Non-binding Arbitrations Before
Martha O. Pagel, Arbitrator

Initiated Pursuant to Final Settlement Stipulation
Kansas v. Nebraska & Colorado
No. 126, Orig., U.S. Supreme Court
Decree of May 29, 2003, 538 U.S. 720

Colorado CCP
(Arbitration Initiated May 2, 2013)

and

Nebraska's Bonny Reservoir accounting change
(Arbitration Initiated May 2, 2013)

PRE-FILED TESTIMONY OF KANSAS EXPERT DALE E. BOOK, P.E.

September 18, 2013

Q: What is your current professional position?

A: I am currently employed as a Principal Engineer with the consulting firm of Spronk Water Engineers, Inc., located in Denver, Colorado. I am president of the firm. The firm provides consulting services in the areas of water resources, water rights engineering and water supply planning. I have been with the firm since its inception in 1984. Ex. CCP/BR-K5 is my curriculum vitae.

Q: Please describe your education and professional experience as it relates to the matters in this hearing.

A: I have a bachelor's and master's degree in civil engineering, with a specialty in water resources. My master's degree was obtained in 1980. I have been a consulting engineer specializing in water resources and water rights for more than 30 years.

Q: Would you summarize your experience as a water resources engineer?

A: My experience has been related to water supply development within the prior appropriation system, primarily in the western United States. Areas of specialization include quantification of water supply, water use demands, irrigation engineering, including crop demand, irrigation systems evaluation and management. Our clients include municipalities, irrigation districts, state agencies and private water users. Our work includes collection and processing hydrologic data and river basin modeling. An important element of this work is to assess impacts of water use on streamflow and available water supply.

Q: Would you generally describe water rights engineering?

A: Water rights engineering involves determination of available water supply distributed pursuant to water rights and requires knowledge and analysis of

hydrology, water demands, water use structures and consumption of water. Analyses typically involve determination of yields over a range of water supply. An important aspect is to assess impacts of changes of water rights on the stream system and other water users. Water rights engineering requires an understanding of administration of water under the prior appropriation system. The administration of interstate compacts is a specialized area of water rights, involving allocation of water supplies over ranges of conditions and water use accounting.

Q: Would you summarize your technical background as it relates to this matter?

A: My technical experience is specialized in issues related to water resources engineering, including water supply, river basin analysis, stream-aquifer interaction, reservoir operations, hydrology and irrigation. I am experienced in the development and use of river basin and groundwater models. I also have experience with irrigation management and crop consumptive use, which is the primary form of water use in the Republican River Basin.

Q: In which states have you worked in on such matters?

A: I have worked in other river basins in Colorado, Kansas, New Mexico, Montana, Wyoming, Idaho, and Oregon.

Q: Have you testified previously as an expert?

A: Yes I have. I have testified in various district water courts in the State of Colorado as an expert witness in water resources and water rights engineering. My experience has been related to water rights applications and changes and plans

for augmentation. I have also testified before the U.S. Supreme Court in the cases of *Kansas v. Colorado*, No. 105, Original and Kansas v. Nebraska & Colorado, No. 126, Original. I am scheduled to testify in the Supreme Court case of Montana v. Wyoming, No. 137 Original, set for trial in October of this year.

Q: In what areas have you been accepted as an expert in those proceedings?

A: I have testified as an expert in the areas of water resources engineering, water rights, hydrology, river basin hydrologic modeling, and irrigation engineering.

Q: Would you please describe your experience working on matters in the Republican River Basin?

A: Since 1994, I have assisted the State of Kansas as a consultant on matters related to the Republican River Compact. I have conducted various investigations related to compact compliance issues as they evolved over the years, since 1994. I participated in the proceedings and settlement negotiations in *Kansas v. Nebraska & Colorado* which resulted in the Final Settlement Stipulation ("FSS"). I was a member of the technical committee that developed the RRCA Groundwater Model (Model) used for annual compact accounting. I participated in the negotiations that resulted in the FSS and the RRCA Accounting Procedures contained in Appendix C of the FSS. Since the entry of the Court's Decree approving the FSS I have continued to assist the State of Kansas in evaluations of compliance with the FSS as it related to the uses both in Nebraska and Colorado. I have provided expert witness testimony in Kansas v. Nebraska & Colorado, No. 126 Original, which went to trial before the Special

Master for the Supreme Court in 2012. I also provided expert witness testimony in the three previous arbitration cases conducted pursuant to the FSS.

Q: Are you familiar with stream augmentation plans through your work?

A: Yes. The development and implementation of stream augmentation as a management tool for water rights administration is common in the State of Colorado as a means to facilitate new development of water supply in basins that are normally fully appropriated. Such use is generally facilitated by changes of existing water rights or importation of water from outside of the basin. Augmentation plans provide replacement supplies to the stream to facilitate diversion or groundwater pumping for new uses.

Q: Have you worked with augmentation plans?

A: Yes. A significant aspect of the work by our firm in Colorado is the development and implementation of augmentation plans. This often involves the analysis of stream depletions caused by groundwater pumping and quantification of the replacement supply, based on changes of use and physical availability.

Q: Are there similarities between augmentation plans you have worked on and a Plan to assist with compact compliance pursuant to the FSS?

A: Yes. The principles are similar. A water supply is provided that is not otherwise available to supplement streamflow and offset stream depletions caused by the project proponent. This is, in effect, a replacement supply of water. Such plans require measurement and accounting to ensure that the replacement is sufficient. For a plan to operate successfully, the replacement supply must be managed to offset the impacts being replaced. An important aspect of such plans is

documentation and monitoring the operation of deliveries and quantification of credit. The plans anticipated under the FSS would most likely rely on groundwater pumped to the stream.

Offer As An Expert

The State of Kansas offers Mr. Book as an expert in the areas of water resources engineering, water rights engineering, hydrology, hydrologic modeling and irrigation engineering.

Q: What was your general assignment from Kansas for this project?

A: I was asked to review the proposals from the State of Colorado to the RRCA for approval of an augmentation plan, referred to as the Colorado Compact Compliance Pipeline (CCP). Based on my familiarity with the Republican River Compact, the FSS and the Accounting Procedures, and augmentation plans in general, I was requested to evaluate whether the CCP conformed with the provisions of the FSS and to develop opinions concerning the adequacy of the proposal. I was also asked to review the Bonny Reservoir Accounting Proposal.

Q: Would you please describe your involvement with the CCP, up to the analysis described in your reports?

A: I previously reviewed the CCP proposal submitted by Colorado to the RRCA in 2010 which was the subject of the arbitration proceeding that year. I participated in that proceeding providing expert witness testimony. Since then I have reviewed variations of proposals for both the CCP and Bonny Reservoir accounting change received from Colorado and participated in negotiations between Kansas and Colorado which occurred over the course of two years.

Q: What is an augmentation plan, in the context of the Republican River Compact?

A: Under the provision of subsection III.B.1.k of the FSS, augmentation plans are described as wells acquired or constructed by a state for the sole purpose of offsetting stream depletions in order to comply with its compact allocations. Such Plans are to be approved by the RRCA.

Q: Would you provide a brief description of the CCP Project?

A: The CCP project consists of a series of wells and pipeline to convey the pumped water to the North Fork of the Republican River near the Nebraska-Colorado Stateline. The project will initially have a capacity to deliver up to approximately 15,000 acre-feet/yr, with the potential to increase to 25,000 acre-feet/yr in the future. Colorado proposes to pump to the extent necessary to achieve a balance between statewide allocation and CBCU, as projected from year to year. The physical facilities, which have been constructed, are the same as those considered in the 2010 proceedings.

Q: Did you prepare a report summarizing your comments and opinions concerning the proposal?

A: Yes. The report is Ex. CCP/BR-K6.

Q: What items have you specifically addressed, as described in your report?

A: There are three items that are addressed in the report; Operational limits, South Fork overuse and Use of the RRCA Groundwater model to determine augmentation credits.

Q: What are your conclusions regarding the Operational limits included in the current proposal?

A: The proposal, as described in the draft resolution and in the Colorado report (Sect. 2.3) is to initially compute a projected delivery, based on the amount of groundwater depletion in the North Fork sub-basin by April 1, and to update the projection in September, based on projected allocations, CBCU and the past four years statewide accounting results. The projected delivery would be set to achieve compact compliance in the proposal.

Q: Does the proposal include sufficient operational limits?

A: No. The proposal is to make a projection of the augmentation delivery based on the amount needed for compact compliance each year but does not address how overuse in the South Fork sub-basin would be considered in the projection.

Q: Would you describe the South Fork issue?

A: Since the pipeline will delivery water to the North Fork into Nebraska, the matter of how much credit should be obtained by Colorado for overuse in the South Fork sub-basin has been raised by the State of Kansas. Augmentation credit should be limited to exclude overuse in the South Fork sub-basin. The proposal does not have a mechanism to account for and exclude South Fork overuse from the augmentation credit received for deliveries into the State of Nebraska.

Q: Did Mr. Slattery indicate any limitation for South Fork overuse in his report of August 21?

A: Mr. Slattery stated that there are clear limitations to prevent replacing South Fork overuse with augmentation deliveries. This was clarified in his deposition to

mean that no augmentation discharge would be included in Colorado's sub-basin non-impairment test for the South Fork (Table 4 of the accounting procedures). Beyond this limitation, the amount of the projected delivery appears to be related to the amount of state-wide overuse, as described in Section 8.E of the draft resolution. The deficit referred to in section 8.E is not related to a specific calculation or table in the Accounting Procedures (i.e Table 3A or Table 4A).

Q: Would you please summarize your opinions regarding South Fork overuse?

A: This issue is related to the need for operational limits. The amount of augmentation pumping credit provided with this plan should not include replacement of overuse in the South Fork sub-basin. The proposal does not explicitly recognize any such limitation on credit. Paragraph 8.E. describes the delivery required for the current year and the deficit from prior years as the parameters to be used to reset the projected delivery by September 1.

Q: Would you describe your conclusions about the determination of augmentation credit for the CCP?

A: The current proposal is to provide 100% credit for augmentation deliveries and determine the groundwater CBCU with the augmentation discharge included in the Groundwater model in both the baseline and no-pumping model runs. This approach is inappropriate because it does not compute the impact of the interaction of the augmentation discharge with the aquifer. It is unreasonable to include the augmentation discharge in the no-pumping run, since augmentation is related to and for the purpose of replacing pumping depletions. As noted in Dr.

Schreuder's report, this has the effect of cancelling out impacts, which is inappropriate when using the model to determine the impacts of the activity.

Q: Did you prepare a report on the Bonny Reservoir Accounting Proposal?

A: Yes. This is a separate report, Ex. CCP/BR-K7, which provides my conclusions and opinions regarding the proposal.

Q: What did you do to review this proposal?

A: I reviewed the historical operation of Bonny Reservoir, the proposed change to the representation of Bonny Reservoir in the RRCA Groundwater model and the resulting effect on Colorado's pumping depletions (CBCU for purposes of compliance accounting)

Q: Please describe the reservoir and history.

A: Bonny Reservoir was constructed between 1948 and 1951, and became operational by 1951. It is located approximately 10 miles upstream of the Colorado – Kansas Stateline. It is located 54 miles upstream of Benkelman, Nebraska where the South Fork joins the Republican River. The reservoir has been used for recreation, fish and wildlife and flood control purposes since it was constructed until several years ago. The reservoir did not provide storage for irrigation purposes, although the diversion works for the Hale Ditch are at the reservoir and were operated to supply direct flow water for the ditch.

Q: What has been the water supply history of the reservoir?

A: From the time of construction until about 1996, the reservoir was operated consistently in a full condition, at approximately 36,000 to 40,000 acre-feet. However, beginning in about 1996, the inflow was no longer sufficient to maintain

the reservoir full, and the storage content began to decline and the reservoir did not refill after that. (See Exhibit CCP/BR-14, Figure 3, Bonny Reservoir historical content). Reservoir inflows, as estimated by Reclamation based on reservoir mass balance and including precipitation, averaged about 9,000 acre-feet per year over the past 10 years (2003 – 2012), as low as 2,000 acre-feet in 2012. The baseflow component of inflow has been reduced substantially.

Q: Have you provided a schematic of the reservoir showing the elevations and capacities?

A: Exhibit CCP/BR-K16 shows the elevations for the outlet works and the elevations of conservation storage for Bonny Reservoir, as currently documented.

Q: Has the reservoir been drained?

A: Yes. As documented by others, the Colorado State Engineer ordered the reservoir evacuated and this was accomplished during 2012.

Q: What are the components of consumptive use that are affected by Bonny Reservoir?

A: Reservoir evaporation will be reduced or eliminated to the extent the reservoir is drained and dead pool is evacuated or eliminated. Another component of consumptive use in the compact accounting related to the reservoir is the effect of Colorado groundwater pumping on reservoir seepage. This is referred to as reduced seepage loss to the aquifer due to pumping. The RRCA Groundwater model output includes an impact due to groundwater pumping at the reservoir. This is calculated as the difference in reservoir seepage due to groundwater pumping (between the with and without pumping conditions), with the difference

identified as GW CBCU for Bonny Reservoir. This effect has been identified as the seepage impact of the reservoir. (Ex. CCP/BR-K14 and CCP/BR-K15). It averaged approximately 1,300 acre-feet/yr for 2003 – 2008 and approximately 1,000 acre-feet /yr over the period 1981 – 2000 (see Appendix U to Ex. CCP/BR J-13).

Q: Is there another effect on Colorado's pumping depletions associated with the proposed Bonny Reservoir accounting change?

A: Yes. The configuration of Bonny Reservoir proposed by Colorado would result in a substantial reduction in the pumping stream depletion in the South Fork sub-basin computed by the accounting formulas.

Q: What is the reason for this change?

A: This change has been referred to as the elimination of re-timing of base inflow to the reservoir. Since there is no actual change in pumping that is associated with draining the reservoir, the change in computed pumping stream depletions (CBCU) is due to modification of the representation of baseflow at the reservoir.

Q: Have you identified the cause of this change in computed pumping depletion for Colorado?

A: Yes. The computation of the difference in modeled baseflow between the historical pumping and the no-pumping simulation is affected by the baseflow specified for the Model at the reservoir. The change in computed groundwater CBCU with this proposal is caused by the difference in baseflow below the reservoir between the two model runs that is introduced by the proposal. The

current configuration has the baseflow below the reservoir equal in both model runs.

Q: What is the reason for the difference created by Colorado's proposal?

A: The no-pumping condition would have more baseflow downstream of the reservoir in the Model than the pumping condition, which results in a larger loss in the downstream reach of the South Fork in the no-pumping condition.

Q: What is the magnitude of the change in pumping depletion due to this effect?

A: For the historical period of 2003 – 2008, the change in computed CBCU for Colorado would be a reduction of 7,610 acre-feet/ yr, from 12,850 to 5,240 acre-feet/yr. Of this difference, 4,926 acre-feet/yr is due to changes in pumping impacts computed below the reservoir to Benkelman.

Q: What was the computed groundwater pumping depletions for Colorado in the South Fork sub-basin with the current configuration of Bonny Reservoir?

A: Impacts of Colorado pumping in the South Fork sub-basin are documented in Appendix U to the Final Report, dated September 17, 2003 for the years of 1981 – 2000. The annual Groundwater CBCU for this period averaged 10,557 acre-feet/yr (summing the South Fork and Bonny impacts). Ex. CCP/BR-K17 is a plot of the South Fork Groundwater impacts for Colorado for the period 1981 – 2008, which combines the values from Appendix U and the results of the Model updates through 2008. Also plotted are the results from the Colorado proposal being considered here.

Q: Have you made an analysis how this change would affect the compact compliance accounting for Colorado and Kansas?

A: Yes. This was done for the historical years 2003 – 2008, as shown on Table 1 of my report. This table compares the allocation and computed beneficial consumptive use for the South Fork Sub-basin for each of these years. The historical balance is compared to the results with the Colorado model proposal in effect. The reservoir evaporation for Bonny Reservoir has also been set to zero for this comparison.

Q: How did you determine the modified allocations?

A: The allocation is determined from the computed water supply for each sub-basin. Due to the change in pumping depletions, the computed water supply would be changed. In addition, it was assumed that the reduction in reservoir evaporation would translate to additional water at the Benkelman streamflow gage. It was assumed that the gage flow would be increased in the amount of 50% of the evaporation for these years. These adjustments to the computed water supply are then translated to the allocation.

Q: What is the estimated effect for Colorado over this period?

A: The amount that the CBCU exceeds the allocation in the South Fork sub-basin would be reduced from 5,600 acre-feet/year to 500 acre-feet/yr, due to a reduction in total CBCU (evaporation + groundwater depletions) of approximately 10,000 acre-feet/yr. The comparison of CBCU to the total available supply (sub-basin allocation + unallocated South Fork supply) would be overuse of 2,300

acre-feet/yr with Bonny Reservoir to underuse of 1,120 acre-feet/yr with the dry Bonny condition.

Q: Did you make a similar projection for Kansas compact accounting?

A: Yes. The effects to the Kansas accounting would be to the CBCU of groundwater and the allocation. The Kansas allocation is reduced from 9,500 to 4,600 acre-feet/yr. Kansas balance of unused allocation would be reduced from 3,600 acre-feet/yr to 1,300 acre-feet/yr.

Q: Did you also analyze the status of Kansas' water short year compliance with the change proposed by Colorado?

A: Yes. Table 3 in my report shows the effect on the two-year average for the water-short year test. This combines the sub-basin allocation with a percentage of the South Fork unallocated supply and applies a two year average. The Kansas balance for the years 2004 – 2007 ranged from 6,010 to 7,500 acre-feet/yr. With the change proposed by Colorado, this range would be reduced to 2,330 to 4,660 acre-feet/yr.

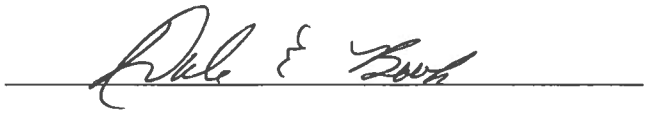
Q: Have you identified where the changes to GW CBCU on the South Fork occur with the Colorado proposal?

A: Yes. The reduction in Colorado CBCU computed from this change is effectively a credit caused by the change in baseflow introduced into the model below Bonny Reservoir in the two model runs. This change results in higher flows between Bonny Reservoir and Benkelman in the no-pumping model run that creates higher losses for that condition. By summing Colorado pumping impacts at Benkelman, there is a credit created for pumping depletions in Colorado. This

effect has been distributed to various reaches between inflow to Bonny Reservoir and Benkelman, by Steve Larson in his report. This effect is much more limited in the current version of the accounting since base inflows below the reservoir are assumed to be equal in each model run.

Q: Is there any other effect of the Colorado proposed change on modeling results?

A: Yes. The reduction is CBCU computed for each state under this proposal results in a significant departure from the computed no-pumping condition at Benkelman. The sum of the individual state depletions, used to compute the water supply and allocations, is less than the depletions for the no-pumping condition at Benkelman. This effect, which also exists to a limited extent with the current accounting procedures, is enlarged to 3,800 acre-feet/yr. This represents water supply that would be unallocated in the compact accounting.

Pursuant to 28 U.S.C. §1746, I declare under penalty of perjury that the foregoing is true and correct.

Executed on September 18, 2013.