



Kathleen Sebelius, Governor  
Adrian J. Polansky, Secretary

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April 22, 2008

Via Email and U.S. Mail

Brian Dunnigan, P.E.  
Acting Director  
Nebraska Department of Natural Resources  
301 Centennial Mall South  
Lincoln, Nebraska 68509

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

Dear Commissioner Dunnigan:

It was a pleasure to see you again at the Republican River Compact Administration meeting on Friday, April 11. This letter is a follow-up to our discussions at that meeting.

My letter to Ann Bleed of December 19, 2007, transmitted Kansas' proposed remedies for Nebraska's violations of the first test of compliance under the Court's decree on the Republican River, for Water-Short Year 2006 as defined in Section V.B.2 of the Final Settlement Stipulation (FSS). My December 19, 2007 letter defined Kansas' position on the payment required as part of the remedy as either Kansas' damages or Nebraska's gains, whichever is greater.

Attached to this letter is Kansas' economic report (Attachment 1) with supporting documentation, which further quantifies the amount of the payment that is referred to in Kansas' proposed remedy. The Kansas economic report is based on the assumption that Nebraska was able to acquire all of the reasonably available surface water in the Republican River Basin in 2005 and 2006 and deliver it to Guide Rock in order to minimize the reduction in groundwater pumping that would be required. This was intended to determine the lowest cost approach Nebraska could have taken to achieve compliance if only 2005 and 2006 are considered. Attachment 2 is our analysis of available surface water and relevant FSS accounting. Attachment 3 documents runs of the RRCA Groundwater Model to quantify the impact of the curtailment of groundwater pumping necessary for Nebraska to achieve compliance in Water-Short Year 2006. The electronic backup of this work is attached to the email transmittal of this letter, except the model runs, which have been uploaded to the RRCA web site.

Brian Dunnigan, Acting Director  
April 22, 2008  
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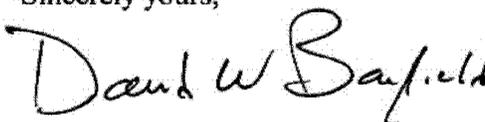
In the opinion of our economists, the benefits realized by Nebraska by not complying with the terms of the Compact and the FSS for Water-Short Year 2006 was \$ 62,926,203.

The Kansas analysis determines the minimum amount that could have been expended by Nebraska to comply with the 2006 Water-Short Year test utilizing the acquisition of available surface water combined with reduction in groundwater irrigated acres sufficient to provide the remaining reduction in consumptive use. The analysis is conservative in that it assumes no transit losses in surface water deliveries and ignores a number of possible physical, legal, and institutional limitations to delivery of surface water. The additional acres of groundwater pumping needed to be shut down for 2005 and 2006 is the groundwater acreage specified by Nebraska in the model stream cells for these two years, which averaged 131,095 acres.

The economic report only addresses the benefits enjoyed by Nebraska as a result of Nebraska's non-compliance; it does not quantify the costs and attorney fees incurred by Kansas as a result of the violations, nor does it acknowledge the need to create a disincentive to Nebraska not to continue its non-compliance. Therefore, Kansas believes that an additional 15% should be added in recognition of these foregoing considerations, bringing the total Kansas demand for payment to \$ 72,365,133.

We expect there will be additional remedies required for other violations to be quantified later this year for the Water-Short Year 2007 and the first 5-year compliance period ending in 2007.

Sincerely yours,



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

cc: Dick Wolfe, Colorado RRCA Commissioner  
Aaron M. Thompson, U.S. Bureau of Reclamation  
James J. DuBois, U.S. Department of Justice  
Colonel Roger Wilson, Jr., U.S. Army Corps of Engineers

## Attachment 1

# Estimate of Nebraska's Cost of Compliance with the Republican River Compact for the Water-Short Year 2006

## Report

Dr. Bill Golden

Dr. Terry Kastens

Dr. Kevin Dhuyvetter

Dr. John Leatherman

Dr. Allen Featherstone

Dr. Tom Johnson

April 21, 2008

## Estimate of Nebraska's Cost of Compliance with the Republican River Compact

### I. Background

This report provides estimates of the economic costs that the state of Nebraska would have incurred had the state taken the necessary steps to achieve compliance with the terms of the 1943 Republican River Compact and the May 19, 2003 Final Settlement Stipulation for the Water-Short Year 2006 (averaging years 2005 and 2006). Put another way, the costs computed here can be viewed as the benefits acquired by Nebraska for not being in compliance. Note that this analysis considers only actions necessary to meet the Water-Short Year test for 2006.

In a letter from the Kansas Department of Agriculture to the Republican River Compact Administration dated December 19, 2007, Kansas outlined its remedy for Nebraska non-compliance with the Final Settlement Stipulation. This included the shutdown of wells irrigating 514,610 acres. However, in the short run, Nebraska would have been able to meet the Water-Short Year test for 2006 through the purchase of surface water and a lesser reduction in groundwater acreage. Hence, the cost analysis employed here considers purchasing all available surface water in Nebraska in 2005 and 2006, and then balances out the additional requirements with groundwater shutdowns. This scenario for Water-Short Year 2006 compliance assumes groundwater pumping is stopped on 140,858 and 121,332 irrigated acres in 2005 and 2006, respectively. This represents an area approximately one-half mile either side of the river (Book, 2008).

This scenario to achieve compliance for Water-Short Year 2006 will have a lower cost to Nebraska than the long-run proposal that requires considerably more acres to be retired. However, it also should be pointed out that this short-run estimate likely will not bring Nebraska into long-run compliance and thus the cost estimate provided here should be viewed as a short-run least cost solution. For example, in a future dry year, there may not be enough surface water to purchase to make up the difference had only an average of 131,095 irrigated acres been retired in 2005 and 2006.

### II. Direct and indirect economic impacts

The difference in irrigated and non-irrigated cash rents on land is a measure of the direct and easily observable impact of turning irrigated land into non-irrigated land. But, it generally is understood that economic impacts emanate beyond that which can be observed directly. This is due to the interconnected nature of the economy. Businesses buy from and sell to other businesses. Labor earns wages and salaries, and proprietors earn profits that are used to purchase household goods and services. Thus, when an economic change occurs, it sets in motion a "ripple" effect that impacts interlinked economic sectors elsewhere in the economy. This means that the overall economic effect is greater than the direct effect by some increment of value. This is more commonly known as the multiplier effect. By estimating the size of the multiplier effect, it becomes possible to determine the magnitude and direction of the indirect and induced (together referred to here as simply indirect) economic effects that are known to accompany the observable direct economic changes. Impact Analysis for Planning (IMPLAN) software was used to calculate the multiplier effect and estimate the direct and indirect impacts of groundwater retirement on value added to the economy.

Change in crop revenue between irrigated and non-irrigated land is an input required of our IMPLAN analysis. For that number we used the \$217 per acre number provided in table 4 of Supalla et al. (2006), who have computed an economic analysis of Nebraska irrigation in the Republican River Watershed in 2006. Starting with that \$217 per acre difference in crop revenue, our IMPLAN analysis derived a total (direct and indirect) impact to value added (a broad measure of total income and, thus, total state economic welfare) of \$180.20 per acre. Supalla et al. (2006) reported a measure of direct impact of \$82/acre (from table 2 in their report). Hence, this suggests a multiplier of 2.1976 (i.e.,  $180.20/82$ ) to go from direct to total impacts. In this report we use the difference in irrigated and non-irrigated land rent as a measure of direct impacts, and subsequently use the multiplier to arrive at indirect or total value-added economic impacts.

### III. Additional surface water purchases required in 2005 and 2006

Based on runs from the hydrologic model underlying our analysis, surface water purchased by Nebraska to achieve compliance in 2005 and 2006 could not be delivered to the farm gate in Nebraska for use there by Nebraska's irrigators. Measured at the farm gate, 14,300 acre-feet in 2005 and 32,700 acre-feet in 2006 would not have been available to Nebraska farmers (see Book, 2008 table 5).

### IV. Water quantity per acre of land affected

Using the differences between irrigated and non-irrigated land rent as the measure of economic cost requires an estimate of irrigation inches applied per acre to convert acre-feet of water at the farm gate to acres of irrigated production. Based on average irrigation amounts for the affected counties, it was assumed that 11.71 and 11.47 inches of irrigation water were applied per acre in 2005 and 2006, respectively.<sup>1</sup> These application depths correspond to 0.976 and 0.956 acre-foot per acre of land, for 2005 and 2006, respectively, whether associated with stopped groundwater pumping or unused surface water. Because it is assumed that wells near the river are shut down, we assume lost surface water usage cannot be made up with groundwater pumping in areas affected.

### V. Dollar values brought to 2008

A 3.41% annual interest rate is used to adjust all time-based dollar values to the present, which is considered to be 2008.<sup>2</sup> Note once again that this is an analysis of what Nebraska would "owe" Kansas in 2008 for its being out of compliance in only the years 2005 and 2006.

### VI. Rents

Table 1 shows rent values used in this analysis and the average number of irrigation inches applied in the 22-county area of the Republican River Basin. For example, the direct impact of stopping groundwater pumping on one acre in 2006 would be \$85.20. Likewise, giving up one acre-foot of water equates to a direct impact of \$89.14 per acre given 11.47 inches of irrigation water (0.956 acre-foot) applied per acre of land.

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<sup>1</sup> These are simple averages of county-specific depths used for the baseline scenario based on 1990-2006 climatic conditions. This run is detailed in section 2a of the March 11, 2008 Kansas City RRCA meeting information provided by Nebraska.

<sup>2</sup> The discount rate is based on the average 3-month T-bill rate from January 2004 through December 2007.

## VII. Cost estimate results

The total (direct and indirect) cost associated with retiring 140,858 acres of irrigated land in 2005 and 121,332 acres in 2006 is estimated to be \$53,081,441 in 2008 dollars (Table 2). These retired acreages are based on the assumption that the maximum amount of surface water available would have been purchased, thus making it unavailable to Nebraska producers. This reduction in surface water would have been a total of 47,000 acre-feet (see Book, 2008 table 5), which is estimated to have a total cost, in 2008 dollars, of \$9,844,763 over the 2005 and 2006 years (Table 3). Thus, the total cost to Nebraska of being in compliance under this short-run scenario for the two-year period (2005 and 2006) is \$62,926,203.

## VIII. Summary

This report provides estimates of Nebraska's economic gains due to non-compliance with the Compact for Water-Short year 2006. It does this by estimating the economic costs that the state of Nebraska would have incurred had the state taken the necessary steps to achieve short-run compliance with the terms of the 1943 Republican River Compact and the May 19, 2003 Final Settlement Stipulation for this test of compliance.

Kansas has proposed a long-run solution for Nebraska to reach compliance that would require retiring 514,610 acres from irrigated production. Because Nebraska could come into compliance with this particular test of compliance with lesser groundwater acreage reduction, an alternative was considered for this analysis. However, it is important to recognize that the scenario considered here likely would not bring Nebraska into long-run compliance. This scenario assumed Nebraska would purchase the maximum amount of surface water possible so as to minimize the amount of acres irrigated with groundwater that would have to be retired. The 2005 and 2006 cost for this scenario was estimated as \$62,926,203.

The estimate of Nebraska's gains provided by this report involves remedies predicated on reduced groundwater pumping and reduced surface water usage. The number of acres presumed transformed from irrigated to nonirrigated crop land, and the quantities of required surface water reductions, were provided to the economics team (Book, 2008). Other combinations of reduced groundwater usage and/or surface water reductions would yield other estimates of Nebraska's gains.

## References

Book, D.E., "Analysis of Measures That Would Have Been Required by Nebraska to Achieve Water-Short Year Compliance with the Republican River Compact in 2006." Report to David Barfield, Kansas Department of Agriculture, Division of Water Resources. April 18, 2008.

Johnson, B., Cornhusker Economics, "Nebraska Farmland Values and Cash Rents Rise Sharply." March 19, 2008 (and previous issues).  
<http://www.agecon.unl.edu/Cornhuskereconomics.html> (last accessed April 21, 2008).

Minnesota IMPLAN Group, Inc. (MIG), 1999. IMPLAN Professional Software, Analysis, and, Data Guide, Minnesota IMPLAN Group, Inc., 1725 Tower Drive West, Suite 140, Stillwater, MN 55082, [www.implan.com](http://www.implan.com)

Supalla, Raymond, T. Buell and B. McMullen. 2006. "Economic and State Budget Cost of Reducing the Consumptive Use of Irrigation Water in the Platte and Republican Basins", Department of Agricultural Economics, UNL. August 21, 2006.  
<http://watercenter.unl.edu/WRRR/Downloads/Supalla-CostToReduce-10-2006.pdf> (last accessed April 21, 2008).

**Tables**

**Table 1. Nebraska Average Cash Rents per Acre for Irrigated and Nonirrigated Cropland<sup>1</sup>**

Year	Irrigated	Nonirrigated	Difference	Inches/acre <sup>2</sup>	Ac-ft/acre	Diff/ac-ft <sup>3</sup>
2003	\$122.20	\$42.00	\$80.20	15.99	1.333	\$60.19
2004	\$125.20	\$44.00	\$81.20	13.25	1.104	\$73.54
2005	\$128.10	\$44.00	\$84.10	11.71	0.976	\$86.18
2006	\$126.70	\$41.50	\$85.20	11.47	0.956	\$89.14
2007	\$137.40	\$45.00	\$92.40	n/a	n/a	n/a
2008	\$164.90	\$54.50	\$110.40	n/a	n/a	n/a

<sup>1</sup> Based on the average of the South and Southwest regions, where each region is a weighted average of center pivot (80%) and gravity irrigation (20%). Source: Johnson

<sup>2</sup> County-level pumping amounts by year data provided by Nebraska.

<sup>3</sup> Diff/ac-ft is the rent difference per acre adjusted to reflect one acre-foot of water.

**Table 2. Nebraska's Cost of Reduction of Groundwater Use**

Year	Acreage	Rent Difference	Direct Costs	Indirect Costs	Total Costs	Adjusted Total Costs <sup>1</sup>	Cost/Ac-Ft Gained <sup>2</sup>
2005	140,858	\$84.10	\$11,846,158	\$14,186,894	\$26,033,052	\$28,788,080	
2006	121,332	\$85.20	\$10,337,486	\$12,380,117	\$22,717,604	\$24,293,361	
Total						\$53,081,441	\$1,171

<sup>1</sup> Adjusted to reflect costs in 2008 dollars.

<sup>2</sup> Based on a total of 45,316 ac-ft of surface water gained over this time period valued at the farm gate.

**Table 3. Nebraska's Cost of Reduction of Surface Water Use**

Year	Acre Foot Shortage	Value per Acre Foot	Direct Costs <sup>1</sup>	Indirect Costs	Total Costs	Adjusted Total Costs <sup>2</sup>	Cost/Ac-Ft Purchased
2005	14,300	\$86.18	\$1,232,413	\$1,475,931	\$2,708,345	\$2,994,964	\$209.44
2006	32,700	\$89.14	\$2,914,776	\$3,490,720	\$6,405,496	\$6,849,799	\$209.47
Total	47,000		\$4,147,189	\$4,966,651	\$9,113,841	\$9,844,763	\$209.46

<sup>1</sup> Based on acre-foot shortage and the value per acre foot derived from rent differences (Table 1).

<sup>2</sup> Adjusted to reflect costs in 2008 dollars.

Attachment 2

Analysis of Measures that would have been Required for Nebraska to Achieve Water-  
Short Year Compliance with Republican River Compact in 2006

Report  
to

David Barfield, P.E.

Chief Engineer

Kansas Department of Agriculture, Division of Water Resources

from

Dale E. Book, P.E.

Spronk Water Engineers, Inc.

April 21, 2008

## Introduction

Spronk Water Engineers was requested to develop an estimate of the combination of reduction in surface water use and groundwater pumping that would have been necessary for Nebraska to achieve compliance with the Water-Short Year test for 2006 as required by the Final Settlement Stipulation (FSS) approved in *Kansas v. Nebraska & Colorado*. The purpose of this analysis was therefore to determine the extent to which surface water was available to reduce Nebraska's overuse in 2005 and 2006 and the remaining reduction in pumping that would have been necessary to completely eliminate Nebraska's overuse. The effect of pumping reduction on streamflow was determined by the Groundwater Model adopted in the FSS, as amended by the Republican River Compact Administration (RRCA).

## Description of Analysis

The analysis incorporates the FSS accounting procedures to determine the effects of the pumping reduction on allocations and Computed Beneficial Consumptive Use (CBCU). Based upon the amount of surface water available, the pumping reduction necessary for compliance was determined with the Groundwater Model. The effects were then included in the accounting to determine the amount of surface water that would have been required. The following is a description of the FSS accounting spreadsheet analysis, which takes into account the interaction of surface and groundwater effects. The electronic versions of the spreadsheets are provided herewith.

Pumping was removed on 140,858 acres in 2005 and 121,332 acres in 2006, corresponding to an area approximately equivalent to a one-mile wide area along the streams in Nebraska. This was accomplished by removing pumping from the model stream cells, as described in Attachment 3. The RRCA GW Model was used to compute the effects of this reduced pumping for the years 2005 and 2006. Impacts of this change compared to the historical condition were 14,900 af in 2005 and 26,300 af in 2006, expressed as reductions in GW (CBCU). Table 1 shows the changes in GW CBCU determined by the model.

The changes to streamflow were evaluated with the RRCA accounting spreadsheets to estimate the benefit to compact compliance for the two years. The analysis required assumptions about the changes in diversions, storage and reservoir evaporation that would have resulted. The changes in GW CBCU were made by tributary and reach. It was assumed that none of the additional flow would have been stored or evaporated, but would have been added to the streamflow or diverted by canals. This assumption is somewhat idealized, since some reregulation of gains to match the diversion season would occur in the system.

It was assumed that the shortfall remaining after accounting for the effects of the pumping reduction could have been offset with additional purchase of surface water. The surface

water supply was estimated from the diversions reported in the compact accounting sheets for the two years.

The availability of reservoir storage was also considered for the purpose of offsetting the two-year shortfall. Based on reservoir storage contents at the end of 2006, the estimated available storage was approximately 28,000 acre-feet, located primarily in Swanson and Strunk Reservoirs. Table 2 shows the reservoir storage status at the end of 2006. It should be noted that when storage is released, it has the effect of changing the water supply and allocations. Release of stored water would be about 50 % effective for reducing the amount of Nebraska overuse. This assumes that the water would have been released and delivered to Kansas.

The RRCA compact accounting sheets for the two years were adjusted to reduce the GW CBCU and incorporate the release of 28,000 af of storage in 2006. The results for compact accounting for the Water-Short Year test for 2006 are provided in Table 3. The effects, as measured at Guide Rock, are summarized as follows:

1.	Overuse of Compact Allocation in 2005 - 2006	79,100 af.
2.	Amount of reduced GW CBCU (Deduction from overuse)	39,100 af
3.	Amount of increased SW CBCU (Addition to overuse)	7,300 af
4.	Increase in Nebraska Allocation	15,000 af
5.	Remaining Overuse of allocation after applying deductions and additions	<b>32,300 af</b>

Available surface water supply is summarized in Table 4. The projected surface water diversions total 95,900 af for the two years, with associated CBCU of 44,600 af. It is assumed for purposes of this analysis that most of these surface water supplies could have been acquired for compact compliance and not used for irrigation. It should be noted that approximately 15% of the CBCU was associated with the small pumps and non-federal ditches and the ability to obtain these small supplies is questionable.

The amount of diversion corresponding to 32,300 af of CBCU would have been approximately 72,900 af. Table 5 shows the effect of the reduction in GW CBCU on compact compliance and the application of the available surface water supply to offset the shortfall. Because the compliance is assessed on a two-year basis, the application of surface

water to the shortfall could have varied from the values computed for each year.

The total available surface water, including storage at the end of 2006 and diversions, was estimated to be 124,000 af. Approximately 81% was calculated to be necessary to offset the overuse, after considering the pumping reduction.

The delivery of surface water downstream to offset overuse would result in some transit loss between the upstream locations of use and the Stateline. Therefore, there would not be a one-to-one correspondence between reduction of SW CBCU in Nebraska or reservoir releases and streamflow at the Stateline. However, for purposes of estimating the amount of surface water necessary to be retired, transit losses were not estimated. It is expected that the actual amount of surface water needed would have exceeded the amount obtained from these calculations, due to occurrence of some transit loss.

There are several key assumptions in this analysis:

- It has been assumed that the surface water could have been acquired and delivered downstream, without incurring significant evaporation, for same year deliveries to KBID.
- It has been assumed that the storage available in the project reservoirs is the amount in excess of the contracted water levels, without additional constraints.
- Transit losses to deliver surface water to Kansas have not been added to the amounts needed to be provided.

## **Conclusions**

The reduction in acreage irrigated by groundwater pumping was 140,858 acres in 2005 and 121,332 acres in 2006. The total surface water needed would have been 100,800 af at the river or reservoir. This would equate to farm deliveries of 47,000 af. Because the use of surface water CBCU for this analysis was considered fully effective to offset Nebraska's overuse, without any transit loss added, the amount of surface water actually necessary to achieve compliance would have been higher.

## Tables

Table 1	Summary of Reduced Ground Water Computed Beneficial Use (GW CBCU)
Table 2	Storage Available for Release in 2006
Table 3	Estimated Effect on Compliance from Reduction in Nebraska's Pumping and Reservoir Releases: 2005-2006 (water-short)
Table 4-A	Nebraska's Surface Water Use Summary: 2005
Table 4-B	Nebraska's Surface Water Use Summary: 2006
Table 5	Summary of Analysis of Nebraska Compliance

**Table 1**  
Summary of Reduced Ground Water Computed Beneficial Consumptive Use (GW CBCU)  
2005 -2006  
acre-ft

Subbasin	<u>Change in Net Nebraska</u>	
	<u>Impacts</u>	
	2005	2006
Arikaree	73	73
Beaver	0	0
Buffalo	74	173
Driftwood	99	234
Frenchman	5,686	5,674
North Fork	131	44
Above Swanson	2,533	3,088
Swanson - Harlan	-3,771	7,819
Harlan - Guide Rock	6,845	5,445
Guide Rock - Hardy	1,045	995
Medicine	1,597	2,012
Prairie Dog	0	0
Red Willow	41	103
Rock	1	6
Sappa	0	0
South Fork	108	371
Hugh Butler	82	3
Bonny	0	0
Keith Sebelius	0	0
Enders	101	82
Harlan	96	52
Harry Strunk	27	11
Swanson	109	99
<b>Total above Guide Rock</b>	13,832	25,289
<b>Total</b>	14,877	26,284

Table 2  
Storage Available for Release in 2006  
1000 acre-ft

Reservoir	September <sup>1</sup> EOM	Minimum <sup>2</sup> Storage	Available for Release in 2006
Enders	10.7	8.9	1.8
Harlan Co	116.1	118	0.0
Harry Strunk	17.7	8.9	8.8
Hugh Butler	12.1	11.2	0.9
Swanson	37.3	20.9	16.4
Total			27.9

(1) Source: ResStorChange06.xls

(2) Minimum Storage is minimum contracted water level

Table 3  
Estimated Effect on Compliance from Reduction in Nebraska's Pumping and Reservoir Releases: 2005 - 2006  
acre-ft

Table 5C: Nebraska's Compliance During Water-Short Year Administration

Year	Actual									
	Allocation		Computed Beneficial Consumptive Use			Imported Water		Allocation -		
	State-Wide Allocation	Allocation Below Guide Rock	State-Wide CBCU	CBCU Below Guide Rock	CBCU Above Guide Rock	Supply above Guide Rock	Credit above Guide Rock	(CBCU - IWS above Guide Rock)		
2005	199,450	4,586	253,740	4,052	249,689	11,965		(42,860)		
2006	186,880	2,290	236,150	3,064	233,086	12,214		(36,281)		
Average	193,170	3,440	244,950	3,560	241,390	12,090		(39,570)		

Year	Adjusted									
	Allocation		Computed Beneficial Consumptive Use			Imported Water		Allocation -		
	State-Wide Allocation	Allocation Below Guide Rock	State-Wide CBCU	CBCU Below Guide Rock	CBCU Above Guide Rock	Supply above Guide Rock	Credit above Guide Rock	(CBCU - IWS above Guide Rock)		
2005	199,440	4,157	242,210	3,007	239,204	11,965		(31,955)		
2006	201,520	2,290	213,820	2,069	211,751	12,214		(306)		
Average	200,480	3,220	228,020	2,540	225,480	12,090		(16,130)		

Source: RRCA Accounting Spreadsheets with adjustments made to Nebraska's GW CBCU  
Note: Adjusted values assume no change in reservoir storage and evaporation while evacuating reservoirs in 2006 to their operational minimum.

Table 4-A  
Nebraska's Surface Water Use Summary  
2005 RRCA Accounting  
acre-ft

Sub Basin	Canal	Historical				Adjusted			
		Canal Diversions	Surface Water Pumping	CU Factor	CU	Canal Diversions	Surface Water Pumping	CU Factor	CU
North Fork	Haigler	4,745	-	60%	2,847	4,745	-	60%	2,847
Arikaree	Non-Federal	-	-	-	-	-	-	-	-
	Small Pumps	-	-	-	-	-	-	-	-
Buffalo	Non-Federal	-	171	60%	103	-	171	60%	103
	Small Pumps	-	34	75%	26	-	34	75%	26
Rock	Non-Federal	-	-	-	-	-	-	-	-
	Small Pumps	-	-	-	-	-	-	-	-
South Fork	Hale	-	-	-	-	-	-	-	-
	Non-Federal	-	-	-	-	-	-	-	-
	Small Pumps	-	-	-	-	-	-	-	-
Frenchman	Champion	-	-	-	-	-	-	-	-
	Riverside	2,096	-	60%	1,258	2,096	-	60%	1,258
	Culbertson	6,562	-	22%	1,438	9,506	-	22%	2,083
	Culbertson Canal Extension	-	-	-	-	-	-	-	-
	Non-Federal	-	-	-	-	-	-	-	-
	Small Pumps	-	1	75%	0.8	-	1	75%	0.8
Driftwood	Meeker-Driftwood	-	-	-	-	-	-	-	-
	Non-Federal	-	-	-	-	-	-	-	-
	Small Pumps	-	-	-	-	-	-	-	-
Red Willow	Red Willow	-	-	-	-	-	-	-	-
	Non-Federal	-	-	-	-	-	-	-	-
	Small Pumps	-	123	75%	92	-	123	75%	92
Medicine Creek	Non-Federal	-	-	-	-	-	-	-	-
	Small Pumps	-	259	75%	194	-	259	75%	194
	Non-Federal - Below Gage	-	-	-	-	-	-	-	-
	Small Pumps - Below Gage	-	78	75%	59	-	78	75%	59
Beaver	Non-Federal	-	-	-	-	-	-	-	-
	Small Pumps	-	-	-	-	-	-	-	-
	Non-Federal - Below Gage	-	-	-	-	-	-	-	-
	Small Pumps - Below Gage	-	-	-	-	-	-	-	-
Sappa	Non-Federal	-	-	-	-	-	-	-	-
	Small Pumps	-	54	75%	41	-	54	75%	41
	Non-Federal - Below Gage	-	-	-	-	-	-	-	-
	Small Pumps - Below Gage	-	-	-	-	-	-	-	-
Prairie Dog	Almena	-	-	-	-	-	-	-	-
	Non-Federal - Below Gage	-	-	-	-	-	-	-	-
	Small Pumps - Below Gage	-	21	75%	16	-	21	75%	16
Mainstem	Bartley	-	-	-	-	-	-	-	-
	Cambridge	19,732	-	46%	9,153	24,508	-	46%	11,368
	Naponee	-	-	-	-	-	-	-	-
	Franklin	-	-	-	-	-	-	-	-
	Franklin Pump	-	-	-	-	-	-	-	-
	Superior	4,712	-	36%	1,687	6,081	-	36%	2,177
	Courtland	-	-	-	-	-	-	-	-
	Non-Federal	-	1,661	60%	997	-	1,661	60%	997
	Small Pumps	-	1,918	75%	1,439	-	1,918	75%	1,439
	Non-Federal - Below Guide Rock	-	-	-	-	-	-	-	-
	Small Pumps - Below Guide Rock	-	1,278	75%	959	-	1,278	75%	959
Total		37,847	5,598		20,306	46,936	5,598		23,657

Source: RRCA Accounting Spreadsheets with adjustments made to Nebraska's GW CBCU.  
Note: Adjusted diversions using assumption of no change in reservoir storage and evaporation.

Table 4-B  
Nebraska's Surface Water Use Summary  
2006 RRCA Accounting  
acre-ft

Sub Basin	Canal	Historical				Adjusted			
		Canal Diversions	Surface Water Pumping	CU Factor	CU	Canal Diversions	Surface Water Pumping	CU Factor	CU
North Fork	Haigler	4,418		60%	2,651	4,418		60%	2,651
Arikaree	Non-Federal Small Pumps		-		-		-		-
Buffalo	Non-Federal Small Pumps		170	60%	102		170	60%	102
Rock	Non-Federal Small Pumps		-		-		-		-
South Fork	Hale Non-Federal Small Pumps		-		-		-		-
Frenchman	Champion Riverside Culbertson Culbertson Canal Extension Non-Federal Small Pumps		-		-	2,919		44%	1,284
Driftwood	Meeker-Driftwood Non-Federal Small Pumps		-		-		-		-
Red Willow	Red Willow Non-Federal Small Pumps		-		-		-		-
			121	75%	91		121	75%	91
Medicine Creek	Non-Federal Small Pumps Non-Federal - Below Gage Small Pumps - Below Gage		-		-		-		-
			305	75%	229		305	75%	229
			-		-		-		-
			94	75%	71		94	75%	71
Beaver	Non-Federal Small Pumps Non-Federal - Below Gage Small Pumps - Below Gage		-		-		-		-
Sappa	Non-Federal Small Pumps Non-Federal - Below Gage Small Pumps - Below Gage		-		-		-		-
			22	75%	17		22	75%	17
Prairie Dog	Almena Non-Federal - Below Gage Small Pumps - Below Gage		-		-		-		-
			-		-		-		-
			21	75%	16		21	75%	16
Mainstem	Bartley Cambridge Naponee Franklin Franklin Pump Superior Courtland Non-Federal Small Pumps Non-Federal - Below Guide Rock Small Pumps - Below Guide Rock	5,830 19,692 - - - - -		44% 45%	2,553 8,813	5,830 25,675 - - - - -		44% 45%	2,553 11,490
			2,460	60%	1,476		2,460	60%	1,476
			590	75%	443		590	75%	443
			-		-		-		-
			697	75%	523		697	75%	523
Total		29,940	4,480		16,982	38,842	4,480		20,944

Source: RRCA Accounting Spreadsheets with adjustments made to Nebraska's GW CBCU.  
Note: Adjusted diversions using assumption of no change in reservoir storage and evaporation.

Table 5  
Summary of Analysis of Nebraska Compliance  
( Above Guide Rock)  
2005 - 2006  
(1000 Acre-feet/year)

	2005	2006	Total
<b>A. Compliance Accounting</b>			
(1) Actual (Allocation -CBCU)	(42.9)	(36.3)	(79.1)
(2) Reduced GW CBCU	13.8	25.3	39.1
(3) Increased SW CBCU	(3.4)	(4.0)	(7.3)
(4) Change in Allocation	0.4	14.6	15.0
(5) Intermediate Compliance	(32.0)	(0.3)	(32.3)
<b>B. Surface Water Required to Achieve Compliance</b>			
<b>Diversions Required</b>			
(6) Surface Water Diversions	34.1	38.8	72.9
(7) SW Delivered to Farm	14.3	19.0	33.3
(8) CBCU	14.4	17.9	32.3
(9) Reservoir Storage	0.0	27.9	27.9
(10) Total Required @ River/Res	34.1	66.7	100.8
(11) Total Required @ Field	14.3	32.7	47.0

Notes:  
Totals are above Guide Rock

canal loss	58%	51%
field efficiency	70%	70%

- (1) Actual results from Table 3
- (2) Reduced GW CBCU from Table 1
- (3) Increased SW CBCU from Adjusted CU in Table 4-A and 4-B
- (4) Difference between adjusted and actual allocation above Guide Rock on Table 3
- (5) Intermediate Compliance = (1) + (2) + (3) + (4)
- (6) Required at river diversions
- (7) SW Delivered to Farm = (6) \* (1 - Canal Loss)
- (8) CBCU = (7) \* field efficiency + consumption of return flows
- (9) Storage water available for release from Table 2
- (10) Total Required @ River or Reservoir = (6) + (9)
- (11) Total Required @ Field = (7) + ((8) \* (1 - Canal Loss))

Attachment 3: RRCA groundwater model analysis  
Reduction in Nebraska impacts under a scenario for 2005-2006

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As part of an analysis of economic damages due to Nebraska’s failure to comply with the Final Settlement Stipulation’s water-short year test for 2006, we were asked to develop a groundwater model scenario for years 2005-2006 that removes groundwater pumping for irrigation within the model stream cells in the Republican River basin in Nebraska for these two years. All other conditions were the same as in the RRCA historical model runs for these years. In particular, the groundwater irrigation area outside the stream cells remains the same as reported for years 2005 and 2006.

As Table 1 shows, this scenario reduced groundwater irrigation pumping by an average of 116,505 acre-feet and groundwater irrigated area by 131,095 acres for years 2005 and 2006. Nebraska’s impact—i.e., the net sum of Nebraska pumping impacts and Platte River import credits—is reduced by a total of 41,175 acre-feet from the actual reported impacts for those two years. Note that both groundwater irrigation pumping and the irrigated area differ between 2005 and 2006, because the amount of irrigation reported by Nebraska and included in the RRCA historic model runs for those two years was different, and all of it in the model stream cells was removed for this model simulation.

Table 2 shows impact reductions at each accounting point for years 2005 and 2006, and shows both averages and sums of impact reductions over years 2005 and 2006.

Table 1. Reduction in groundwater irrigation and pumping, and corresponding reduction of Nebraska impact on Republican River streamflow, under the scenario simulated.

Year	Groundwater irrigation pumping reduction (acre-feet)	Groundwater irrigation area reduction (acres)	Nebraska impact reduction, pumping + mound (acre-feet)
2005	134,105	140,858	14,885
2006	98,905	121,332	26,290
2005-2006 Average:	116,505	131,095	Sum: 41,175

Table 2. Impact reductions by accounting point for 2005 and 2006

Year Account point	2005	2006	Average 2005- 2006	Sum 2005- 2006
Arikaree	73	73	73	146
Beaver	0	0	0	0
Buffalo	74	173	124	247
Driftwood	99	234	166	333
Frenchman	5686	5674	5679	11360
North Fork	131	44	87	175
Above Swanson	2533	3088	2811	5621
Swanson - Harlan	-3771	7819	2024	4048
Harlan - Guide Rock	6845	5445	6144	12290
Guide Rock - Hardy	1045	995	1021	2040
Medicine	1597	2012	1805	3609
Prairie Dog	0	0	0	0
Red Willow	41	103	72	144
Rock	1	6	3	7
Sappa	0	0	0	0
South Fork	109	379	244	488
Hugh Butler	82	3	43	85
Bonny	0	0	0	0
Keith Sebelius	0	0	0	0
Enders	101	82	92	183
Harlan	96	52	73	148
Harry Strunk	27	11	19	38
Swanson	109	99	104	208
Mainstem Total	6656	17346	12000	24002
Total	14885	26290	20587	41175