IN RE: NON-BINDING ARBITRATION PURSUANT TO THE FINAL SETTLEMENT STIPULATION, *KANSAS v. NEBRASKA AND COLORADO*, NO. 126 ORIGINAL

BEFORE MARTHA O. PAGEL, ARBITRATOR

REBUTTAL REPORT OF WILLEM SCHREÜDER, Ph.D.

I, Willem A. Schreüder, state the following:

(1) I understand that my role as an expert, both in preparing this report and in giving evidence, is to assist the arbitrator to understand the evidence or to determine facts in issue. The opinions expressed in my report are my own professional opinions.

(2) I have endeavored in my report and disclosures to be accurate and complete, and have addressed matters that I regard as being material to the opinions expressed, including the assumptions that I have made, the bases for my opinions, and the methods that I have employed in reaching those opinions.

(3) I have been advised by the attorney for my client of the disclosure requirements of the rules of the arbitration, and I have provided in my report the information required by those rules. I have not included anything in my report and disclosures that has been suggested by anyone, including the attorney for my client, without forming my own independent judgment on the matter.

(4) I will immediately notify, in writing, the attorney for the party for whom I am giving evidence if, for any reason, I consider that my existing report requires any correction or qualification; and, if the correction or qualification is significant, will prepare a supplementary report or disclosure to the extent permitted by the applicable rules of the arbitration.

(5) I have used my best efforts in my report and disclosures, and will use my best efforts in any evidence that I am called to give, to express opinions within those areas in which I have been offered or qualified as an expert by the arbitrator, and to state whether there are qualifications to my opinions.

(6) I have made the inquiries that I believe are appropriate and, to the best my knowledge, no matters of significance that I regard as relevant have been withheld from the arbitrator.

(7) I have disclosed any financial or pecuniary interest that I have in the results of this lawsuit or in any property or rights that are the subject of the lawsuit for which my report and disclosures are being submitted.

Dated this 2nd day of July, 2010.

Willem A. Schreüder

I. Introduction

The following opinions are provided in rebuttal to the opinions of Steven P. Larson in his report titled "Kansas Expert Response to Colorado's Expert Report," dated June 22, 2010 ("Larson Report")

II. Source of Water for the Pipeline

Mr. Larson expresses the opinion that the origin of the augmentation water that will be pumped as part of Colorado's Compact Compliance Pipeline proposal distinguishes it from other water that might be in the surface stream system such as surface runoff, return flows from surface water irrigation, or releases of water in reservoirs that retain surface water for later use (Larson Report p.3). He states that this water should be considered as "short circuited" baseflow because it is water that would ultimately have contributed to stream baseflow but has been intercepted by the augmentation wells and placed in the stream sooner than it would have reached the stream otherwise (Larson Report p. 3).

It is incorrect that groundwater that will be pumped from the Compact Compliance Pipeline Wells (Pipeline Wells) is water that would ultimately have contributed to stream baseflows. Runs of the RRCA Groundwater Model demonstrate that the depletions to stream baseflows caused by the Pipeline Wells are only a small percentage of the total volume of groundwater produced by these wells. The balance of the water comes primarily from groundwater storage. Water that will be placed in the Pipeline is groundwater that was historically used for the irrigation of crops in Colorado and was fully consumed. However, under the Colorado proposal the water will instead be placed in the North Fork of the Republican River to offset stream depletions. To the extent that pumping of the Pipeline Wells will cause stream depletions, the Colorado proposal is to use the RRCA Groundwater Model to compute the net stream depletions caused by the Pipeline Wells and include the resulting stream depletions in Colorado's Computed Beneficial Consumptive Use of groundwater ($CBCU_G$). This procedure complies with Subsection III.B.1.k and Subsection IV.H of the Final Settlement Stipulation (FSS).

Further, the origin of the augmentation water does not distinguish it from other water that might otherwise be in the surface stream system. Stream baseflow in a surface stream that is diverted for irrigation use or stored in reservoirs, such as Swanson Reservoir and Harlan County Reservoir, is considered surface flow when it is diverted or evaporated or released from the reservoirs, and the Computed Beneficial Consumptive Use of such diversions, evaporation, and reservoir releases is calculated using the RRCA Accounting Procedures for calculating the Computed Beneficial Consumptive Use of surface water. *See* RRCA Accounting Procedures, Subsection IV.A.2.a-f. Therefore, the origin of the augmentation water is not a proper basis for determining whether the augmentation credit should or should not be calculated with the RRCA Groundwater Model. If the augmentation water is discharged into a surface stream in the Basin, as in Colorado's proposal, the water should be treated as other surface water is treated in the RRCA Accounting Procedures. If the augmentation water is not discharged directly into a surface stream but is used to recharge the groundwater

system, the RRCA Groundwater Model should be used to determine the credit, for the same reason the RRCA Groundwater Model is used to determine the credit for water imported into the basin by Nebraska. The origin of the water imported into the basin by Nebraska was not the reason the credit for the imported water is calculated using the RRCA Groundwater Model. Instead, Nebraska's imported water supply credit is calculated with the model because the imported water recharges the groundwater system and is not delivered to a surface stream. If the imported water had been delivered directly to a surface stream, the RRCA Groundwater Model should not be used to calculate the credit for the imported water.

II. Accuracy of the Model

Mr. Larson states that Colorado asserts that the RRCA Groundwater Model is not sufficiently accurate to calculate changes to surface water that is added to the stream (Larson Report p. 7). This distorts my opinion.

I stated that the RRCA Groundwater Model is sufficiently reliable for the purpose of calculating $CBCU_G$ as provided in the RRCA Accounting Procedures. All Compact accounting, except for determining Nebraska's Compact compliance during water-short year administration, is done on a five-year running average in accordance with the RRCA Accounting Procedures. *See* FSS, Subsection IV.D. The RRCA Groundwater Model was considered calibrated to a sufficient degree that depletions from groundwater pumping and accretions from imported water from the Platte River could be quantified and assigned to prescribed streamflow reaches in accord with the RRCA Accounting Procedures. Final Report of the Special Master with Certificate of Adoption of RRCA Groundwater Model, p. 7. However, the model has not been demonstrated to be reliable when:

1 Operated at a shorter time scale such as, for example, months;

2 Operated at a finer spatial resolution, for example, less than a sub-basin;

3 Operated to quantify impacts other than well pumping or imported water recharge on baseflows, for example, the impact of adding water to a surface stream represented in the model, such as augmentation water.

It should be reiterated that while the RRCA Groundwater Model calculates baseflow at selected points in the Basin, it is only used to quantify ***changes*** in baseflow as a result of well pumping or the recharge resulting from imported water. *See* RRCA Accounting Procedures, Subsections III.D.1 and III.A.3. Use of the model for any other purpose has not been demonstrated to be reliable.

III. Negative Impacts

Mr. Larson devotes much of his report to a discussion of the "negative" pumping impacts that occur in the State Line-Swanson reach on the Main Stem. It appears that Kansas' proposal to include the Pipeline water in the RRCA Groundwater Model is primarily intended to counteract what it views as the "benefit" that Colorado derives in some

years from the “negative impacts” that are calculated for the reach from the State Line to Swanson.

It is worth noting that the RRCA Groundwater Model does not predict an increase in baseflows as a result of groundwater pumping, but the values for sub-basins and the Main Stem include depletions as well as accretions because in a losing stream reach the depletions to baseflow will diminish if the baseflow entering that reach diminishes. Subsection III.D.1 of the RRCA Accounting Procedures recognizes that the values calculated for each sub-basin and the Main Stem using the RRCA Groundwater Model will include depletions and accretions:

> An output of the model is baseflows at selected stream cells. Changes in the baseflows predicted by the model between the “base” run and the “no-State-pumping” model run is assumed to be the depletions to streamflows. i.e., groundwater computed beneficial consumptive use, due to State groundwater pumping at that location. The values for each Sub-basin will include all depletions and accretions upstream of the confluence of the Main Stem. The values for the Main Stem will include all depletions and accretions in stream reaches not otherwise accounted for in a Sub-basin.

In the area where the North Fork of the Republican River crosses the Colorado-Nebraska State Line, the Pierre Shale underlying the Ogallala aquifer is very near the ground surface. Therefore, much of the groundwater flowing from west to east in this area appears as baseflow in the North Fork upstream of this location. To the east of the state line, where the aquifer deepens, the stream loses much of this baseflow as it seeps back into the aquifer.

The result is that the Main Stem is a losing reach between the State Line and Swanson Reservoir. While nearby well pumping would exacerbate the losses in this reach, the reach was a losing reach before well development. The RRCA Accounting Procedures quantify the ***change*** in these losses due to well pumping as $CBCU_G$. However, the stream losses that occur through such processes as groundwater storage and evaporation are not an activity of man and are not charged against any State’s CBCU.

The State Line-Swanson reach is not unique. Other losing reaches in the model include the South Fork in Kansas and the lower reaches of Sappa Creek.

“Negative impacts,” which are nothing more than decreased losses in stream reaches, are not unique to this reach either. Kansas' $CBCU_G$ on Sappa Creek was negative (i.e., decreased losses) from 1999 to 2007. This provided a “benefit” to Kansas. “Negative impacts” were also calculated for Kansas on the Swanson to Harlan reach of the Main Stem, in addition to the State Line-Swanson reach.

The fact that there are “negative impacts,” or decreased losses, simply reflects the physical reality that when the basin is subdivided into sub-basins, the impacts do not occur in a simple pattern. The basinwide impacts are the arithmetic sum of the sub-

basins and the Main Stem, and the appearance of “negative impacts” or decreased losses simply reflects the physical reality that the losses occurred in another sub-basin because groundwater impacts cross sub-basin boundaries. In every sub-basin where there is a losing reach, losses decrease when baseflows into that reach is decreased by upstream depletions. In most cases, the impacts in these sub-basins are just diminished. However, in the case of the Above Swanson reach, the decrease is sometimes sufficient to result in a negative.

IV. Fate of Augmentation Water

Mr. Larson states that when augmentation water is delivered to the stream system, it will interact with the underlying groundwater system in the same manner as other baseflows as it flows downstream (Larson Report p. 5). He states that the stream baseflow would have experienced this same fate if it had not been depleted by pumping (Larson Report p. 5). His proposal to include the augmentation water in the RRCA Groundwater Model, which is adopted by the other Kansas experts, in essence charges Colorado a transit loss for the Pipeline water from the Colorado-Nebraska State Line to Swanson Reservoir by using the groundwater model to determine how much of the flow will be lost in the reach.

I disagree with including the water discharged from the Colorado Pipeline in the RRCA Groundwater Model for this purpose because this would be inconsistent with how other surface water in the Basin is handled in accordance with the RRCA Accounting Procedures. The RRCA Groundwater Model is not used to calculate the losses on any other surface flows and it would be completely inconsistent to make an exception for water discharged from the Colorado Pipeline simply because there are “negative Impact” in the reach below where the Pipeline water is added. The RRCA Groundwater Model is not used to determine losses on other water in the surface stream, even when the water in the surface stream is consumed or added above a losing reach.

For example, baseflows that are stored in Swanson Reservoir and Harlan County Reservoir are not included in the RRCA Groundwater Model when releases are made from the reservoirs to calculate the losses on the reservoir releases. Once baseflow becomes part of a surface stream, it is accounted for in accordance with the RRCA Accounting Procedures for surface water. The transit losses are indirectly reflected in the diversions in the stream reach, stream gage readings, or the storage contents of a reservoir where a reservoir is at the end of the stream reach.

Evaporation from Bonny Reservoir occurs about 50 miles upstream of the Benkelman streamflow gage (USGS gaging station number 06827500, South Fork of the Republican River near Benkelman, Nebraska). This reach of the South Fork is also a losing reach. It has been well established by releases from Bonny Reservoir in recent years that if the water that evaporated from the reservoir were instead to have been released, only a fraction (if any) of the water would have reached the Benkelman gage. However, the RRCA Accounting Procedures do not provide that the RRCA Groundwater Model will be used to determine how much of that evaporated water would have reached the gage. Instead, 100% of the evaporated water is added to the virgin water supply and Colorado's CBCU.

Furthermore, when a surface water right that was historically used for irrigation is retired, and additional stream flow becomes available as a result, the RRCA Groundwater Model is not used to determine the fate of that water. Nor is the RRCA Groundwater Model used to determine the fate of surface runoff that occurs from rainfall. In all these instances, water is simply accounted for using the RRCA Compact Accounting Procedures for surface water and the specific formulas for each sub-basin and the Main Stem.

It is worth repeating that the RRCA Compact Accounting Procedures were applied for decades with an understanding that streams lose and gain water. What is new since the FSS is that the RRCA Groundwater Model is used to estimate the CBCU of groundwater, which is added to the CBCU from other sources. This is done by estimating the *changes* in the baseflows as a result of turning all well pumping "on" in the "base" run and turning the pumping of one State "off" in the "no State pumping" run. *See* RRCA Accounting Procedures, Subsections III.D.1. In no instance is the RRCA Groundwater Model used to calculate transit losses on surface water as proposed by Kansas and, in my opinion, it would not be appropriate to use the model for that purpose and would be inconsistent with the way other surface water is accounted for in the RRCA Accounting Procedures.

V. Expected Aquifer Life

Mr. Larson states that groundwater levels in Colorado, and especially in the area within and near the proposed augmentation well field, have been steadily declining over the past several decades (Larson Report p. 7). He states that water level data collected by the USGS show that water levels have declined by more than 50 feet since the late 1960s and almost 20 feet in the last decade in the proposed well field area. He expresses the opinion that based on current rates of water level decline, the thickness would be exhausted in about 150 years (Larson Report p. 7).

Mr. Larson's opinion about the expected aquifer life appears to be based on a simple extrapolation of the current rate of decline into the future. While one can make such as extrapolation, it is not reasonable in my opinion to assume that current rates of groundwater level decline in the proposed well field area will continue indefinitely into the future. It is important to note that the Pipeline Wells were specifically chosen because they are located in the area of the aquifer within Colorado with the most saturated thickness. In some parts of the basin in Colorado, the saturated thickness has already been significantly depleted. Under Colorado law, replacement wells must be placed within 200 feet of the original permitted well location. Furthermore, the drilling of additional wells to improve the water supply is prohibited. The result is that as the saturated thickness decreases, it becomes increasingly difficult to produce an adequate water supply. Towards the edge of the Basin in Colorado, this problem is particularly acute. In the southern half of the Basin in Colorado, there is also significantly less remaining saturated thickness than in the northern part of the Basin.

Due to declining water levels and the physical difficulty of obtaining a water supply in areas of limited saturated thickness, the high cost of the power required to lift water to the surface when well production is extremely limited, as well as the fee imposed by the

RRWCD WAE on the diversion of groundwater for irrigation, it is anticipated that the current rate of pumping will decline significantly in the future. The RRWCD WAE has also provided cost sharing for federal programs to convert irrigated lands in the RRWCD to non-irrigated use. Making a projection of when the saturated thickness in the proposed well field area will be exhausted based on the current rates of water level decline is therefore not reasonable, especially because Colorado experienced an extended period of significant drought in the last decade, and in my opinion the 150-year estimate significantly underestimates the expected aquifer life in the vicinity of the Pipeline Wells.

VI. Conclusion

I am not persuaded by Mr. Larson's arguments that it is correct to include the Augmentation water in the model. It remains my opinion that the Colorado proposal is correct and consistent with other procedures in the Compact Accounting procedures.