2006 dataset outside the basin. However, within the no-pumping zone, whereas groundwater irrigation area is excluded, the commingled irrigation area is retained, under the assumption that commingled area could be irrigated if surface water is available. Commingled irrigated area inside the no-pumping zone totaled 47,840 acres in 2000 and 11,040 acres in 2006.

The combined effects of imposing the no-pumping zone and fixing irrigated area at 2000 elsewhere in the Republican River basin are to reduce groundwater irrigated area within the Republican River basin by 514,600 acres, or 43 percent, from 1,200,600 acres for assumed status quo conditions to 686,000 acres under the proposed remedy.

Evaluation of impacts of Nebraska pumping under status quo and reduced pumping conditions

In order to compute Nebraska impacts of both groundwater pumping and imported water supply, three additional cases were run for comparison against the status quo and reduced pumping cases, above. Conditions for the third case specify no groundwater pumping in Nebraska for the entire simulation period, beginning in 1918, but are otherwise the same as conditions for the base case. Similarly, conditions for the fourth case specify no imported water supply from the Platte River in Nebraska for the entire simulation period, beginning in 1918, but are otherwise the same as conditions for the base

case. The fifth case is identical to the reduced pumping cases (above), except for the assumption that future imported water supplies from the Platte River are excluded.

Based on these five future scenario runs, impacts of Nebraska pumping and imported water supply were evaluated with respect to both base case (status quo) and reduced pumping conditions. First, the impact of Nebraska pumping under status quo conditions was evaluated as the difference given by computed Republican River flows for the "no Nebraska pumping" case minus corresponding flows for the status quo case. Second, the impact of Nebraska pumping under the proposed remedy is evaluated as the difference given by computed Republican River flows for the "no Nebraska pumping" case minus corresponding flows for the proposed remedy case. Similarly, imported water supply credits were evaluated twice: first, with respect to status quo conditions, and then with respect to reduced pumping conditions under the proposed remedy case.

Results: impacts of Nebraska pumping and imported water supply from Platte River

The reduction in groundwater irrigated area of 514,600 acres within the Republican River basin under the proposed remedy results in a groundwater pumping reduction of 564,400 acre-feet/year. Impacts of this reduction on streamflow are presented here.

Table 1 lists computed annual impacts for years 2007-2057, and averages over the same period, of Nebraska pumping on Republican River streamflow and of imported water supply under both the status quo and reduced pumping scenarios. The rightmost column of Table 1 lists the reduction of impacts achieved under the reduced pumping scenario.

Table 1 shows that projected average annual impacts over 51 years (2007-2057) on Republican River streamflow under base case, or status quo, conditions are 259,900 acre-feet/per year (afy) for Nebraska groundwater pumping, reduced by 13,300 afy for imports from the Platte River, for a net impact of 246,600 afy. The corresponding impacts under the reduced pumping scenario are 163,500 afy for Nebraska pumping, reduced by 27,700 afy for imported water supply, for a net average impact of 135,800. However, the net impact under the proposed remedy shows an initial decline followed by an upward trend for years 2015-2057 that indicates a possibly larger net impact beyond the modeled time period. Compared with the base case scenario, the proposed remedy scenario shows an average decreased pumping impact of 96,400 afy and increase in imported water supply credit of 14,400 afy, or an average net Nebraska impact reduction of 110,800 afy.

Nebraska impacts are shown graphically in Figures 2 and 3. Figure 2 shows the separate impacts of Nebraska pumping and imported water supply under both scenarios. Figure 3 shows the net impacts given by the sum of pumping and imported water supply impacts for each of the scenarios.

Figure 2 shows historical impacts of Nebraska pumping on Republican River streamflow and imported water supply according to the RRCA groundwater model for years 1960-2006. The historical impact of Nebraska pumping reached peak levels of 212,900 acre-feet/year in 2001 and 213,100 acre-feet/year in 2004, and was 198,400 acre-feet/year in 2006.

Figure 2 also shows projected impacts of Nebraska pumping on Republican River streamflow and imported water supply under both the status quo scenario and the reduced pumping scenarios for years 2007-2057. The impact of Nebraska pumping on Republican River streamflow in future years under the status quo scenario shows greater variability than under the reduced pumping scenario because of the greater magnitudes of the pumping under the status quo scenario. Projected pumping impacts under both scenarios appear to have upward trends, although impacts under status quo conditions show a decreasing rate of change. Projected impacts of imported water supply under the proposed remedy are greater and show less variability than those under status quo conditions.

Figure 2 shows that the impact of Nebraska pumping under the proposed remedy is projected to fall below 175,000 acre-feet/year for the first time in 2011, or in the fifth year of the future scenario, and

then occasionally exceeds 175,000 acre-feet/year beginning in 2044. Based on linear trends for years 2011-2057, the impact of Nebraska pumping increases by 383 acre-feet/year under the proposed remedy, and by 994 afy under status quo conditions.

Figure 3 shows that the net impact of Nebraska pumping and imported water supply under the proposed remedy is projected to fall below 150,000 acre-feet/year for the first time in 2011, and then stay below 150,000 acre-feet/year for the remaining years of the simulation. Based on linear trends for years 2011-2057, the net impact of Nebraska pumping and imported water supply increases by 250 acre-feet/year under the proposed remedy, and by 1,113 afy under status quo conditions.

Figure 4 shows computed Republican River flows contributed by groundwater for the historical period 1960-2006 and for the two scenarios 2007-2057. Under status quo conditions, computed annual flows for years 1960-2057 diminish at an average rate of 2.2 percent per year, based on an exponential fit. Under the proposed remedy scenario, computed flows after 2006 show relatively rapid recovery during the first few years, followed by a relatively slow decline; annual flows for years 2010-2057 decline at an average linear rate of 480 acre-feet/year.

Future hydrologic conditions

It is important to keep in mind that the projections, particularly on an annual basis or in the short term, are strongly dependent on the hydrological conditions of the assumed sequence of years. Because of this, the time required to reduce the impact of Nebraska pumping to less than 175,000 acre-feet/year, and the net impact of Nebraska pumping and imported water supply to less than 150,000 acre-feet/year, will be strongly influenced by future and unknown hydrological conditions.

Table 1. Projected impacts of Nebraska pumping and Platte River imports under both status quo conditions and the proposed remedy (acre-feet/year)

year	Status quo conditions			Proposed remedy			Impact reduction
	pumping	imports	Net impact	pumping	imports	Net impact	
2007	204,840	16,072	188,768	189,184	17,473	171,711	-17,057
2008	224,512	11,250	213,262	185,857	18,154	167,703	-45,559
2009	228,325	10,407	217,918	184,071	24,614	159,457	-58,461
2010	262,371	29,825	232,546	187,111	28,769	158,342	-74,204
2011	227,775	18,017	209,758	167,089	23,559	143,530	-66,228
2012	249,359	18,470	230,889	168,252	25,807	142,445	-88,444
2013	269,801	23,542	246,259	169,507	27,090	142,417	-103,842
2014	247,313	18,602	228,711	160,491	25,647	134,844	-93,867
2015	232,593	14,668	217,925	152,431	24,340	128,091	-89,834
2016	252,899	14,009	238,890	161,317	27,746	133,571	-105,319
2017	228,620	14,548	214,072	148,757	23,986	124,771	-89,301
2018	241,910	13,523	228,387	150,532	26,722	123,810	-104,577
2019	213,099	10,189	202,910	137,112	20,616	116,496	-86,414
2020	233,198	9,847	223,351	150,146	25,743	124,403	-98,948
2021	243,676	9,844	233,832	153,893	27,341	126,552	-107,280
2022	242,742	10,139	232,603	151,289	25,869	125,420	-107,183
2023	227,972	9,722	218,250	147,370	26,385	120,985	-97,265
2024	234,629	11,778	222,851	149,546	25,218	124,328	-98,523
2025	253,547	9,674	243,873	157,124	26,165	130,959	-112,914
2026	254,536	10,212	244,324	157,983	27,613	130,370	-113,954
2027	299,036	25,412	273,624	166,395	29,939	136,456	-137,168
2028	257,289	18,679	238,610	156,655	27,783	128,872	-109,738
2029	278,120	14,386	263,734	160,228	29,111	131,117	-132,617
2030	303,309	18,195	285,114	165,524	30,221	135,303	-149,811
2031	271,865	19,952	251,913	159,834	29,159	130,675	-121,238
2032	259,045	12,091	246,954	154,699	27,922	126,777	-120,177
2033	279,529	11,753	267,776	164,346	30,380	133,966	-133,810
2034	250,874	11,838	239,036	153,979	27,265	126,714	-112,322
2035	265,920	11,035	254,885	156,601	29,499	127,102	-127,783
2036	232,417	8,482	223,935	145,034	23,281	121,753	-102,182
2037	246,038	9,503	236,535	158,008	28,340	129,668	-106,867
2038	260,994	9,665	251,329	162,361	29,600	132,761	-118,568
2039	265,103	9,975	255,128	160,195	28,326	131,869	-123,259
2040	247,751	9,535	238,216	157,100	28,648	128,452	-109,764
2041	255,502	9,350	246,152	158,959	27,569	131,390	-114,762
2042	273,424	9,374	264,050	167,868	28,276	139,592	-124,458
2043	273,450	10,131	263,319	169,192	29,706	139,486	-123,833
2044	327,385	19,966	307,419	178,860	32,329	146,531	-160,888
2045	275,049	18,063	256,986	167,419	29,994	137,425	-119,561
2046	299,589	12,203	287,386	172,202	31,344	140,858	-146,528
2047	327,204	14,606	312,598	178,452	32,458	145,994	-166,604
2048	290,800	18,403	272,397	172,503	31,556	140,947	-131,450
2049	277,063	10,468	266,595	166,163	29,937	136,226	-130,369
2050	296,299	11,600	284,699	177,440	32,434	145,006	-139,693
2051	269,532	10,047	259,485	166,064	29,195	136,869	-122,616
2052	283,437	10,507	272,930	169,363	31,609	137,754	-135,176
2053	242,200	8,300	233,900	155,725	24,755	130,970	-102,930
2054	257,282	9,441	247,841	170,669	29,988	140,681	-107,160
2055	271,890	9,582	262,308	174,923	31,432	143,491	-118,817
2056	280,087	10,047	270,040	173,130	30,086	143,044	-126,996
2057	263,074	9,547	253,527	168,435	30,162	138,273	-115,254
2007-2057	259,888	13,264	246,624	163,478	27,670	135,808	-110,816

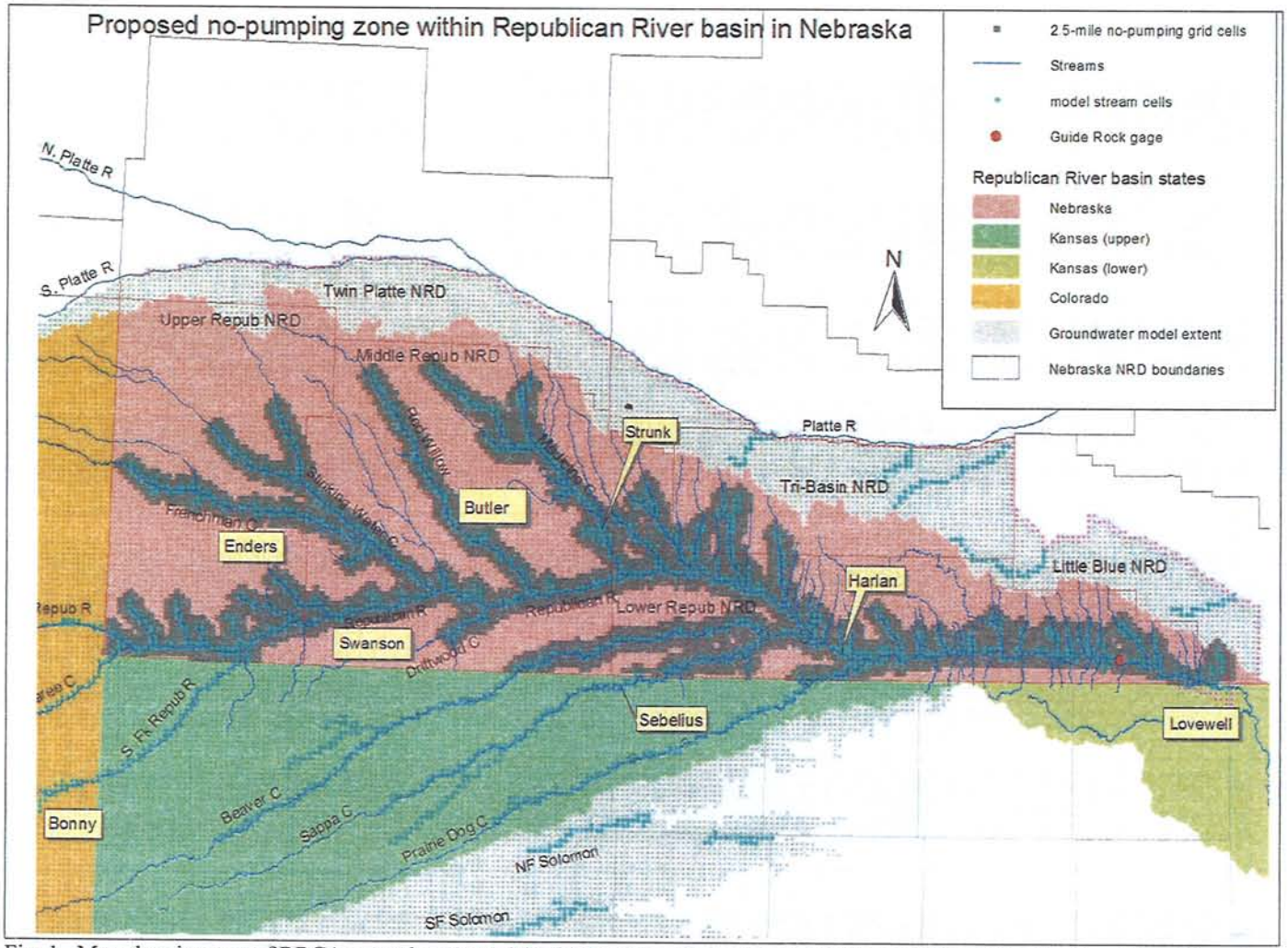

Fig. 1. Map showing part of RRCA groundwater model grid domain. Proposed no-pumping zone lies within the Republican River basin in Nebraska. Grid cells shaded dark gray are those whose centers lie within three miles of centers of stream cells (turquoise).

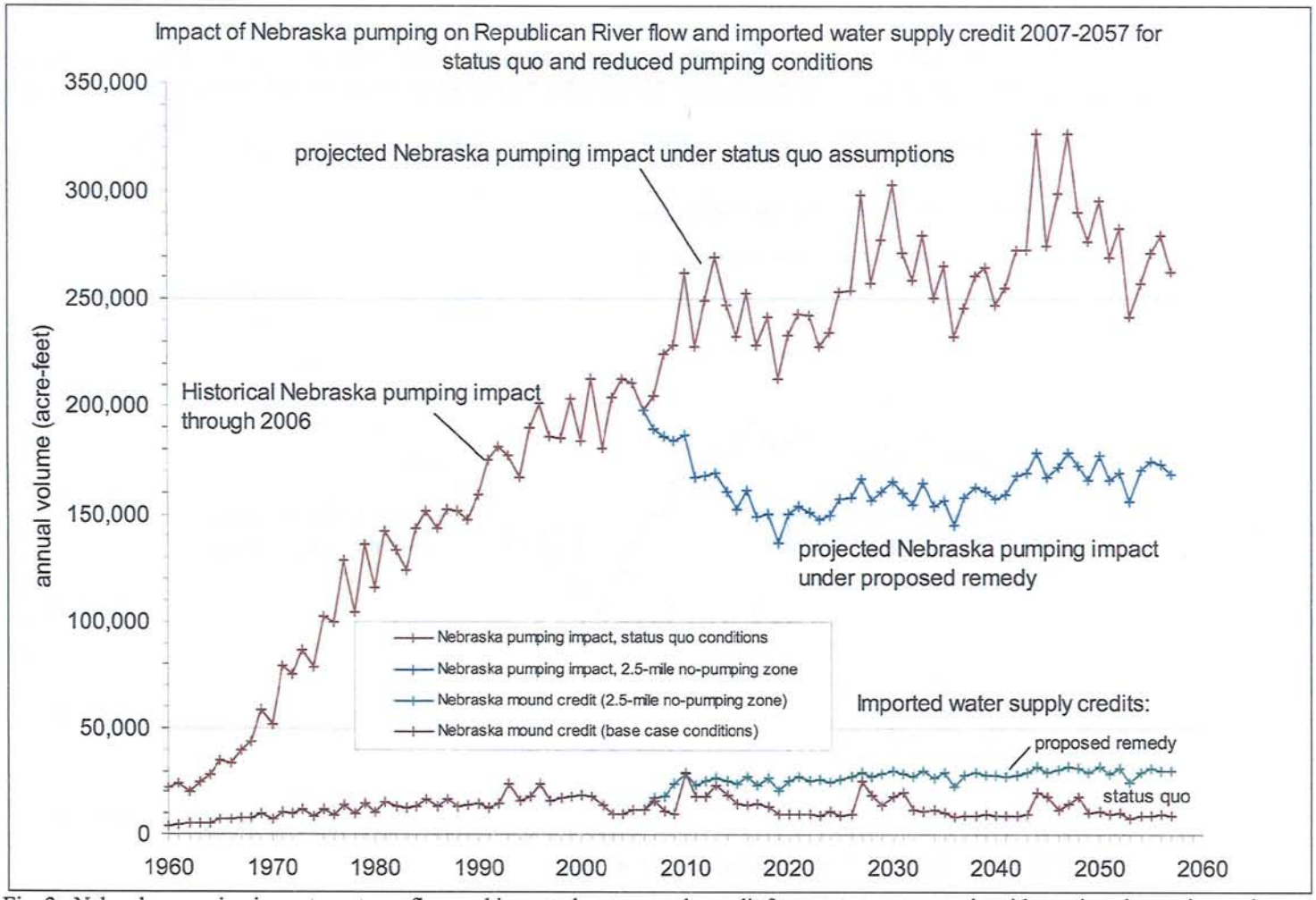

Fig. 2. Nebraska pumping impact on streamflow and imported water supply credit for a status quo scenario with continued pumping under current conditions, and for a reduced pumping scenario corresponding to the proposed remedy.

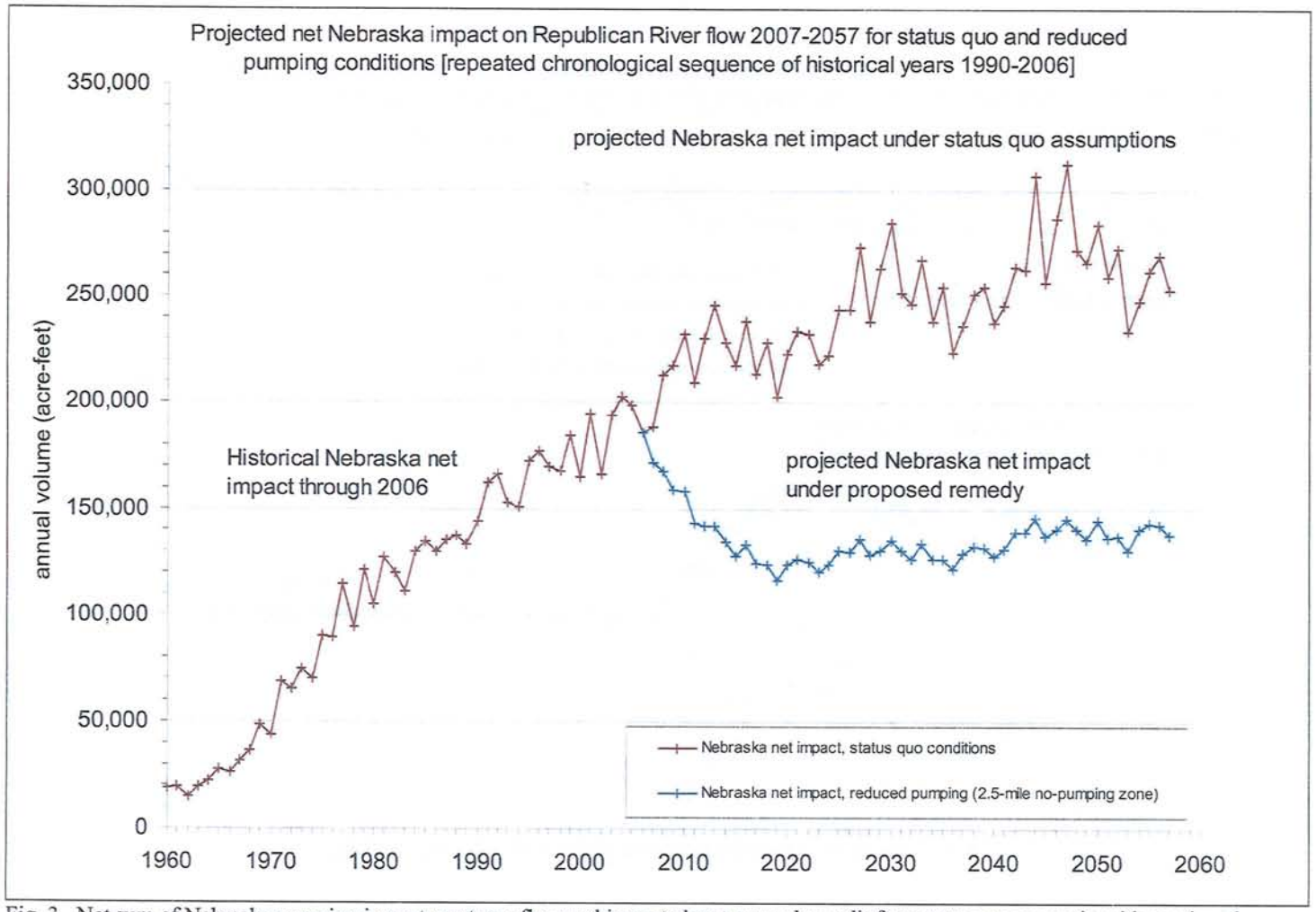

Fig. 3. Net sum of Nebraska pumping impact on streamflow and imported water supply credit for a status quo scenario with continued pumping under current conditions, and for a reduced pumping scenario corresponding to the proposed remedy.

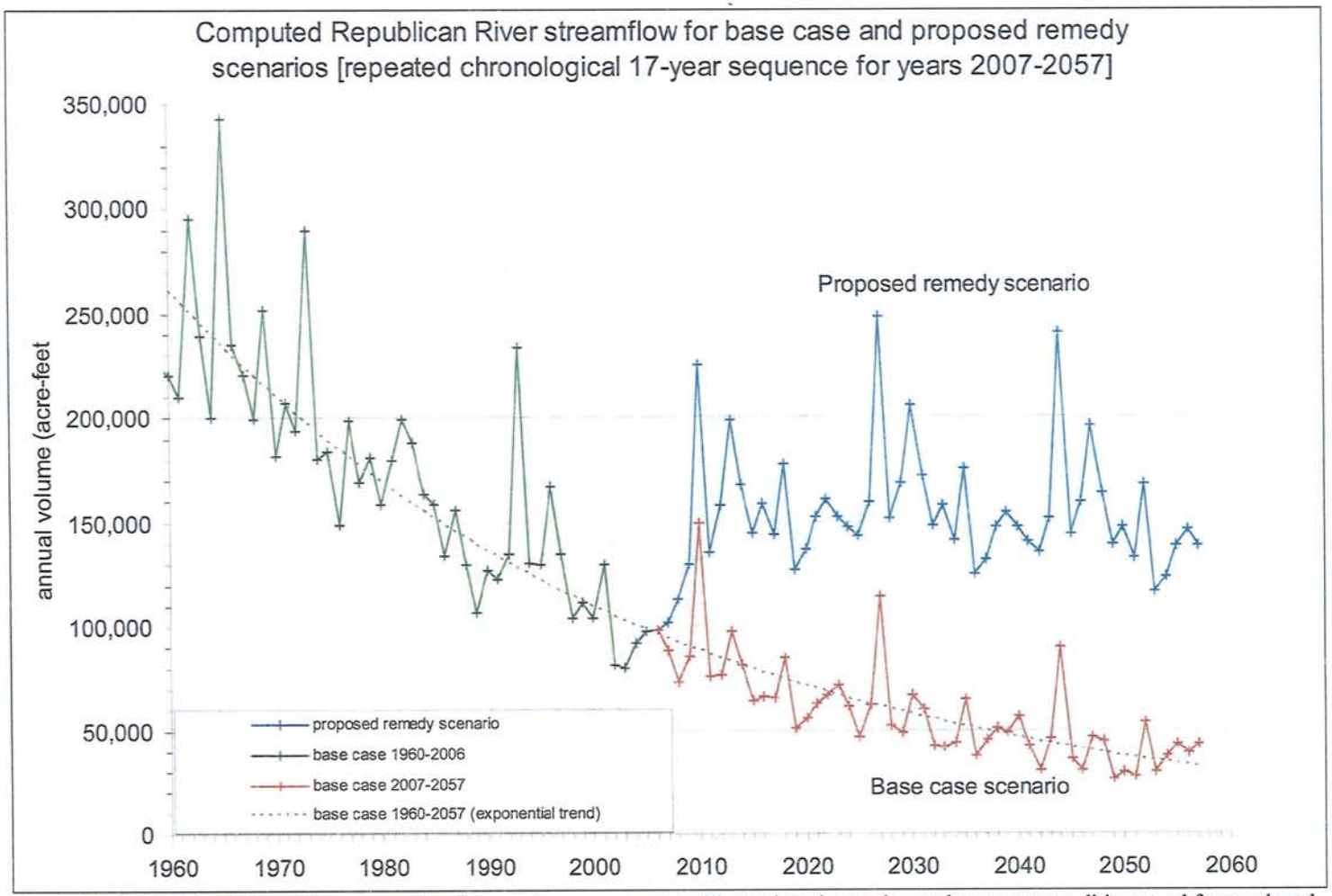

Fig. 4. Computed Republican River streamflow for a status quo scenario with continued pumping under current conditions, and for a reduced pumping scenario corresponding to the proposed remedy.

Attachment 6

Kansas v. Nebraska & Colorado,
No. 126, Orig., U.S. Supreme Court

Designated Schedule for Resolution

December 19, 2007	Kansas provides proposed remedy to Nebraska with copies to Colorado and United States.
February 4, 2008	If agreement is not reached, Kansas submits dispute to the Republican River Compact Administration (RRCA) as a "fast-track" issue.
March 5, 2008	By this date, the RRCA meets to resolve the dispute.
March 20, 2008	If the RRCA fails to resolve the dispute, Kansas invokes nonbinding arbitration.
April 3, 2008	Kansas or Nebraska may amend the scope of the dispute to address additional issues.
April 17, 2008	Kansas and Nebraska submit names of proposed arbitrators and qualifications to each other.
April 28, 2008	Kansas and Nebraska representatives meet in person or by telephone to confer and agree on arbitrators; if agreement cannot be reached, the selection is submitted to CDR Associates of Boulder, Colo.
May 1, 2008	Arbitrators engaged.
May 12, 2008	Initial meeting/scheduling conference of Kansas and Nebraska before the arbitrators.
November 12, 2008	Deadline to complete arbitration and render decision.
December 12, 2008	Kansas and Nebraska give written notice whether they will accept the arbitrators' decision.
Thereafter	If the dispute is not resolved, Kansas makes the appropriate filings in the U.S. Supreme Court.