

**Calculation of Computed Beneficial Consumptive  
Use and Imported Water Supply Credit  
Using the RRCA Ground Water Model  
Nebraska Department of Natural Resources  
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### Introduction

The state of Nebraska has raised an issue with the RRCA regarding an inaccuracy in the calculation of the Imported Water Supply Credit (Mound Credit) and ground water Computed Beneficial Consumptive Use (GW CBCU) of the Virgin Water Supply using the Republican River Compact Administration (RRCA) ground water model. Nebraska first raised the concerns about this inaccuracy in June of 2007. Discussions within the RRCA Engineering Committee pointed to the need for further clarification of the issue by Nebraska. The state of Nebraska submitted a document, by email, to the states of Kansas and Colorado on January 4, 2008 further describing the issue and reflecting on explanations and potential remedies to eliminate the inaccuracy. The state of Kansas responded to that document, by email, on January 23, 2008, addressing Nebraska's reflections on explanations and potential remedies. This document is meant to further clarify the issue so that all three states can understand why the accounting procedures need to be changed to ensure that the RRCA Accounting Procedures reaches the highest possible standard of accuracy.

The RRCA ground water model was developed to calculate base-flow to the Republican River. It is able to do so for a variety of conditions including conditions that have prevailed in the past, conditions that might have prevailed in the past if stresses to the ground water flow regime --- e.g. pumping, recharge from precipitation, seepage from canals and importation of water --- had been different in magnitude and/or location, and conditions that may be expected to prevail in the future.

The model was intended to be used to estimate impacts of such stress changes to the ground water system on discharge of base-flow to the Republican River. To estimate such impacts the model represents what we call "scenarios". One scenario represents conditions without the change in stresses and the second scenario represents conditions with the change in stresses. The difference between discharge to base-flow in the first scenario and discharge to base-flow in the second scenario is an estimate of the impact of the change in stresses.

The primary application of the model was expected to be the estimation of depletion to base-flow caused by ground water pumping (GW CBCU) by a state, and, in the case of the state of Nebraska, the estimation of accretion to base-flow (Mound Credit) caused by importation of water from the Platte basin. The changes in stresses due to ground water pumping in each state were to be represented by two scenarios: one representing base-flow conditions with ground water pumping in that state turned on; the other representing base-flow conditions with no ground water pumping in that state. A secondary application is the estimation of impacts of changes in stresses within states in order to plan controls within that state to comply with the compact.

### **Issue**

To estimate the impact of ground water pumping by each state on the base-flow, the RRCA Accounting Procedures currently compares a model run scenario with all states' ground water pumping turned on with a model run scenario with one state's ground water pumping turned off. The difference in base-flows between the two scenarios represents the depletions to base-flow caused by the state whose ground water pumping was turned off. An alternative set of scenarios that could be used to estimate a state's depletions to base-flow caused by ground water pumping would be to compare a scenario in which there is no ground water pumping by any state with a scenario in which one state's ground water pumping is turned on. Both sets of scenarios represent an equally reasonable method to determine the depletions to stream flow from each state's ground water pumping. However, the state of Nebraska has observed that the two choices of equally reasonable sets of scenarios used to estimate impacts by each state yield dramatically different results. The choice of the sets of scenarios also impacts the estimate of the Mound Credit.

### **Discussion**

Table 1 lists scenarios that might be used to calculate the GW CBCU for each state and the Mound Credit for Nebraska. The scenarios were numbered arbitrarily merely to facilitate reference in this document. Other scenarios could be used, but those listed illustrate Nebraska's issue.

Table 2 lists choices of scenarios that might be used to calculate GW CBCU for each of the states and the Mound Credit for Nebraska's importation of water into the Republican basin from the Platte basin. The column headed "Current choice of scenarios used to calculate impacts on base-flow" shows the choice of scenarios currently used. The column headed "Alternative choice of scenarios used to calculate impacts on base-flow" shows alternative, equally reasonable choices.

Table 3 for each set of scenarios in Table 2 lists the average of values of GW CBCU for each state and Mound Credit for Nebraska using the RRCA ground water model and inputs for the period 2001-2006. Notice that with the current choice of scenarios the entry for KS GW CBCU is 10,849 acre-feet/year, whereas with the alternative choice of scenarios the entry for KS GW CBCU is 16,330 acre-feet/year. Similarly, with the current choice of scenarios, the entry for the Mound Credit is 12,869 acre-feet/year, whereas with the alternative choice of scenarios, the entry for Mound credit is 28,359 acre-feet/year.

### **Conclusions**

The state of Nebraska believes that in the interest of the integrity and credibility of the Republican River Compact Accounting Procedures, it is imperative that the RRCA continually strive to ensure that the accounting procedures are an accurate estimate of the actual depletions to stream flow caused by each state's ground water pumping and an accurate estimate of the Mound Credit. Therefore, in accordance with the Final Settlement Stipulation, the accounting procedures must be changed to account for the disparity between estimates of impacts based on one pair of scenarios as opposed to an equally reasonable pair of scenarios.

Table 1. List of scenarios that might be used to calculate base-flow for estimates of impacts.

Scenario Number	Representation of Stresses	NE Importation On?	NE Pumping On?	KS Pumping On?	CO Pumping On?
1	Importation of water by NE and Pumping by NE, KS, and CO On	YES	YES	YES	YES
2	Pumping by NE, KS, and CO On; Importation of water by NE Off	NO	YES	YES	YES
3	Importation of water by NE On; Pumping by NE, KS, and CO Off	YES	NO	NO	NO
4	Importation of water by NE and Pumping by NE, KS, and CO Off	NO	NO	NO	NO
5	Importation of water by NE and pumping by KS and CO On; Pumping by NE Off	YES	NO	YES	YES
6	Importation of water by NE and pumping by NE and CO On; Pumping by KS Off	YES	YES	NO	YES
7	Importation of water by NE and pumping by NE and KS On; Pumping by CO Off	YES	YES	YES	NO
8	Pumping by NE On; Importation of water by NE and pumping by KS and CO Off	NO	YES	NO	NO
9	Pumping by KS On; Importation of water by NE and pumping by NE and CO Off	NO	NO	YES	NO
10	Pumping by CO On; Importation of water by NE and pumping by NE and KS Off	NO	NO	NO	YES

Table 2. Choices of scenarios that might be used to calculate impacts used in accounting procedures.

Expected Results	Current choice of scenarios used to calculate impacts on base-flow	Alternative choice of scenarios used to calculate impacts on base-flow
Nebraska GW CBCU	Scenario (5) – Scenario (1)	Scenario (4) – Scenario (8)
Kansas GW CBCU	Scenario (6) – Scenario (1)	Scenario (4) – Scenario (9)
Colorado GW CBCU	Scenario (7) – Scenario (1)	Scenario (4) – Scenario (10)
Mound Credit	Scenario (1) – Scenario (2)	Scenario (3) – Scenario (4)

Table 3. Average Results of Calculations for 2001-2006.

Expected Results	Estimates of GW CBCU and Mound Credit calculated using current choice of scenarios. (acre-feet/year)	Estimates of GW CBCU and Mound Credit calculated using alternative choice of scenarios. (acre-feet/year)
Nebraska GW CBCU	202,348	200,845
Kansas GW CBCU	10,849	16,330
Colorado GW CBCU	24,983	32,147
Mound Credit	12,869	28,359