Engineering Committee Report Republican River Compact Administration

August 31st, 2023

EXECUTIVE SUMMARY

This document reports the activities of the RRCA Engineering Committee from the August 31st, 2022 RRCA Annual Meeting to the August 31st, 2023 RRCA Annual Meeting. The Engineering Committee (EC) met four times since the August 31st, 2022, Republican River Compact Administration (RRCA) Annual Meeting. Over the past year, the EC completed these assignments: 1) hold quarterly meetings; 2) exchange information listed in Section V of the RRCA Accounting Procedures and Reporting Requirements, including all required data and documentation; 3) finalize 2022 accounting; 4) continue work on documenting historical changes to the RRCA Accounting Procedures; 5) provide updates on the progress of new and ongoing management strategies for maintaining compact compliance; 6) continue development and maintenance of the RRCA administrative website that serves as an informational page for the public and provide regular updates to the EC; 7) continue work and provide updates on improving accounting tools developed by the Engineering Committee; 8) work to prepare the 2022 RRCA annual meeting report; and 9) work to find a solution regarding the NCORPE pumping reporting error in the 2021 accounting.

Ongoing assignments include: 1) hold quarterly meetings; 2) continue work on documenting historical changes to the RRCA Accounting Procedures; 3) provide updates on the progress of new and ongoing management strategies for maintaining compact compliance; 4) work on maintaining and enhancing the RRCA public website; 5) continue work and provide future updates on improving accounting tools developed by the Engineering Committee.

The EC recommends discussion by the RRCA on the exchange of data, modeling results, and proposed accounting for 2022 incorporating the EC′s proposed course of action for dealing with correction of 2021 NCORPE pumping; modeling and data tasks to be assigned to Principia Mathematica for 2023; the document summarizing historical changes to the RRCA Accounting Procedures; and recommended EC assignments and other potential assignments for the next year.

Details of the various EC tasks are described further in the remainder of this report, including:

Attachment 1: Minutes of the quarterly meetings of the EC
Attachment 2: Accounting Inputs and Accounting Tables from the RRCA Accounting for 2022 recommended by the EC for approval by the RRCA (Task 3)
Attachment 3: Report on Error in the 2021 NCORPE augmentation project pumping data

COMMITTEE ASSIGNMENTS AND RELATED WORK ACTIVITIES

1. Meet quarterly to review the tasks assigned to the committee.
    a. The EC met November 10, 2022; January 19, 2023; April 20, 2023; and July 13, 2023. See Attachment 1 for the approved minutes of these meetings.
    b. The EC recommends that this task continue.

2. Exchange by April 15, 2023, the information listed in Section V of the RRCA Accounting Procedures and Reporting Requirements, and other data required by that document, including all necessary documentation. By July 15, 2023, the states will exchange any updates to these data.
    a. Nebraska posted its data on April 14, 2023, and provided an update on July 14, 2023.
    b. Kansas posted its data on April 14, 2022, and provided an update to the data on July 6, 2023.
    c. Colorado posted its data on April 4, 2023, and added Crop Irrigation Requirement (CIR) data on July 1, 2023.
3. Finalize the 2022 accounting and recommend it for approval by the RRCA.
    a. Colorado, Kansas, and Nebraska accounting data for 2022 are final and the EC hereby recommends approval of the accounting by the RRCA.
    b. The applicable summary accounting tables are presented in Attachment 2.
4. Continue work on creating a document memorializing when RRCA Accounting Procedures have changed over the years and incorporate it into the Accounting Procedures (AP).
    a. The EC will continue to maintain the AP tracking document and publish it on the website.
5. Provide updates on the progress of new and ongoing management strategies for maintaining compact compliance.
    a. Nebraska provided updates on the current year forecasting and kept the other states abreast of the status of Water Short and Compact Call Year determinations. Nebraska discussed anticipated management actions for the 2023.
    b. Kansas informed the EC that minimum desirable streamflows were being enforced in parts of the basin. The EC heard several updates on the status of automation efforts on the Courtland Canal along with preliminary information on the status of the NRCS-sponsored Regional Conservation Partnership Program in the Upper Republican River Basin, which will focus on phreatophyte removal along the river channel.
    c. The EC continued to explore use of the climate-based analyses for projecting pumping by Kansas.
    d. Colorado provided updates on deliveries by the Colorado Compliance Pipeline.
    e. The EC recommends this task as a recurring assignment.
6. Continue efforts to develop and publish an administrative website that would be an informational page for the public.
    a. State staff have maintained and updated the website, which is accessible to the public, and reported back to the EC.
    b. The EC recommends this task as a recurring assignment.

7. Continue work and provide future updates on improving accounting tools developed by the Engineering Committee.
    a. The EC continues to use the website accounting tool to validate the accounting spreadsheet results.
    b. The EC discussed the overlap in the Courtland Canal above Lovewell and Attachment 7 inputs and calculations that when combined with varying data sources were causing inconsistencies in the accounting spreadsheet. The EC will address this issue by performing a quality control check upon receiving these data from the United States Bureau of Reclamation.
    c. The EC recommends this task as a recurring assignment.
8. Prepare the 2022 RRCA annual meeting report for approval by the RRCA at the 2023 annual meeting.
    a. The report has been finalized and approved by the EC and is hereby recommended for approval by the RRCA.
9. Make a recommendation on a course of action for dealing with the 2021 NCORPE data correction.
    a. On January 12, 2023, Nebraska provided a memorandum (Attachment 3) describing an error in 2021 NCORPE augmentation pumping data and updated 2021 pumping data from the NCORPE augmentation project wells. Since 2021 accounting was approved at the 2022 annual meeting, the memorandum from Nebraska also provided the differences in pumping and concluded that the differences in pumping would not impact the results of the 2021 accounting. The EC discussed how to calculate the accounting for 2022.
    b. The EC recommends that the approved accounting for 2021 be left as it is since correcting the 2021 groundwater model runs results in no change to the 2021 groundwater impacts to streamflow.
    c. The EC recommends that the 2022 accounting use groundwater model runs with starting heads for 2022 that incorporate the correction for 2021, and documentation explaining the difference is included with the 2022 accounting.

ITEMS FOR RRCA DISCUSSION & ACTION

1. Data exchange and modeling results for 2022 incorporating the EC′s proposed course of action for dealing with correction of 2021 NCORPE pumping. The EC recommends the proposed 2022 accounting presented in Attachment 2 and in the spreadsheet titled “RRCA Accounting 2022 Final.xlsx” for approval by the RRCA. Upon approval of the accounting, the above-mentioned spreadsheet file will be placed on the public website.
2. Modeling and data tasks to be assigned to Principia Mathematica for 2023. The EC recommends that Principia Mathematica continue to maintain the web-based accounting tool and perform periodic model and accounting updates at the same level of service as in 2022.

3. The document summarizing historical changes to the RRCA Accounting Procedures is current and being maintained by the EC. The EC recommends that the document continue to be maintained by the EC as an ongoing assignment.
4. Discussion of the recommended EC assignments and other potential assignments for the next year and agreement on a final set of assignments. The EC presents the following list of recommended assignments to report on at the 2024 annual meeting of the RRCA.

RECOMMENDED ASSIGNMENTS FOR THE COMING YEAR

The Engineering Committee recommends that the Republican River Compact Administration assign the following tasks:

1. Meet quarterly to review the tasks assigned to the committee.
2. Exchange by April 15, 2024, the information listed in Section V of the RRCA Accounting Procedures and Reporting Requirements, and other data required by that document, including all necessary documentation. By July 15, 2024, the states will exchange any updates to these data.
3. Finalize the 2023 accounting and recommend it for approval by the RRCA.
4. Maintain and publish updates to *Summary of Historical Changes to the RRCA's Accounting Procedures and Reporting Requirements* as necessary.
5. Provide updates on the progress of new and ongoing management strategies for maintaining compact compliance.
6. Continue development and maintenance of the RRCA administrative website that serves as an informational page for the public and provide regular updates to the EC.
7. Continue work and provide future updates on improving accounting tools developed by the Engineering Committee.
8. Prepare the 2023 RRCA annual meeting report for approval by the RRCA at the 2024 annual meeting.

The Engineering Committee Report and the exchanged data will be posted on the web at http://republicanriver.org/

SUBMITTED TO THE RRCA BY

Ivan Franco, Chair and Engineering Committee Member for Colorado

Christopher Beightel, Engineering Committee Member for Kansas

Kari Burgert, Engineering Committee Member for Nebraska

MINUTES for the
QUARTERLY MEETING of the
ENGINEERING COMMITTEE of the
REPUBLICAN RIVER COMPACT ADMINISTRATION
November 10, 2022 9:00 AM Mountain Time

Meeting was held via Google Meet.

Attendees:

Chris Beightel, KS
Kari Burgert, NE
Hongsheng Cao, KS
Jesse Bradley, NE
Chelsea Erickson, KS
Elizabeth Esseks, NE
Samantha Capps, NE
Brian Flynn, NE
Ivan Franco, CO
Sam Perkins, KS
Willem Schreüder CO

ENGINEERING COMMITTEE TASK LIST

1. Introductions
   1.1. The meeting started at approximately 9:00 a.m. MT
2. Review/Modify Agenda
   2.1. No revisions or modifications to the agenda.
3. Review and Update Progress on Engineering Committee Task List
   3.1. Meet quarterly to review the tasks assigned to the committee.
   - This is the first meeting of the year and the subsequent meetings have been scheduled.

   3.2. Exchange by April 15, 2023, the information listed in Section V of the RRCA Accounting Procedures and Reporting Requirements, and other data required by that document, including all necessary documentation. By July 15, 2023, the states will exchange any updates to these data.

   - Willem emailed all parties at the start of November with a CBCU update that included climate data updated thru October of 2022. The update also included a preliminary 2023 model run assuming the year would be water short.

   3.3. Finalize the 2022 accounting and recommend it for approval by the RRCA.

   - Courtland Canal Data is in two locations in the accounting.
     - Nebraska informed the group that they continue to work on an email detailing Courtland Canal Data improvements.
     - **Action Item: Kari will draft an email distilling down where we have seen issues with the data reporting in order to get a good sense of the issue and for the EC to be able to provide feedback to the USBR.**

   3.4. Maintain and publish updates to Summary of Historical Changes to the RRCA's Accounting Procedures and Reporting Requirements as necessary.

   - No discussion necessary

   3.5. Provide updates on the progress of new and ongoing management strategies for maintaining compact compliance.

   - Willem noted that the CCP forecast is out and that the pipeline is expected to run into April 2023 as the forecast is less than optimal. The original estimate put the pumping at 9,500 acre-feet and we expect a rise of perhaps 2,000 acre-feet to account for the water short year.
   - Kari noted that Nebraska has their early forecast meeting with the natural resources districts and the

irrigation districts coming up next week and the final forecast will be out by the end of the year. Her intuition is that 2023 would likely be a Compact Call Year.

- Chris informed the group that Kansas is enforcing minimum desirable stream flows in their part of the basin due to streamflow declines. Chris reminded the group of the automation taking place throughout the KBID/NBID system. Chelsea informed the group of the Upper Republican South Fork work being done. She noted that in the 2021 bid round there were more than 70 applicants for things like soil moisture probes, nozzle packages, pivot controls and so on. Chelsea noted that there is still about 1.2 million left to be awarded.

3.6. Continue development and maintenance of the RRCA administrative website that serves as an informational page for the public and provide regular updates to the EC.

- There have been no significant changes to the website. Chelsea noted that Kansas renewed the hosting and backup service for another three years.
- Sam Capps informed the group that Avery Dresser would now be the contact person for Nebraska on the website committee.

3.7. Continue work and provide future updates on improving accounting tools developed by the Engineering Committee.

- Continue evaluating usefulness/applicability of the climate pumping estimator proposed by Kansas.
- Willem informed the group that he is still thinking about how to best utilize Sam Perkins' precipitation estimate methodology. Willem noted that Sam provides a result in inches of application and Willem is still unsure of how to convert that into a useful pumping distribution. Willem noted that the CBCU is not terribly sensitive to this year's pumping based on a model run where he mistakenly entered zero pumping.
- Chris thought it would be interesting to understand when each year's pumping had the largest impact on the system. Willem noted that as the system is non-linear it would be difficult to pinpoint exactly but his intuition was that it was likely a decade, or so, out from the actual pumping year.

3.8. Prepare the 2022 RRCA annual meeting report for approval by the RRCA at the 2023 annual meeting.

- Kansas has performed an initial review and edit of the 2022 annual meeting transcript and has forwarded along the edited document to Nebraska for further edits. The plan moving forward is to collect everyone's final edits and return the draft document to the stenographer's office for production of a final copy.

4. Summary of Meeting Actions/Assignments (in bold)
   - **Kari will send out an email summarizing the Courtland Canal issue.**
   - **Sam Perkins will continue to work with Willem on how best to utilize the pumping estimate tool.**
5. Future Meetings
   5.1. **The next meeting will be on January 19th, 2023 at 1 pm MST.**
6. Adjourn
   6.1. The meeting adjourned at approximately 9:29 a.m.

MINUTES for the
QUARTERLY MEETING of the
ENGINEERING COMMITTEE of the
REPUBLICAN RIVER COMPACT ADMINISTRATION
January 19, 2023 1:00 PM Mountain Time

Meeting was held via Google Meet.

Attendees:

Chris Beightel, KS
Kari Burgert, NE
Hongsheng Cao, KS
Jesse Bradley, NE
Chelsea Erickson, KS
Lizzie Hickman, KS
Samantha Capps, NE
Brian Flynn, NE
Ivan Franco, CO
Sam Perkins, KS
Willem Schreüder CO
Elizabeth Esseks, NE

ENGINEERING COMMITTEE TASK LIST

1. Introductions
   1.1. The meeting started at approximately 1:00 P.M. MT
2. Review/Modify Agenda
   2.1. No revisions or modifications to the agenda.
3. Review and Update Progress on Engineering Committee Task List
   3.1. Meet quarterly to review the tasks assigned to the committee.
   - This is the second meeting of the year and the subsequent meetings have been scheduled.

   3.2. Exchange by April 15, 2023, the information listed in Section V of the RRCA Accounting Procedures and Reporting Requirements, and other data required by that document, including all necessary documentation. By July 15, 2023, the states will exchange any updates to these data.

   - Kari noted that Elizabeth has been working with Nebraska staff who will be copying everyone on data request emails to the Bureau of Reclamation.
   - Willem noted that one last piece of data that he is waiting on is for the USGS to clean up the icing record on the gauges from November 2022.

   3.3. Finalize the 2022 accounting and recommend it for approval by the RRCA.

   - Courtland Canal Data is in two locations in the accounting.
     - Nebraska informed the group that they continue to work on an email detailing Courtland Canal Data improvements.
     - Chris asked if the BOR was providing two sets of data. Kari noted that Nebraska receives the monthly water distributions spreadsheet and a ”Court wrk sht” spreadsheet and at times the data can differ.
     - **Action Item: Kari will draft an email distilling down where we have seen issues with the data reporting in order to get a good sense of the issue and for the EC to be able to provide feedback to the USBR.**

   3.4. Maintain and publish updates to Summary of Historical Changes to the RRCA’s Accounting Procedures and Reporting Requirements as necessary.

   - No discussion necessary

   3.5. Provide updates on the progress of new and ongoing management strategies for maintaining compact compliance.

- Kari noted that Nebraska's forecast for 2023 was completed at the end of 2022 and has designated 2023 as a Compact Call Year. All states should have received this letter. In April, Nebraska will send a letter of proposed Water Short Year Administration (which is anticipated) measures for 2023 as required by the FSS.
- Willem noted that the CCP pipeline is running. The pipeline should be running into April 2023. There are a number of CREP acres coming into retirement on the South Fork so that is looking promising.
- Chris noted that Kansas was planning on contacting the Cheyenne County Conservation District to discuss the RCPP. Chelsea noted that she contacted Dani Holzwarth and she noted that this is no forward movement on this project. There appears to be a hang-up on the Federal level. The planned activities largely revolve around phreatophyte removal.
- Chris further noted that Pete Gile had a useful presentation that the Engineering Committee may be interested in hearing. The presentation revolved around efficiency improvements that have been implemented in the District.

3.6. Continue development and maintenance of the RRCA administrative website that serves as an informational page for the public and provide regular updates to the EC.

- There have been no significant changes to the website. Chelsea noted that the updated version of the CCP agreement with the new dates was somewhat difficult to locate. In order to remedy this the document may be copied to a new location that makes more sense.

3.7. Continue work and provide future updates on improving accounting tools developed by the Engineering Committee.

- Continue evaluating usefulness/applicability of the climate pumping estimator proposed by Kansas.
    - Sam Perkins has no further discussion prepared for this. Chris noted that Kansas was not interested in pressing this issue further. If there was utility to be gained from it that is great. Chris noted it may be useful in scaling the previous year's pumping and if it's useful to Willem that is up to him.
    - Willem noted that he was developing a procedure where he took the estimated pumping from the previous three years and applied a scaling factor to each states pumping using the climate-based estimator methodology and compared it to the pumping that actually occurred in that year, as reported.
    - Willem noted that the state-by-state correlation was about 0.6 and the basin wide correlation was about 0.7. He is still trying to understand why looking at state-by-state precipitation would be less accurate than a basin wide precipitation analysis.

3.8. Prepare the 2022 RRCA annual meeting report for approval by the RRCA at the 2023 annual meeting.

- Samantha Capps noted that there was a lot of work done on the transcripts by Kansas and Nebraska. The transcriptionist had many areas where she was not able to make out what was being said and, in some places, appears to have paraphrased the discussions.
- Chelsea noted that some areas were quite difficult to edit and that it required an extensive effort to get the current draft version. Chelsea believes that the final copy that includes everyone's edits will be very good.
- Elizabeth Esseks noted that the original version of the transcripts were very poor.
- Samantha noted that each state has focused on their individual sections and that Colorado should work thru everything putting an emphasis on Colorado's section.
- Nebraska noted that they have a contact with a transcriptionist that is more familiar with water terminology and that may be an available option for the 2023 annual meeting.
- Chris suggested including language in the Engineering Committee Report that staff had to make an

unusually high amount of edits the transcript or something to that effect, and this would be sufficient when approving the transcripts. The group generally felt that this would be a good idea.

- Chelsea noted that she had not posted any versions of the 2022 Annual Meeting video on the website and was not sure if we would or not. Ivan Franco noted that he would look into potentially producing a final version suitable for posting on the RRCA website.

4. Nebraska identified an issue with the NCORPE pumping date for 2021
    - Kari explained that the discrepancy identified occurred because monthly summary data as received from the NCORPE data systems was not properly vetted/corrected. Nebraska is actively working to assure that a process is in place to assure this error does not happen again.
    - Kari provided the group with a report describing the issue dated January 12, 2023.
    - Willem asked if it was possible to pump up to 14,000 acre-feet per year in one cell as the report describes. Willem was wondering if there was a limit that could be inserted to that an upper bound check could be integrated into his analysis.
    - Willem noted that there is no actual difference in the total approved accounting. Willem noted that in the past a new run is produced which addresses the error and a new starting head is ready for 2022. The alternative solution would be to change the pumping inputs to the model and change the model run that was used for 2021. The group noted that this second option has never been exercised and the EC has produced new starting heads for the upcoming years twice prior, this would potentially be the third time. The group decided to continue to think about how to move forward correcting the issue that Nebraska identified.
5. Summary of Meeting Actions/Assignments (in bold)
    - **Kari will send out an email summarizing the Courtland Canal issue.**
    - **Sam will continue to work with Willem on how best to utilize the pumping estimate tool.**
    - **The group will consider how best to resolve the NCORPE over pumping issue identified by Nebraska.**
6. Future Meetings

    6.1. **The next meeting will be on April 20th, 2023 at 9 am MST.**
7. Adjourn

    7.1. The meeting adjourned at approximately 1:50 p.m.

MINUTES for the
QUARTERLY MEETING of the
ENGINEERING COMMITTEE of the
REPUBLICAN RIVER COMPACT ADMINISTRATION
April 20, 2023 9:00 AM Mountain Time

Meeting was held via Google Meet.

Attendees:

Chris Beightel, KS
Kari Burgert, NE
Hongsheng Cao, KS
Sam Perkins, KS
Chelsea Erickson, KS
David Engelhaupt, KS
Stefan Remund, NE
Samantha Capps, NE
Brian Flynn, NE
Ivan Franco, CO
Willem Schreüder, CO
Elizabeth Esseks, NE

ENGINEERING COMMITTEE TASK LIST

1. Introductions
   1.1. The meeting started at approximately 9:00 A.M. MT
2. Review/Modify Agenda
   2.1. No revisions or modifications to the agenda.
3. Review and Update Progress on Engineering Committee Task List
   3.1. Meet quarterly to review the tasks assigned to the committee.
   - This is the third meeting of the year and the Annual Meeting has been scheduled for August 31st, 2023.

   3.2. Exchange by April 15, 2023, the information listed in Section V of the RRCA Accounting Procedures and Reporting Requirements, and other data required by that document, including all necessary documentation. By July 15, 2023, the states will exchange any updates to these data.

   - Ivan noted that each state had distributed their preliminary data, and Willem had produced a preliminary run from said data. Each state explicitly stated when the data was distributed.
   - Data for Kansas was made available on April 10th.
   - Data for Nebraska was made available on April 14th.
   - Data for Colorado was made available on April 4th.
   - Kari noted that the USGS is in the process of finalizing any preliminary gage data that is left.
   - Willem noted that the CIR data is coming soon from Randy Hendrix and there will likely not be any changes to Colorado data.
   - Chris noted that he thought the Kansas data was about 95% complete with only slight updates coming in July.

   3.3. Finalize the 2022 accounting and recommend it for approval by the RRCA.

   - Courtland Canal Data is in two locations in the accounting.
     - Nebraska informed the group that they continue to work on an email detailing Courtland Canal Data improvements. Kari contacted the BOR by email on the 13th or 14th of April telling the BOR that the data they had provided was contradicting itself in the Attachment7 and Courtland Canal worksheet. Kari noted that this worked and this may just end up being a quality control issue each year when these are received.

- Kari noted that in the coming weeks she would provide a preliminary accounting sheet for comparison to Willem's sheet.
- **Action Item: Kari will draft an email distilling down where we have seen issues with the data reporting in order to get a good sense of the issue and for the EC to be able to provide feedback to the USBR.**

3.4. Maintain and publish updates to Summary of Historical Changes to the RRCA's Accounting Procedures and Reporting Requirements as necessary.

- No discussion necessary

3.5. Provide updates on the progress of new and ongoing management strategies for maintaining compact compliance.

- Samantha noted that Nebraska has distributed its annual letter to the states, earlier in the month, detailing the anticipated management actions. Conditions will continue to be monitored and updates will continue to be provided as the year progresses.
- Willem noted that the CCP had pumped about 7,000 acre-feet and in the next 10 days another 500 acre-feet will likely be pumped. The current projection is for 12,500 acre-feet and we are still anticipating a water short year for 2023, but that may change.
- Chelsea provided an update on Northwest Kansas activities. Dan Holzwerth with the Cheyenne County Conservation District provided Chelsea an updated on the RCPP. A partnership agreement is getting closer to being finalized and there are still meetings with groups to figure out logistics. Applications may start to be accepted this summer. Originally, Kansas Water Office provided five-hundred thousand dollars and this was matched by other sources and and is earmarked for a number of equipment improvements throughout the region.

3.6. Continue development and maintenance of the RRCA administrative website that serves as an informational page for the public and provide regular updates to the EC.

- There have been no significant changes to the website. When annual meeting data is made available those documents will be posted on the website.
- Samantha noted that Stefan Remund will be the new Nebraska contact for the website committee.

3.7. Continue work and provide future updates on improving accounting tools developed by the Engineering Committee.

- Continue evaluating usefulness/applicability of the climate pumping estimator proposed by Kansas.
- No further discussion on these topics.

3.8. Prepare the 2022 RRCA annual meeting report for approval by the RRCA at the 2023 annual meeting.

- Ivan noted that the transcripts are very close to being finalized and he had received final comments from Kansas and when Nebraska completes their review he would send them to the transcriptionist for production of a final copy.

4. Nebraska identified an issue with the NCORPE pumping data for 2021
   - The group discussed the issue and the two proposed solutions. Ultimately, the group decided that either solution would work but that the decision should be left in the hands the commissioners. The group agreed to speak with their respective commissioner so that they were abreast of the situation. At some point in the future the three commissioners should decide on a path forward on this issue.
5. Summary of Meeting Actions/Assignments (in bold)
   - **Kari will send out an email with summarizing the Courtland Canal issue.**
   - **Kari would send out a preliminary accounting run for comparison purposes.**
   - **Sam will continue to work with Willem on how best to utilize the pumping estimate tool.**

- **The group will consult their individual commissioners on how to resolve the NCORPE over pumping issue identified by Nebraska.**

6. Future Meetings
   6.1. **The next meeting will be on July 12th, 2023 at 9 am MST.**
7. Adjourn
   7.1. The meeting adjourned at approximately 9:33 a.m.

MINUTES for the
QUARTERLY MEETING of the
ENGINEERING COMMITTEE of the
REPUBLICAN RIVER COMPACT ADMINISTRATION
July 13, 2023 9:00 AM Mountain Time

Meeting was held via Google Meet.

Attendees:

Chris Beightel, KS
Kari Burgert, NE
Hongsheng Cao, KS
Sam Perkins, KS
Willem Schreüder, CO
Stefan Remund, NE
Samantha Capps, NE
Brian Flynn, NE
Ivan Franco, CO
Chelsea Erickson, KS
David Engelhaupt, KS

ENGINEERING COMMITTEE TASK LIST

1. Introductions
   1.1. The meeting started at approximately 9:00 A.M. MT
2. Review/Modify Agenda
   2.1. No revisions or modifications to the agenda.
3. Review and Update Progress on Engineering Committee Task List
   3.1. Meet quarterly to review the tasks assigned to the committee.
   - The Engineering Committee has now met four times and the next meeting will be the Annual Meeting on August 31st in Burlington.

   3.2. Exchange by April 15, 2023, the information listed in Section V of the RRCA Accounting Procedures and Reporting Requirements, and other data required by that document, including all necessary documentation. By July 15, 2023, the states will exchange any updates to these data.

   - Ivan noted that Kari has sent out Nebraska's most current accounting for comparison to Willem's accounting. There was only one very minor difference that needs addressing.
     - Willem sent out an email earlier in the week detailing one difference when he compared the two accounting calculations, which occurs for Table 3C. Willem has changed which output he uses for Nebraska Imported Water Supply Credit. He is now pulling row 28 from the Nebraska Mound impacts which sums the pre-rounded subbasin values instead of row 31, which sums the subbasin rounded values. This approach is slightly different and makes a 10-acre-foot difference only. However, it is something to consider if we want the exact same number. Kari will look into this and get back to group but would likely implement Willem's change.
   - Kari noted that a very slight change to 2022 data would be coming from Nebraska by the end of the week. The volume of water has not changed but the location will be changed to reflect the correct canal return flow location.
   - Colorado does not expect any additional changes to their data between now and July 15, 2023.

   3.3. Finalize the 2022 accounting and recommend it for approval by the RRCA.

   - Courtland Canal Data are in two locations in the accounting.
     - Previously, Kari contacted the BOR by email on the 14th of April telling the BOR that the data they had provided was contradicting itself in the Monthly Water Distribution for Courtland in Nebraska and Courtland Canal worksheet. Kari noted that this fixed the discrepancy and any

implications in the accounting. Kari suggested that, rather than pursuing any modifications to the locations of the data in the accounting spreadsheet, the EC continue this assignment to implement a quality control check on this data every year.

- **Action Item: Ivan Franco will change this item to continue forward as implementation of a quality control check that should be performed each year.**

3.4. Maintain and publish updates to Summary of Historical Changes to the RRCA's Accounting Procedures and Reporting Requirements as necessary.

- Ivan noted that the Commissioners unanimously decided during a three-states meeting on June 20, 2023 to proceed to amend Nebraska's 2021 NCORPE pumping in a manner similar to the PRISM data correction. Therefore, updates to this document will be necessary. He noted his uncertainty as to whether this should be updated at the Annual Meeting in 2023 or afterwards as a housekeeping task for the Engineering Committee.
- Prior to the meeting, Kari provided language for the suggested update. Ivan noted he would take another look at that document and incorporate/edit the suggested language and make sure other changes are not required.

3.5. Provide updates on the progress of new and ongoing management strategies for maintaining compact compliance.

- Ivan started by noting that Colorado had reached its goal of retiring more than 10,000 acres of land along the South Fork and that initial documents had been forwarded to each state. A response was received by Nebraska asking for a map and suggesting packaging all pertinent documentation for acceptance by the RRCA at the Annual Meeting in 2023. Colorado is working on putting together an overall package so that it may be included in the annual meeting data and the commissioners can make a motion for acceptance.
- Ivan noted that 2023 will not be a water short year and therefore this changes some early predictions for Colorado's pumping but other factors are at play as well and he asked Willem to elaborate.
- Willem informed the group that Colorado's predicted pumping for 2023 remains unchanged at 12,500 acre-feet due to the effects of the wet spring on the current year's consumptive use.
- Kari informed the group that while 2023 is officially not water short, it is still a compact call year and therefore pursuant to the resolution Nebraska is still required to send monthly updates by the 10th of each month. The other states can expect normal updates pursuant to a compact call year.
- Samantha noted that there are contracts in the works for telemetry meters in Lower Republican Natural Resources District in Nebraska and a Lower Republican augmentation project. Chris asked the group if there was a timeline for the augmentation project. Samantha noted the project is still in the consultation phase with some pump testing being performed.
- Chelsea provided an update on RCPP monies. Contracts or beginning to sign contracts for phreatophyte removal. Work on some of this removal may start as soon as this fall/winter.

3.6. Continue development and maintenance of the RRCA administrative website that serves as an informational page for the public and provide regular updates to the EC.

- There have been no significant changes to the website. When annual meeting data are made available those documents will be posted on the website.

3.7. Continue work and provide future updates on improving accounting tools developed by the Engineering Committee.

- Continue evaluating usefulness/applicability of the climate pumping estimator proposed by Kansas.
  - Willem informed the group that he would like to continue this task and is looking forward to utilizing this tool to better estimate 2023's pumping impacts.
- Chris Beightel asked Willem a question about the preliminary accounting posted on the website and

what a page that shows differences was intended to delineate.

- Willem noted that when he runs the integrated accounting, he has a program that reads all of the fields in the spreadsheet and in the integrated accounting and if there's a difference, it just says, there's a difference between what's in the official accounting spreadsheet and what the integrated accounting would show.

3.8. Prepare the 2022 RRCA annual meeting report for approval by the RRCA at the 2023 annual meeting.

- Ivan noted that a couple of weeks ago he sent a copy of the draft annual meeting report that contained the final amended transcripts (this was not noted in the email) and that Kansas is taking a first stab at edits and will forward comments to Nebraska.
- Chelsea noted that she had sent edits to the April meeting minutes and had already commented on the previous two meeting minutes. Nebraska sent out an email, prior to the meeting, where they provided edits on the three previous meetings. Ivan noted that he had received all of these comments and would incorporate all of these changes in the final copies.

4. Nebraska identified an issue with the NCORPE pumping data for 2021
   - As noted, the Commissioners unanimously decided to amend Nebraska's 2021 NCORPE pumping in a manner similar to the PRISM data correction. Prior to the meeting, Kari sent draft language that could be included in the EC report and with the 2022 accounting to note the revisions. Willem has already implemented the change in the groundwater model runs.
5. Summary of Meeting Actions/Assignments (in bold)
   - **The group will continue to review/compare draft accounting for final approval at the annual meeting.**
   - **The group will continue to review the draft 2022 Annual Meeting Report that is circulating.**
   - **Ivan Franco will draft the Engineering Committee Report**
     - **The report will include language regarding QAQC for item 3.3 of this agenda.**
     - **Ivan will review Kari's draft language for the NCORPE pumping fix**
     - **Colorado will continue to work on producing an acceptable package showing acreage retirement in the South Fork.**
   - **Sam will continue to work with Willem on how best to utilize the pumping estimate tool.**
6. Future Meetings

   6.1. **The next meeting will be on August 31st in Burlington, Colorado.**
7. Adjourn

   7.1. The meeting adjourned at approximately 9:38 a.m.

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Accounting Inputs

Calendar Year		**2022**
Groundwater Data		
North Fork Subbasin	GW CBCU Colorado	*17,903*
	GW CBCU Kansas	*0*
	GW CBCU Nebraska	*1,288*
Arikaree Subbasin	GW CBCU Colorado	*735*
	GW CBCU Kansas	*128*
	GW CBCU Nebraska	*105*
Buffalo Subbasin	GW CBCU Colorado	*394*
	GW CBCU Kansas	*0*
	GW CBCU Nebraska	*3,535*
Rock Subbasin	GW CBCU Colorado	*88*
	GW CBCU Kansas	*0*
	GW CBCU Nebraska	*5,015*
South Fork Subbasin	GW CBCU Colorado	*12,347*
	GW CBCU Kansas	*4,381*
	GW CBCU Nebraska	*820*
Frenchman Subbasin	GW CBCU Colorado	*192*
	GW CBCU Kansas	*0*
	GW CBCU Nebraska	*76,085*
Driftwood Subbasin	GW CBCU Colorado	*0*
	GW CBCU Kansas	*0*
	GW CBCU Nebraska	*866*
Red Willow Subbasin	GW CBCU Colorado	*0*
	GW CBCU Kansas	*0*
	GW CBCU Nebraska	*7,773*
Medicine Creek Subbasin	GW CBCU Colorado	*0*
	GW CBCU Kansas	*0*
	GW CBCU Nebraska	*19,933*
Beaver Subbasin	GW CBCU Colorado	*0*
	GW CBCU Kansas	*3,243*
	GW CBCU Nebraska	*1,840*
Sappa Subbasin	GW CBCU Colorado	*0*
	GW CBCU Kansas	*51*
	GW CBCU Nebraska	*1,011*
Prairie Dog Subbasin	GW CBCU Colorado	*0*
	GW CBCU Kansas	*1,450*
	GW CBCU Nebraska	*0*
Mainstem Subbasin	GW CBCU Colorado	*(5,340)*
	GW CBCU Kansas Above Guide Rock	*(103)*
	GW CBCU Kansas Below Guide Rock	*63*
	GW CBCU Nebraska Above Guide Rock	*43,723*
	GW CBCU Nebraska Below Guide Rock	*2,203*

Import Water Data		
North Fork Subbasin	Imported Water Nebraska	*0*
Arikaree Subbasin	Imported Water Nebraska	*0*
Buffalo Subbasin	Imported Water Nebraska	*0*
Rock Subbasin	Imported Water Nebraska	*0*
South Fork Subbasin	Imported Water Nebraska	*0*
Frenchman Subbasin	Imported Water Nebraska	*0*
Driftwood Subbasin	Imported Water Nebraska	*0*
Red Willow Subbasin	Imported Water Nebraska	*26*
Medicine Creek Subbasin	Imported Water Nebraska	*9,351*
Beaver Subbasin	Imported Water Nebraska	*0*
Sappa Subbasin	Imported Water Nebraska	*13*
Prairie Dog Subbasin	Imported Water Nebraska	*0*
Mainstem Subbasin	Imported Water Nebraska Above Guide Rock	*6,769*
	Imported Water Nebraska Below Guide Rock	*(17)*
	Total	***16,142***
SW Pumping Data		
North Fork Subbasin	SW Diversions - Irrigation -Non-Federal Canals- Colorado	349
	SW Diversions - Irrigation - Small Pumps - Colorado	7
	SW Diversions - M&I - Colorado	0
Arikaree Subbasin	SW Diversions - Irrigation -Non-Federal Canals- Colorado	0
	SW Diversions - Irrigation - Small Pumps - Colorado	0
	SW Diversions - M&I - Colorado	0
	SW Diversions - Irrigation - Non-Federal Canals- Kansas	0
	SW Diversions - Irrigation - Small Pumps - Kansas	0
	SW Diversions - M&I - Kansas	0
	SW Diversions - Irrigation - Non-Federal Canals - Nebraska	0
	SW Diversions - Irrigation - Small Pumps - Nebraska	0
	SW Diversions - M&I - Nebraska	0

Calendar Year		2022
Buffalo Subbasin	SW Diversions - Irrigation -Non-Federal Canals- Colorado	0
	SW Diversions - Irrigation - Small Pumps - Colorado	0
	SW Diversions - M&I - Colorado	0
	SW Diversions - Irrigation - Non-Federal Canals - Nebraska	29
	SW Diversions - Irrigation - Small Pumps - Nebraska	0
	SW Diversions - M&I - Nebraska	0
Rock Subbasin	SW Diversions - Irrigation - Non-Federal Canals - Nebraska	0
	SW Diversions - Irrigation - Small Pumps - Nebraska	0
	SW Diversions - M&I - Nebraska	0
South Fork Subbasin	SW Diversions - Irrigation -Non-Federal Canals- Colorado	0
	SW Diversions - Irrigation - Small Pumps - Colorado	0
	SW Diversions - M&I - Colorado	0
	SW Diversions - Irrigation - Non-Federal Canals- Kansas	0
	SW Diversions - Irrigation - Small Pumps - Kansas	0
	SW Diversions - M&I - Kansas	0
	SW Diversions - Irrigation - Non-Federal Canals - Nebraska	0
	SW Diversions - Irrigation - Small Pumps - Nebraska	0
	SW Diversions - M&I - Nebraska	0
Frenchman Subbasin	SW Diversions - Irrigation - Non-Federal Canals - Nebraska	0
	SW Diversions - Irrigation - Small Pumps - Nebraska	0
	SW Diversions - M&I - Nebraska	0
Driftwood Subbasin	SW Diversions - Irrigation - Non-Federal Canals- Kansas	0
	SW Diversions - Irrigation - Small Pumps - Kansas	0
	SW Diversions - M&I - Kansas	0
	SW Diversions - Irrigation - Non-Federal Canals - Nebraska	0
	SW Diversions - Irrigation - Small Pumps - Nebraska	0
	SW Diversions - M&I - Nebraska	0
Red Willow Subbasin	SW Diversions - Irrigation - Non-Federal Canals - Nebraska	0
	SW Diversions - Irrigation - Small Pumps - Nebraska	0
	SW Diversions - M&I - Nebraska	0
Medicine Creek Subbasin	SW Diversions - Irrigation - Non-Federal Canals - Nebraska - Above Gage	0
	SW Diversions - Irrigation - Small Pumps - Nebraska - Above Gage	68
	SW Diversions - M&I - Nebraska - Above Gage	0
	SW Diversions - Irrigation - Non-Federal Canals - Nebraska -Below Gage	0
	SW Diversions - Irrigation - Small Pumps -Nebraska - Below Gage	62
	SW Diversions - M&I - Nebraska - Below Gage	0
Beaver Subbasin	SW Diversions - Irrigation -Non-Federal Canals- Colorado	0
	SW Diversions - Irrigation - Small Pumps - Colorado	0
	SW Diversions - M&I - Colorado	0
	SW Diversions - Irrigation - Non-Federal Canals- Kansas	0
	SW Diversions - Irrigation - Small Pumps - Kansas	14
	SW Diversions - M&I - Kansas	0
	SW Diversions - Irrigation - Non-Federal Canals - Nebraska - Above Gage	0
	SW Diversions - Irrigation - Small Pumps - Nebraska - Above Gage	0
	SW Diversions - M&I - Nebraska - Above Gage	0
	SW Diversions - Irrigation - Non-Federal Canals - Nebraska -Below Gage	0
	SW Diversions - Irrigation - Small Pumps -Nebraska - Below Gage	0
	SW Diversions - M&I - Nebraska - Below Gage	0
Sappa Subbasin	SW Diversions - Irrigation - Non-Federal Canals- Kansas	0
	SW Diversions - Irrigation - Small Pumps - Kansas	0
	SW Diversions - M&I - Kansas	0
	SW Diversions - Irrigation - Non-Federal Canals - Nebraska - Above Gage	0
	SW Diversions - Irrigation - Small Pumps - Nebraska - Above Gage	0
	SW Diversions - M&I - Nebraska - Above Gage	0
	SW Diversions - Irrigation - Non-Federal Canals - Nebraska -Below Gage	0
	SW Diversions - Irrigation - Small Pumps -Nebraska - Below Gage	0
	SW Diversions - M&I - Nebraska - Below Gage	0
Prairie Dog Subbasin	SW Diversions - Irrigation - Non-Federal Canals- Kansas	0
	SW Diversions - Irrigation - Small Pumps - Kansas	531
	SW Diversions - M&I - Kansas	383
	SW Diversions - Irrigation - Non-Federal Canals - Nebraska -Below Gage	0
	SW Diversions - Irrigation - Small Pumps -Nebraska - Below Gage	63
	SW Diversions - M&I - Nebraska - Below Gage	0
Mainstem Subbasin	SW Diversions - Irrigation - Non-Federal Canals- Kansas	0
	SW Diversions - Irrigation - Small Pumps - Kansas	797
	SW Diversions - M&I - Kansas	0
	SW Diversions - Irrigation - Non-Federal Canals - Nebraska	3,332
	SW Diversions - Irrigation - Small Pumps - Nebraska	1,830
	SW Diversions - M&I - Nebraska	0
	SW Diversions - Irrigation - Non-Federal Canals - Nebraska Below Guide Rock	0
	SW Diversions - Irrigation - Small Pumps - Nebraska Below Guide Rock	763
	SW Diversions - M&I - Nebraska - Below Guide Rock	0

Calendar Year		**2022**

Non-Federal SW Consumptive Use		
	% Non-Federal Canal Diversion Consumed	60%
	% Small Surface Water Pumps Consumed	75%
	% Municipal And Industrial SW Consumed	50%

Non-Federal Reservoir Evaporation Data		
North Fork Subbasin	Non-Federal Reservoir Evaporation - Colorado	44
Arikaree Subbasin	Non-Federal Reservoir Evaporation - Colorado	0
	Non-Federal Reservoir Evaporation - Kansas	21
	Non-Federal Reservoir Evaporation - Nebraska	0
Buffalo Subbasin	Non-Federal Reservoir Evaporation - Colorado	0
	Non-Federal Reservoir Evaporation - Nebraska	16
Rock Subbasin	Non-Federal Reservoir Evaporation - Nebraska	184
South Fork Subbasin	Non-Federal Reservoir Evaporation - Colorado	0
	Non-Federal Reservoir Evaporation - Kansas	180
	Non-Federal Reservoir Evaporation - Nebraska	0
Frenchman Subbasin	Non-Federal Reservoir Evaporation - Nebraska	154
Driftwood Subbasin	Non-Federal Reservoir Evaporation - Kansas	22
	Non-Federal Reservoir Evaporation - Nebraska	0
Red Willow Subbasin	Non-Federal Reservoir Evaporation - Nebraska	353
Medicine Creek Subbasin	Non-Federal Reservoir Evaporation - Nebraska - Above Gage	413
	Non-Federal Reservoir Evaporation - Nebraska - Below Gage	5
Beaver Subbasin	Non-Federal Reservoir Evaporation - Colorado	0
	Non-Federal Reservoir Evaporation - Kansas	522
	Non-Federal Reservoir Evaporation - Nebraska - Above Gage	226
	Non-Federal Reservoir Evaporation - Nebraska - Below Gage	0
Sappa Subbasin	Non-Federal Reservoir Evaporation - Kansas	561
	Non-Federal Reservoir Evaporation - Nebraska - Above Gage	99
	Non-Federal Reservoir Evaporation - Nebraska - Below Gage	6
Prairie Dog Subbasin	Non-Federal Reservoir Evaporation - Kansas	410
	Non-Federal Reservoir Evaporation - Nebraska	33
Mainstem Subbasin	Non-Federal Reservoir Evaporation - Kansas	135
	Non-Federal Reservoir Evaporation - Nebraska - Above Guide Rock Gage - Whole Basin Value:	1,934
	Non-Federal Reservoir Evaporation - Nebraska - Below Guide Rock Gage - Whole Basin Value:	95

Stream Gage Data		
North Fork Subbasin	North Fork Republican River At Colorado-Nebraska State Line	21,129
Arikaree Subbasin	Arikaree River At Haigler	982
Buffalo Subbasin	Buffalo Creek Near Haigler	1,030
Rock Subbasin	Rock Creek At Parks	2,955
South Fork Subbasin	South Fork Republican River Near Benkelman	0
Frenchman Subbasin	Frenchman Creek At Culbertson	10,761
Driftwood Subbasin	Driftwood Creek Near McCook	992
Red Willow Subbasin	Red Willow Creek Near Red Willow	2,678
Medicine Creek Subbasin	Medicine Creek Below Harry Strunk	29,716
Beaver Subbasin	Beaver Creek Near Beaver City	484
Sappa Subbasin	Sappa Creek Near Stamford	5,718
Prairie Dog Subbasin	Prairie Dog Creek Near Woodruff	2,414
Mainstem Subbasin	Republican River At Guide Rock	32,213
	Republican River Near Hardy	69,608

Hardy Gage Data	USGS Gage 06853500 Republican River Near Hardy, NE	
Mainstem Subbasin	January	8,005
	February	7,615
	March	9,074
	April	6,592
	May	4,958
	June	3,981
	July	18,172
	August	3,666
	September	2,326
	October	1,624
	November	1,775
	December	1,815
	ANNUAL	69,603

Calendar Year		**2022**
Reservoir Data		
South Fork Subbasin	Bonny Reservoir Evaporation	0
	Bonny Reservoir Change In Storage	0
Frenchman Subbasin	Enders Reservoir Evaporation	2,133
	Enders Reservoir Change In Storage	(1,438)
Red Willow Subbasin	Hugh Butler Lake Evaporation	4,171
	Hugh Butler Lake Change In Storage	(4,825)
Medicine Creek Subbasin	Harry Strunk Lake Evaporation	4,246
	Harry Strunk Lake Change In Storage	(8,481)
Prairie Dog Subbasin	Keith Sebelius Lake Evaporation	4,223
	Keith Sebelius Lake Change In Storage	(5,431)
Mainstem Subbasin	Swanson Lake Evaporation	10,634
	Swanson Lake Change In Storage	(21,713)
	Harlan County Evaporation Subject to Nebraska/Kansas Split	31,111
	Harlan County Evaporation Charged to Kansas	0
	Harlan County Change In Storage	(54,915)
	Lovewell Reservoir Ev charged to the Republican River	3,332

Canal Data		
North Fork Subbasin	Haigler Canal Diversions - Colorado	0
	Haigler Canal Diversions - Nebraska	6,216
	Haigler Canal Diversions	***6,216***
South Fork Subbasin	Hale Ditch Diversions	0
Frenchman Subbasin	~~Champion Canal Diversions~~	~~0~~
	Riverside Canal Diversions	0
	Culbertson Canal Diversions	3,788
	Culbertson Canal Extension Diversions	0
	Culbertson Canal % Return Flow	82%
	Culbertson Canal Extension % Return Flow	100%
Driftwood Subbasin	Meeker-Driftwood Canal Diversions	21,898
	Meeker-Driftwood Canal % Return Flow	62.3%
Red Willow Subbasin	Red Willow Canal Diversions	5,451
	Red Willow Canal % Return Flow	65%
Prairie Dog Subbasin	Almena Canal Diversions	2,542
	Almena Canal % Return Flow	61.3%
Mainstem Subbasin	Bartley Canal Diversion	6,640
	Bartley Canal % Return Flow	59%
	Cambridge Canal Diversion	26,873
	Cambridge Canal % Return Flow	55.6%
	Naponee Canal Diversion	1,288
	Naponee Canal % Return Flow	71%
	Franklin Canal Diversion	24,542
	Franklin Canal % Return Flow	67%
	Franklin Pump Canal Diversions	1,739
	Franklin Pump Canal % Return Flow	61%
	Superior Canal Diversions	9,827
	Superior Canal % Return Flow	66%
	Courtland Canal Diversions At Headgate	*74,964*
	Diversions to Nebraska Courtland	2,007
	Nebraska Courtland % Return Flow	29%
	Courtland Canal, Loss in NE assigned to upper Courtland KS	4,905
	Courtland Canal, Loss in NE assigned to delivery to Lovewell	12,385
	Courtland Canal At Kansas-Nebraska State Line	*55,667*
	Courtland Canal Diversions to the Upper Courtland District	22,666
	Courtland Canal Above Lovewell % Return Flow	*53.3%*
	Courtland Canal, Loss assigned to deliveries of water to Lovewell, Stateline to Lovewell	*6,051*
	Courtland Canal Deliveries To Lovewell Reservoir	*31,855*
	Diversions of Republican River water from Lovewell Reservoir to the Courtland Canal below Lovewell	28,522
	Courtland Canal Below Lovewell % Return Flow	*42.3%*
	To allocate Harlan County evaporation:	
	Kansas Bostwick Diversions During Irrigation Season (actual, or 3-year average)	44,970
	Nebraska Bostwick Diversions During Irrigation Season (actual or 3-year average)	39,336

NOTE:
The initial heads for the RRCA Groundwater Model 2022 Update are the ending heads from a groundwater model generated using corrected 2021 pumping data from the NCORPE augmentation project wells rather than the RRCA Groundwater Model 2021 Update used for approved 2021 accounting. After the 2021 Update was approved, Nebraska provided updated pumping for NCORPE wells. The corrected 2021 groundwater model run used to generate the 2022 initial heads has 2,264.63 acre-feet of NCORPE pumping rather than 38,438.22 acre-feet used in the approved 2021 groundwater model runs. The updated 2022 initial heads will serve as the basis for future RRCA Groundwater Model updates.

Accounting Tables

Table 1: Annual Virgin and Computed Water Supply, Allocations, and Computed Beneficial Consumptive Uses by State, Main Stem, and Sub-Basin

2022	Virgin Water	Computed	Allocations				Computed Beneficial Consumptive Use		
Basin	Supply	Water Supply	Colorado	Kansas	Nebraska	Unallocated	Colorado	Kansas	Nebraska
North Fork	38,290	38,290	8,580	0	9,420	20,290	18,160	0	5,020
Arikaree	1,980	1,980	1,550	100	330	0	740	150	110
Buffalo	4,990	4,990	0	0	1,650	3,340	390	0	3,570
Rock	8,250	8,250	0	0	3,300	4,950	90	0	5,200
South Fork	17,730	17,730	7,870	7,130	250	2,480	12,350	4,560	820
Frenchman	89,090	90,530	0	0	48,520	42,010	190	0	79,050
Driftwood	(1,390)	(1,390)	0	(100)	(230)	(1,060)	0	20	870
Red Willow	15,220	20,050	0	0	3,850	16,200	0	0	8,730
Medicine	36,530	45,010	0	0	4,100	40,910	0	0	20,450
Beaver	6,330	6,330	1,270	2,460	2,570	30	0	3,780	2,070
Sappa	6,950	6,950	0	2,860	2,860	1,230	0	610	1,120
Prairie Dog	4,640	10,070	0	4,600	770	4,700	0	7,660	80
Main Stem	88,090	160,360	0	81,940	78,420	0	(5,340)	50,990	122,870
Total All Basins	316,700	409,150	19,270	98,990	155,810	135,080	26,580	67,770	249,960
Main Stem Including Unallocated		295,440	0	150,970	144,470				
Total	316,700	409,150	19,270	168,020	221,860	0	26,580	67,770	249,960

Table 2: Original Compact Virgin Water Supply and Allocations

Basin	Virgin Water Supply	Colorado Allocation	% of Basin Supply	Kansas Allocation	% of Basin Supply	Nebraska Allocation	% of Basin Supply	Unallocated	% of Basin Supply
North Fork	44,700	10,000	22.4%			11,000	24.6%	23,700	53.0%
Arikaree	19,610	15,400	78.5%	1,000	5.1%	3,300	16.8%	(90)	-0.4%
Buffalo	7,890					2,600	33.0%	5,290	67.0%
Rock	11,000					4,400	40.0%	6,600	60.0%
South Fork	57,200	25,400	44.4%	23,000	40.2%	800	1.4%	8,000	14.0%
Frenchman	98,500					52,800	53.6%	45,700	46.4%
Driftwood	7,300			500	6.9%	1,200	16.4%	5,600	76.7%
Red Willow	21,900					4,200	19.2%	17,700	80.8%
Medicine	50,800					4,600	9.1%	46,200	90.9%
Beaver	16,500	3,300	20.0%	6,400	38.8%	6,700	40.6%	100	0.6%
Sappa	21,400			8,800	41.1%	8,800	41.1%	3,800	17.8%
Prairie Dog	27,600			12,600	45.7%	2,100	7.6%	12,900	46.7%
Tributaries Sub-Total	384,000							175,500	
Main Stem	94,500								
Main Stem + Unallocated	270,000			138,000	51.1%	132,000	48.9%		
Total	478,900	54,100		190,300		234,500			

Table 3A: Table to Be Used to Calculate Colorado's Five-Year Running Average Allocation and Computed Beneficial

	Col. 1	Col. 2	Col. 3	Col. 4
Year	Allocation	Computed Beneficial Consumptive	Imported Water Supply Credit and CORWS	Difference between Allocation and the Computed Beneficial Consumptive Use offset by Imported Water Supply Credit and CORWS Credit Col 1 – (Col 2- Col 3)
2018	25,630	35,130	13,578	4,078
2019	22,710	32,740	8,905	(1,125)
2020	24,200	26,910	6,218	3,508
2021	22,790	30,200	9,390	1,980
2022	19,270	26,580	8,501	1,191
Avg 2018-2022	22,920	30,310	9,320	1,930

Table 3B: Table to Be Used to Calculate Kansas's Five-Year Running Average Allocation and Computed Beneficial

	Col. 1	Col. 2	Col. 3	Col. 4
Year	Allocation	Computed Beneficial Consumptive	Imported Water Supply Credit	Difference between Allocation and the Computed Beneficial Consumptive Use offset by Imported Water Supply Credit Col 1 – (Col 2- Col 3)
2018	179,780	51,450	NA	128,330
2019	333,300	47,910	NA	285,390
2020	247,750	53,810	NA	193,940
2021	201,890	57,130	NA	144,760
2022	168,020	67,770	NA	100,250
Avg 2018-2022	226,150	55,610	NA	170,530

Table 3C: Table to Be Used to Calculate Nebraska's Five-Year Running Average Allocation and Computed Beneficial

	Col. 1	Col. 2	Col. 3	Col. 4
Year	Allocation	Computed Beneficial Consumptive	Imported Water Supply Credit and NERWS	Difference between Allocation and the Computed Beneficial Consumptive Use offset by Imported Water Supply Credit and NERWS Credit Col 1 – (Col 2- Col 3)
2018	241,680	266,080	25,943	1,543
2019	389,300	262,870	26,541	152,971
2020	303,070	252,400	18,995	69,665
2021	258,180	252,650	21,456	26,986
2022	221,860	249,960	16,157	(11,943)
Avg 2018-2022	282,820	256,790	21,820	47,840

Table 4A: Colorado Compliance with the Sub-basin Non-impairment Requirement

Table 4A is left unpopulated pursuant to the August 24, 2016 "RESOLUTION BY THE REPUBLICAN RIVER COMPACT ADMINISTRATION APPROVING OPERATION AND ACCOUNTING FOR THE COLORADO COMPACT COMPLIANCE PIPELINE AND COLORADO'S COMPLIANCE EFFORTS IN THE SOUTH FORK REPUBLICAN RIVER BASIN", paragraph E.

2022

	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
Sub-basin	Colorado Sub-basin Allocation (Five-year Running Average)	Unallocated Supply (Five-year Running Average)	Credits from Imported Water Supply and CORWS Credit (Five-year Running Average)	Total Available Supply (Five-year Running Average)	Colorado Computed Beneficial Consumptive Use (Five-year Running Average)	Difference Between Available Supply and Computed Beneficial Consumptive Use (Five-year Running Average)
North Fork						
Arikaree						
South Fork						
Beaver						

Table 4B: Kansas's Sub-Basin Non-impairment Compliance

2022

	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
Sub-basin	Kansas Sub-basin Allocation (Five-year Running Average)	Unallocated Supply (Five-year Running Average)	Unused Allocation from Colorado (Five Year Running Average)	Credits from Imported Water Supply (Five-year Running Average)	Total Available Supply Col 1 + Col 2 + Col 3 + Col 4 (Five-year Running Average)	Kansas Computed Beneficial Consumptive Use (Five-year Running Average)	Difference Between Available Supply and Computed Beneficial Consumptive Use Col 5 - Col 6 (Five-year Running Average)
Arikaree	162	(10)	790	N/A	942	138	804
South Fork	8,426	2,936	0	N/A	11,362	4,746	6,616
Driftwood	44	500	0	N/A	544	16	528
Beaver	4,034	60	2,080	N/A	6,174	5,856	318
Sappa	7,472	3,230	0	N/A	10,702	2,172	8,530
Prairie Dog	8,124	8,298	0	N/A	16,422	10,324	6,098

Table 5A: Colorado's Compliance During Water-Short Year Administration

	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
Year	Is the year Water Short Pursuant to III.J?* (Yes or No)	Statewide Allocation	Beaver Creek Reduction Pursuant to Table 5F	Allocation - Beaver Creek Reduction (Col. 2 - Col.3)	Computed Beneficial Consumptive (excluding the Beaver Creek Sub-basin)	Imported Water Supply Credit - IWS Beaver Creek + CORWS Credit	Difference between Allocation and the Compuated Beneficial Consumptive Use offset by Imported Water Supply Credit and CORWS Credit (Col. 4 - Col. 5 + Col. 6)
2018	Yes	25,630	1,852	23,778	35,130	13,578	2,226
2019	No	22,710	0	22,710	32,740	8,905	(1,125)
2020	No	24,200	0	24,200	26,910	6,218	3,508
2021	No	22,790	0	22,790	30,200	9,390	1,980
2022	No	19,270	0	19,270	26,580	8,501	1,191
Avg 2018-2022	Yes	22,920	370	22,550	30,310	9,320	1,560

Table 5F: Colorado's Beaver Creek Reduction During Water-Short Years

Water Short Year (WSY) Pursuant to III.J	Beaver Creek Allocation	Reduction = Average of last five WSY Beaver Creek Allocations
	Col. 1	Col. 2
2002	770	N/A
2003	260	N/A
2004	360	N/A
2005	910	N/A
2006	1,420	N/A
2007	2,320	744
2013	1,130	1,054
2014	1,250	1,228
2015	2,130	1,406
2016	2,430	1,650
2018	1,940	1,852

Table 5B: Kansas's Compliance During Water-Short Year Administration
Kansas

Year	Allocation				Computed Beneficial Consumptive Use	Imported Water Supply Credit	Difference Between Allocation and the Computed Beneficial Consumpitve Use offset by Imported Water Supply Credit
Column	1	2	3	4	5	6	7
	Sum Sub-basins	Kansas' Share of Unallocated Supply	Kansas' Share of the Unused Colorado Allocation	Total Col 1 + Col 2 + Col 3			Col 4 - (Col 5 - Col 6)
2021	25,860	6,607	1,589	34,056	20,650	N/A	13,406
2022	17,050	3,771	1,063	21,884	16,780	N/A	5,104
Avg 2021-2022	21,455	5,189	1,326	27,970	18,715	N/A	9,255

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

	Allocation			Computed Beneficial Consumptive Use	Imported Water Supply Credit and AWS	Allocation - (CBCU - IWS-AWS)
Year	Sub-Basin Total	Share of Unallocated Supply	Total			
2020	95,240	78,440	173,680	132,980	10,716	51,416
2021	89,710	68,225	157,935	133,520	10,822	35,237
2022	77,390	66,054	143,444	127,090	9,442	25,796
Avg 2021-2022	83,550	67,140	150,690	130,305	10,132	30,517

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

Year	Allocation				Computed Beneficial Consumptive Use			Imported Water Supply Credit and NERWS Credit	Difference Between Allocation and Computed Beneficial Consumptive Use offset by Imported Water Supply Credit Above Guide Rock and NERWS Credit
Column	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9
	State-Wide Allocation	Allocation Below Guide Rock	Allocation Above Guide Rock	Nebraska's Share of Unused Colorado Allocation	State-Wide CBCU	CBCU Below Guide Rock	CBCU Above Guide Rock	Credits Above Guide Rock	Col 3 + Col 4 - (Col 7 - Col 8)
2021	258,180	6,503	251,677	1,521	252,650	3,084	249,566	21,485	25,116
2022	221,860	9,277	212,583	1,017	249,960	2,870	247,090	16,174	(17,316)
Avg 2021-2022	240,020	7,890	232,130	1,270	251,310	2,980	248,330	18,830	3,900

Table 5D: Nebraska's Compliance Under a Alternative Water-Short Year Administration Plan

Year	Allocation				Computed Beneficial Consumptive Use			Imported Water	Difference Between Allocation
Column	Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9
	State-Wide Allocation	Allocation Below Guide Rock	Allocation Above Guide Rock	Share of Unused Colorado Allocation	State-Wide CBCU	CBCU Below Guide Rock	CBCU Above Guide Rock	Credits Above Guide Rock	Col 3 + Col 4 - (Col 7 - Col 8)
2020	303,070	17,777	285,293	1,628	252,400	2,266	250,134	18,995	55,783
2021	258,180	6,503	251,677	1,521	252,650	3,084	249,566	21,485	25,116
2022	221,860	9,277	212,583	1,017	249,960	2,870	247,090	16,174	(17,316)
Avg 2020-2022	261,040	11,190	249,850	1,390	251,670	2,740	248,930	18,880	21,190

Attachments

Attachment 1: Sub-basin Flood Flow Thresholds

Sub-basin	Sub-basin Flood Flow Threshold Acre-feet per Year[3]
Arikaree River	16,400
North Fork of Republican River	33,900
Buffalo Creek	9,800
Rock Creek	9,800
South Fork of Republican River	30,400
Frenchman Creek	51,900
Driftwood Creek	9,400
Red Willow Creek	15,100
Medicine Creek	55,100
Beaver Creek	13,900
Sappa Creek	26,900
Prairie Dog	15,700

[3] Flows considered to be Flood Flows are flows in excess of the 94% flow based on a flood frequency analysis for the years 1971-2000. The Gaged Flows are measured after depletions by Beneficial Consumptive Use and change in reservoir storage.

Attachment 6: Computing Water Supplies and Consumptive Use Above Guide Rock

Note: At its Annual Meeting on August 21, 2020, the RRCA agreed that the Accounting Procedures (Rev. May 25, 2017) do not properly implement the Flood Flows provisions at the Hardy gage with respect to the calculation of Computed Water Supply above and below Guide Rock. The current implementation could impact Nebraska's Table 5C compliance test, specifically the Allocation above Guide Rock. Nebraska and Kansas each offered proposals to resolve the issue but could not reach agreement on a solution. Due to the infrequent occurrence of Flood Flows, the RRCA deferred resolution of the matter to a future date necessitated by and preceding impact to Nebraska's Table 5C compliance. The states wish to acknowledge and memorialize the issue to encourage work towards its resolution. As it stands, Attachment 6 calculates Virgin Water Supply Guide Rock to Hardy rather than Computed Water Supply Guide Rock to Hardy which would reduce Virgin Water Supply by the relevant Flood Flows as described in Section II. Definitions and Section III. Basic Formulas.

Year	Total Mainstem CWS	Hardy Gage	Superior Courtland Diversion Dam	Courtland Canal Diversions	Superior Canal Diversion	Courtland Canal Returns	Superior Canal Returns	Total Bostwick Returns Below Guide Rock	NE CBCU Below Guide Rock	KS CBCU Below Ruide Rock	Total CBCU Below Guide Rock	Gain Guide Rock to Hardy	VWS Guide Rock to Hardy	Mainstem VWS Above Guide Rock	NE MS Allocation Above Guide Rock	KS MS Allocation Above Guide Rock	Nebraska Guide Rock to Hardy Allocation	Kansas Guide Rock to Hardy Allocation
2022	160,360	69,608	32,213	73,224	9,827	15,494	6,460	21,954	2,870	661	3,531	15,441	18,972	141,388	69,139	72,249	9,277	9,695

COURTLAND CANAL					
	2018	2019	2020	2021	2022
Return Flow From Courtland Canal To Republican River Above Lovewell From Kansas	608	761	536	912	835
Return Flow From Courtland Canal To Republican River Above Hardy From Nebraska	4,706	3,519	6,791	9,625	14,659
Courtland Canal Diversions At Headgate	46,704	55,120	44,380	73,224	74,964
Courtland Canal At Kansas-Nebraska State Line	40,559	50,721	35,756	60,776	55,667
NE Courtland Canal CBCU (includes transportation loss)	405	108	342	711	1,420
Superior Canal CBCU	2,744	1,433	2,046	3,076	3,367

NEBRASKA					
	2018	2019	2020	2021	2022
SW Diversions - Irrigation - Small Pumps - Nebraska Below Guide Rock	1,177	84	552	665	763
SW Diversions - M&I - Nebraska - Below Guide Rock	0	0	0	0	0
SW Non-Federal Reservoir Evaporation - Below Guide Rock	(9)	(6)	84	51	95
SW Return - Irrigation	294	21	138	166	191
SW Return - M&I	0	0	0	0	0
GW CBCU Nebraska Below Guide Rock	2,440	1,723	1,769	2,534	2,203

KANSAS					
	2018	2019	2020	2021	2022
SW CBCU - Irrigation - Small Pumps	518	148	565	667	598
SW CBCU - M&I	0	0	0	0	0
GW CBCU Kansas Below Guide Rock	47	49	51	56	63

2022

Attachment 7: Calculations of Return Flows from Bureau of Reclamation Canals

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10	Col 11	Col 12
Canal	Canal Diversion	Spill to Waste-Way	Net Diversion	Field Deliveries	Canal Loss	Average Field Loss Factor	Field Loss	Total Loss from District	Percent Field and Canal Loss That Returns to the Stream	Total return to Stream from Canal and Field Loss	Return as Percent of Canal Diversion
Name Canal	Headgate Diversion	Sum of measured spills to river	Col 2 - Col 3	Sum of Deliveries to the field	Col 4 - Col 5	1 -Weighted Average Efficiency of Application System for the District*	Col 5 x Col 7	Col 6 + Col 8	Estimated Percent Loss*	Col 9 x Col 10 + Col 3	Col 11/Col 2
Σ Irrigation Season											
Σ Non- Irrigation Season											
Culbertson	3,575	0	3,575	23	3,552	30%	7	3,559	82%	2,918	82%
	213	0	213	0	213	30%	0	213	92%	196	92.0%
Culbertson Extension	0	0	0	0	0	30%	0	0	82%	0	100%
	0	0	0	0	0	30%	0	0	92%	0	100.0%
Meeker - Driftwood	21,898	2,740	19,158	8,381	10,777	30%	2,514	13,291	82%	13,639	62.3%
	0	0	0	0	0	30%	0	0	92%	0	100.0%
Red Willow	5,451	389	5,062	1,699	3,363	30%	510	3,873	82%	3,565	65.4%
	0	0	0	0	0	30%	0	0	92%	0	100.0%
Bartley	6,640	355	6,285	2,735	3,550	30%	821	4,371	82%	3,939	59.3%
	0	0	0	0	0	30%	0	0	92%	0	100.0%
Cambridge	26,873	1,188	25,685	12,715	12,970	30%	3,815	16,785	82%	14,951	55.6%
	0	0	0	0	0	30%	0	0	92%	0	100.0%
Naponee	1,288	355	933	383	550	35%	134	684	82%	916	71.1%
	0	0	0	0	0	35%	0	0	92%	0	100.0%
Franklin	24,542	2,299	22,243	7,468	14,775	35%	2,614	17,389	82%	16,558	67.5%
	0	0	0	0	0	35%	0	0	92%	0	100.0%
Franklin Pump	1,739	415	1,324	816	508	35%	286	794	82%	1,066	61.3%
	0	0	0	0	0	35%	0	0	92%	0	100.0%
Almena	2,542	0	2,542	915	1,627	30%	275	1,902	82%	1,559	61.3%
Superior	9,827	1,224	8,603	3,214	5,389	31%	996	6,385	82%	6,460	65.7%
	0	0	0	0	0	31%	0	0	92%	0	100.0%
Nebraska Courtland	2,007	0	2,007	1,677	330	23%	386	716	82%	587	29.2%
Courtland Canal Above Lovewell (KS)	22,667	1,453	21,214	10,725	10,489	23%	2,467	12,956	82%	12,077	53.3%
Courtland Canal Below Lovewell	36,666	4,095	32,571	24,228	8,343	23%	5,572	13,915	82%	15,506	42.3%

* The average field efficiencies for each district and percent loss that returns to the stream may be reviewed and, if necessary, changed by the RRCA to improve the accuracy of the estimates.

Attachment 8: Calculations of the Computed Water Supply Adjustment and Remaining Compact Compliance Volume for implementation of 2016 RRCA Resolution

	CCV and RCCV Tracking[a]												APV and RWS						RCCV Calc
	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11	Col. 12	Colorado		Nebraska				
Year	Start of Year RCCV	RCCV Adjustment	CCV	CCV Inflow Into HCL	RCCV Inflow Into HCL	Total CCV and RCCV Inflow Into HCL	Total CCV and RCCV Available for Release	CCV Released from HCL as Flow	CCV Released from HCL as Evaporation	CCV Retained in HCL (at End of Year)	CWSA	End of Year RCCV	Aug. Pumping Volume (APV)	Resolution Water Supply Credit (CORWS)	Aug. Pumping Volume (APV) Rock Creek That Passed Sub-basin Gage in the Current Year	Aug. Pumping Volume (APV) N-CORPE That Passed Sub-basin Gage in the Current Year	Resolution Water Supply Credit (NERWS)	Extra CCV Efforts Above CCV (Use with RCCV Calc)
	=Col 12 of previous year	b	c			= Col. 4 + Col. 5	=Col. 6 + Col. 10 of previous year			= Col. 7 – (Col. 8 + Col. 9)	=Col. 10 – Col. 10 of previous year	= Col. 1 – Col. 2 + Col. 3 - Col. 6[d]						
2007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15,766	0	15,766	0
2014	0	0	0	0	0	0	0	0	0	0	0	0	7,448	7,448	19,397	42,758	62,155	0
2015	0	0	0	8332	0	8332	8332	0	0	8332	8332	0	10,760	10,760	1,098	25,932	18,698	8332
2016	0	0	41,935	24752	0	24752	33084	5084	4321	23679	15347	9,300	10,130	10,130	499	22,803	41,935	449
2017	9300	0	20,000	20,000	0	20000	43679	20000	2241	21438	-2241	9,300	11,330	11,330	4,563	11,106	20,000	0
2018	9300	0	0	0	0	0	21438	0	1339	20099	-1339	9,300	13,578	13,578	0	0	0	0
2019	9300	0	0	0	0	0	20099	0	2340	17759	-2340	9,300	8,905	8,905	0	0	0	0
2020	9300	1860	0	0	0	0	17759	0	3889	13870	-3889	7,440	6,218	6,218	0	0	0	0
2021	7,440	1860	0	0	0	0	13870	0	1550	12320	-1550	5,580	9,390	9,390	0	0	0	0
2022	5,580	1860	0	0	0	0	12320	0	4354	7966	-4354	3,720	8,501	8,501	0	0	0	0

a. Calculations for RCCV, CWSA, & RWS don't start until Oct. 1, 2015

b. See Provision 10 of the RRCA Resolution signed August 24, 2016, titled “Resolution Approving Long-Term Agreement Related to the Operation of Harlan County Lake for Compact Call Years” for the terms of assigning RCCV Adjustment. The RCCV Adjustment for each year is equal to 20% of the unadjusted portion of the RCCV, if it is a non-Compact Call Year, plus any remaining volumetric reductions from the previous four years.

c. In years when the contributions from Nebraska’s water management activities, consistent with the 2016 CCY HCL Operations Resolution, are greater than CCV and the NERWS is equal to the greater contribution volume, CCV in Column 3 should also be set equal to the contribution.

d. The formula for calculation of RCCV is based on calendar year operations and will vary when operations occur in a different calendar year than NERWS Credit is applied.

Flood Flow Calculations Based on Accounting Procedures III.B.1 and Attachment 1.

Hardy Gage Monthly Data (acre-feet)					
	2018	2019	2020	2021	2022
January	4,619	13,289	55,339	7,475	8,005
February	5,521	6,875	33,332	7,332	7,615
March	7,386	61,131	33,775	28,746	9,074
April	3,658	21,669	23,421	20,400	6,592
May	2,309	66,000	31,732	25,198	4,958
June	7,601	69,761	10,810	14,672	3,981
July	3,805	118,015	30,811	8,141	18,172
August	5,065	82,834	8,337	8,550	3,666
September	23,848	30,188	3,488	3,034	2,326
October	17,603	21,527	4,298	2,535	1,624
November	9,231	59,330	7,632	7,470	1,775
December	20,216	75,757	8,265	8,600	1,815
ANNUAL	110,862	626,376	251,239	142,153	69,603
Over 400K	0	226,376	0	0	0

Sub-basin Flows Above Attachment 1 Flood Flow Thresholds					
	2018	2019	2020	2021	2022
North Fork	0	0	0	0	0
Arikaree	0	0	0	0	0
Buffalo	0	0	0	0	0
Rock	0	0	0	0	0
South Fork	0	0	0	0	0
Frenchman	0	0	0	0	0
Driftwood	0	0	0	0	0
Red Willow	0	0	0	0	0
Medicine Creek	0	0	0	0	0
Beaver	0	0	0	0	0
Sappa	0	15,988	0	0	0
Prairie Dog	0	25,260	0	0	0
Sub-basin Sum	0	41,248	0	0	0

5-month Consecutive Period Flows (acre-feet)					
	2018	2019	2020	2021	2022
Jan-May	23,494	168,964	177,598	89,151	36,244
Feb-Jun	26,475	225,436	133,069	96,348	32,220
Mar-Jul	24,760	336,576	130,548	97,157	42,777
Apr-Aug	22,438	358,279	105,110	76,961	37,369
May-Sep	42,628	366,798	85,177	59,595	33,103
Jun-Oct	57,922	322,325	57,743	36,932	29,769
Jul-Nov	59,552	311,894	54,566	29,730	27,563
Aug-Dec	75,962	269,636	32,020	30,189	11,206

5-month Consecutive Period Test					
	2018	2019	2020	2021	2022
Jan-May	0	0	0	0	0
Feb-Jun	0	0	0	0	0
Mar-Jul	0	1	0	0	0
Apr-Aug	0	1	0	0	0
May-Sep	0	1	0	0	0
Jun-Oct	0	0	0	0	0
Jul-Nov	0	0	0	0	0
Aug-Dec	0	0	0	0	0
TOTAL	0	3	0	0	0

2-month Consecutive Period Flows (acre-feet)					
	2018	2019	2020	2021	2022
Jan-Feb	10,140	20,164	88,671	14,807	15,620
Feb-Mar	12,907	68,006	67,107	36,078	16,689
Mar-Apr	11,045	82,800	57,195	49,146	15,666
Apr-May	5,967	87,669	55,152	45,598	11,550
May-Jun	9,910	135,761	42,541	39,870	8,939
Jun-Jul	11,406	187,776	41,621	22,813	22,153
Jul-Aug	8,870	200,849	39,148	16,691	21,838
Aug-Sep	28,912	113,022	11,825	11,584	5,992
Sep-Oct	41,451	51,715	7,786	5,569	3,950
Oct-Nov	26,834	80,857	11,930	10,005	3,399
Nov-Dec	29,447	135,087	15,898	16,070	3,590

2-month Consecutive Period Test					
	2018	2019	2020	2021	2022
Jan-Feb	0	0	0	0	0
Feb-Mar	0	0	0	0	0
Mar-Apr	0	0	0	0	0
Apr-May	0	0	0	0	0
May-Jun	0	0	0	0	0
Jun-Jul	0	0	0	0	0
Jul-Aug	0	1	0	0	0
Aug-Sep	0	0	0	0	0
Sep-Oct	0	0	0	0	0
Oct-Nov	0	0	0	0	0
Nov-Dec	0	0	0	0	0
TOTAL	0	1	0	0	0

Final Sub-basin Flood Flows					
	2018	2019	2020	2021	2022
North Fork Flood Flow	0	0	0	0	0
Arikaree Flood Flow	0	0	0	0	0
Buffalo Flood Flow	0	0	0	0	0
Rock Flood Flow	0	0	0	0	0
Southfork Flood Flow	0	0	0	0	0
Frenchman Flood Flow	0	0	0	0	0
Driftwood Flood Flow	0	0	0	0	0
Red Willow Flood Flow	0	0	0	0	0
Medicine Creek Flood Flow	0	0	0	0	0
Beaver Flood Flow	0	0	0	0	0
Sappa Flood Flow	0	15988	0	0	0
Prairie Dog Flood Flow	0	25260	0	0	0
Mainstem Flood Flow	0	185128	0	0	0

Combined Test					
	2018	2019	2020	2021	2022
FINAL TOTAL	0	4	0	0	0

NEBRASKA
Good Life. Great Water.
DEPT. OF NATURAL RESOURCES

Pete Ricketts, Governor

Date: 1/12/2023

To: RRCA EC Representatives - Ivan Franco, Colorado, and Chris Beightel, Kansas

From: Kari Burgert, Nebraska RRCA EC representative

Subject: Report on error in the 2021 NCORPE augmentation project pumping data

Summary

The purpose of this document is to inform the Engineering Committee of an issue in the 2021 NCORPE well pumping volumes that were included in the 2021 RRCA Groundwater Model and 2021 Accounting and to initiate correction. Over 36,000 acre-feet of NCORPE pumping were erroneously reported by Nebraska for 2021. The lagged impacts from this pumping error will continue to affect future CBCU calculations. Nebraska recommends the Engineering Committee discuss and propose a solution to the RRCA at the 2023 Annual Meeting.

2021 NCORPE Data Error and Impacts on Accounting

On December 16, 2022, Nebraska Department of Natural Resources (NeDNR) received confirmation that the NCORPE augmentation project pumping data reported to the RRCA for 2021 is incorrect. The following table displays originally reported and correct total 2021 pumping for each well. The spreadsheet titled *2021Aug_NcorpeCorrect.*xlsx has the correct 2021 monthly pumping for each well.

Well	Model Row	Model Column	Original (acre-feet)	Correct (acre-feet)
W132	**18**	**161**	1.05	0.00
W133	**19**	**160**	357.79	0.00
W134	**19**	**161**	0.28	0.00
W143	**19**	**159**	168.81	0.00
W144	**19**	**160**	0.00	0.00
W154	**19**	**159**	21.56	0.00
W161	**18**	**163**	0.01	0.00
W163	**19**	**163**	335.74	475.62

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Well	Model Row	Model Column	Original (acre-feet)	Correct (acre-feet)
W164	**19**	**164**	11.79	649.99
W171	**18**	**162**	79.75	4.74
W172	**18**	**163**	3.10	0.00
W173	**19**	**162**	109.10	0.00
W174	**19**	**163**	13.57	0.00
W181	**18**	**161**	0.00	0.00
W182	**18**	**162**	376.80	0.00
W183	**19**	**161**	289.90	0.00
W184	**19**	**162**	0.00	0.00
W191	**19**	**161**	6,588.47	531.07
W192	**19**	**162**	0.11	0.00
W201	**19**	**162**	19.65	0.00
W202	**19**	**163**	0.01	0.00
W211	**19**	**163**	0.31	0.00
W212	**19**	**164**	14,811.44	0.00
W213	**20**	**163**	7,827.75	599.37
W222	**19**	**159**	7,189.49	0.00
W231	**19**	**159**	18.52	0.00
W232	**19**	**160**	0.58	0.00
W241	**19**	**160**	209.25	3.85
W242	**19**	**161**	1.86	0.00
W281	**20**	**163**	1.53	0.00
		2021 Total	38,438.22	2,264.63

In total, approximately 36,174 acre-feet of pumping was over-reported for the NCORPE wells for 2021.

We corrected the 2021 NCORPE pumping and re-ran the RRCA Groundwater Model to obtain the 2021 Impacts in acre-feet shown in the following table. There were no differences in the 2021 Impacts with the corrected NCORPE pumping.

2021	Colorado		Kansas		Nebraska		Mound	
Location	**Original**	**Corrected**	**Original**	**Corrected**	**Original**	**Corrected**	**Original**	**Corrected**
Arikaree	1,443	1,443	115	115	110	110	0	0
Beaver	0	0	5,163	5,163	3,228	3,228	0	0
Buffalo	437	437	0	0	3,569	3,569	0	0
Driftwood	0	0	0	0	828	828	0	0
Frenchman	183	183	0	0	74,743	74,743	0	0
North Fork	17,951	17,951	0	0	1,272	1,272	0	0
Above Swanson	-3,856	-3,856	34	34	6,209	6,209	0	0
Swanson - Harlan	0	0	-470	-470	29,183	29,183	9,921	9,921
Harlan - Guide Rock	0	0	0	0	26,527	26,527	742	742
Guide Rock - Hardy	0	0	56	56	2,534	2,534	-14	-14
Medicine	0	0	0	0	20,219	20,219	10,693	10,693
Prairie Dog	0	0	2,164	2,164	0	0	0	0
Red Willow	0	0	0	0	6,670	6,670	49	49
Rock	82	82	0	0	5,113	5,113	0	0
Sappa	0	0	1,241	1,241	1,560	1,560	29	29
South Fork	12,250	12,250	5,155	5,155	774	774	0	0
Hugh Butler	0	0	0	0	2,192	2,192	0	0
Bonny	1,514	1,514	21	21	0	0	0	0
Keith Sebelius	0	0	560	560	0	0	0	0
Enders	17	17	0	0	5,179	5,179	0	0
Harlan	0	0	83	83	730	730	36	36
Harry Strunk	0	0	0	0	343	343	0	0
Swanson	17	17	0	0	302	302	0	0
Mainstem	-3,866	-3,866	-371	-371	64,452	64,452	10,649	10,649
Total	30,029	30,029	14,137	14,137	191,284	191,284	21,471	21,471

Using Willem's January 2, 2023, groundwater model update and carrying the resulting 2021 heads from the corrected run forward to the 2022 and 2023 model projections, we obtain 2022 and 2023 CBCU shown in the following tables. Impact differences are in bold italics.

2022	Colorado		Kansas		Nebraska		Mound	
Location	**Original**	**Corrected**	**Original**	**Corrected**	**Original**	**Corrected**	**Original**	**Corrected**
Arikaree	728	728	128	128	122	122	0	0
Beaver	0	0	3,406	3,406	1,863	1,863	0	0
Buffalo	391	391	0	0	3,525	3,525	0	0
Driftwood	0	0	0	0	816	816	0	0
Frenchman	174	174	0	0	71,053	71,053	0	0
North Fork	17,977	17,977	0	0	1,288	1,288	0	0
Above Swanson	-5,509	-5,509	52	52	4,275	4,275	0	0
Swanson - Harlan	0	0	-458	-458	11,095	11,095	6,113	6,113
Harlan - Guide Rock	0	0	0	0	26,024	26,024	701	701
Guide Rock - Hardy	0	0	62	62	2,272	2,272	-19	-19
Medicine	0	0	0	0	19,248	19,247	***9,490***	***9,492***
Prairie Dog	0	0	872	872	0	0	0	0
Red Willow	0	0	0	0	5,429	5,429	26	26
Rock	88	88	0	0	5,012	5,012	0	0
Sappa	0	0	128	128	1,013	1,013	13	13
South Fork	10,755	10,755	4,369	4,369	811	811	0	0
Hugh Butler	0	0	0	0	2,270	2,270	0	0
Bonny	1,542	1,542	22	22	0	0	0	0
Keith Sebelius	0	0	580	580	0	0	0	0
Enders	18	18	0	0	5,265	5,265	0	0
Harlan	0	0	66	66	727	727	38	38
Harry Strunk	0	0	0	0	351	351	0	0
Swanson	16	16	0	0	296	296	0	0
Mainstem	-5,516	-5,516	-335	-335	43,666	43,666	6,795	6,795
Total	26,173	26,173	9,241	9,241	162,755	1627,55	***16,376***	***16,378***

2023	Colorado		Kansas		Nebraska		Mound	
Location	**Original**	**Corrected**	**Original**	**Corrected**	**Original**	**Corrected**	**Original**	**Corrected**
Arikaree	976	976	175	175	135	135	0	0
Beaver	0	0	3,131	3,131	1,455	1,455	0	0
Buffalo	386	386	0	0	3,559	3,559	0	0
Driftwood	0	0	0	0	817	817	0	0
Frenchman	164	164	0	0	76,768	76,768	0	0
North Fork	18,588	18,588	0	0	1,320	1,320	0	0
Above Swanson	-2,102	-2,102	0	0	8,324	8,324	0	0
Swanson - Harlan	0	0	-1,350	-1,350	21,565	21,565	6,697	6,697
Harlan - Guide Rock	0	0	0	0	26,563	26,563	745	745
Guide Rock - Hardy	0	0	66	66	2,522	2,522	-16	-16
Medicine	0	0	0	0	***21,491***	***21,486***	***10,888***	***10,910***
Prairie Dog	0	0	1,369	1,369	0	0	0	0
Red Willow	0	0	0	0	6,816	6,816	37	37
Rock	94	94	0	0	5,057	5,057	0	0
Sappa	0	0	-350	-350	872	872	0	0
South Fork	12,499	12,499	5,801	5,801	856	856	0	0
Hugh Butler	0	0	0	0	2,334	2,334	0	0
Bonny	1,568	1,568	23	23	0	0	0	0
Keith Sebelius	0	0	596	596	0	0	0	0
Enders	20	20	0	0	5,342	5,342	0	0
Harlan	0	0	60	60	728	728	40	40
Harry Strunk	0	0	0	0	351	351	0	0
Swanson	21	21	0	0	298	298	0	0
Mainstem	-2,106	-2,106	-1,275	-1,275	58,974	58,974	7,425	7,425
Total	32,210	32,210	9,537	9,537	***187,173***	***187,169***	***18,405***	***18,427***

Since Willem's January 2, 2023, groundwater model update used 2021 pumping files for 2022 and 2023 impacts runs, we ran additional 2022 and 2023 runs that have the 2021 heads from the corrected 2021 and the corrected 2021 pumping repeated. As expected, there was no difference in the 2022 Impacts and a 2 acre-feet difference in 2023 Mound Impacts with the corrected starting heads and approved or corrected 2021 pumping repeated.

The following table summarizes the change in total CBCU by year in acre-feet from correcting the 2021 NCORPE pumping in the 2021 run and carrying the corrected heads forward to the 2022 and 2023 runs.

Impact difference in acre-feet	2021	2022	2023
Colorado	0	0	0
Kansas	0	0	0
Nebraska	0	0	-4
Mound	0	2	22

The two attached accounting spreadsheets are a draft 2023 Accounting spreadsheet with the original model impacts (from the uncorrected runs) and that accounting spreadsheet updated with the impacts from the corrected runs to show the difference in 2022 and 2023 Accounting balances that result from the correction.

Discussion

As shown above, the correction of NCORPE pumping has no effect on the Impacts from the RRCA Groundwater Model for 2021. Due to the location of the NCORPE wells, there is a lag from the time of pumping to the impacts to streamflow, which we expect to peak in future years. In addition, the pumping from these wells primarily impact the Medicine Creek subbasin. With the current model runs, the impacts to the Mound begin in 2022. Nebraska's CBCU begins to change in 2023. Since the CBCU decrease is to the Medicine Creek subbasin, allocation of that subbasin is reduced which does not affect Colorado's balances and slightly decreases Kansas's balance in 2023. Nebraska's allocation is also decreased but the reduction in Nebraska's CBCU and increase in Imported Water Supply credit increases Nebraska's balances.

Nebraska recommends that the Engineering Committee recognize this error and take action to correct it to continue to use the best available data. There are two general courses of action that Nebraska would propose:

1. Revise the 2021 Model with the correct data inputs
2. Establish a new 2022 starting head condition for the model based on the corrected model output (this approach would be similar to the approach used to correct erroneous PRISM data that was identified after the 2019 data was approved by the RRCA)

Since there are no changes to any approved Accounting, option 1 would allow for correction of the error while keeping the post-2020 runs continuous. Whereas, option 2 would allow correction of the error with no revisions to any approved 2021 datasets, but would create an additional discontinuity for the model starting heads.

Nebraska recommends the Engineering Committee discuss and propose a solution to the RRCA at the 2023 Annual Meeting.

Attachments: 2021Aug_NcorpeCorrect.xlsx,
20230103_RRCAAccounting_EarlyDraft2023_NoCorrection.xlsx,
20230103_RRCAAccounting_EarlyDraft2023_Correction.xlsx