Engineering Presentation

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General Terms

- Republican River Water Conservation District (RRWCD)
- Republican River Compact Administration (RRCA)
- Computed Beneficial Consumptive Use (CBCU)
- Consumptive Use (CU)
- Compact Compliance Pipeline (CCP)
- RRCA Groundwater Model (GW Model)
  - Model used to calculate the CBCU.
- South Fork Focus Zone (SFFZ)

Topics Covered

- Total CBCU versus Colorado's allocation
- Historical Irrigation Pumping in Colorado
- Groundwater impacts of the CBCU
- Anticipated results should conditions remain the same for the next 10 years
- Retirement of 25,000 acres within the South Fork Focus Zone
- Impact of Colorado being out of compliance with the Compact
- Recommend actions by priority to reduce the CBCU or increase Colorado's Allocation

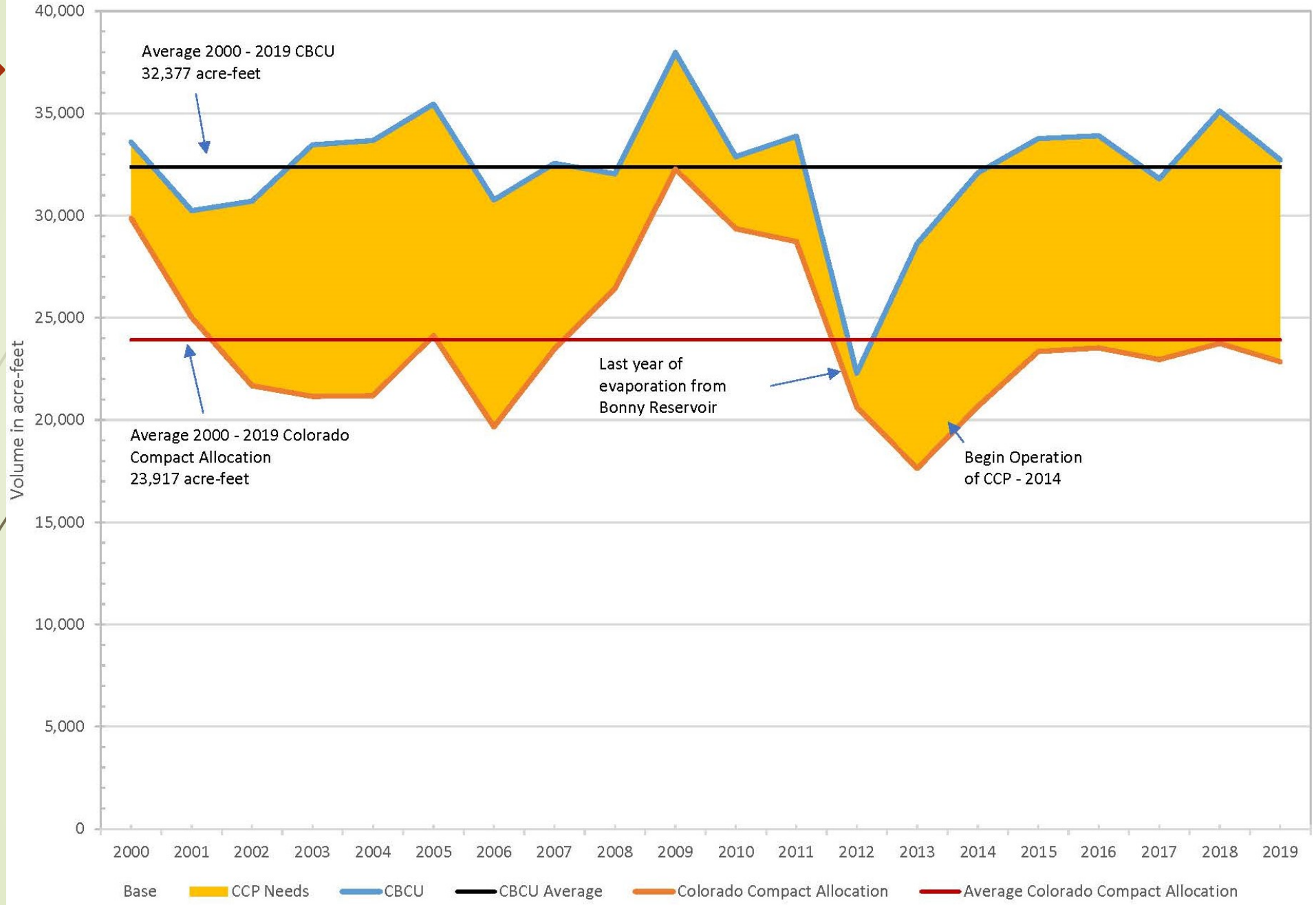
Total CBCU versus Colorado's Allocation

- CBCU is compared to Colorado's Compact allocation annually.
- CBCU includes groundwater CU, surface water CU, small reservoir evaporation, and Bonny Reservoir seepage and evaporation.
- Groundwater CU is determined by the GW Model.
- Surface water CU is calculated as 60% of the recorded diversions.
- Small reservoir evaporation is calculated by multiplying the reservoir surface area by the net evaporation from the nearest climate station.
- Bonny Reservoir seepage was derived from the GW Model.
- Bonny Reservoir evaporation was obtained from Federal reservoir data during the period of operation.
- CBCU (Stream impacts) are calculated by the GW model and applied through the RRCA Accounting.
- Colorado's 2000 to 2019 average CBCU was 32,377 acre-feet.

Total CBCU versus Colorado's Allocation

- Colorado's Compact Allocation is based on virgin flows within the North Fork, South Fork and Arikaree.
- 2000 to 2019 Average Allocations:
  - North Fork: 9,252 acre-feet
  - Arikaree: 2,225 acre-feet
  - South Fork: 11,157 acre-feet
  - Total: 22,634 acre-feet without Beaver Creek
  - Total: 23,917 acre-feet with Beaver Creek
- Beaver Creek
  - During a water short year Beaver Creek provides no or limited allocation to Colorado.
  - From 2000 to 2019 there were 5 years Colorado received no Beaver Creek allocation when the year was deemed to be a water short year.
  - There were 6 years when Colorado received a reduced Beaver Creek allocation.
  - In those 15 years Colorado received an allocation the average allocation from Beaver Creek was 1,711 acre-feet.
  - Average allocation from Beaver Creek from 2000 to 2019 including water short years was 1,283 acre-feet.

Figure 1 - Total Computed Beneficial CU versus Colorado Allocation - 2000 to 2019

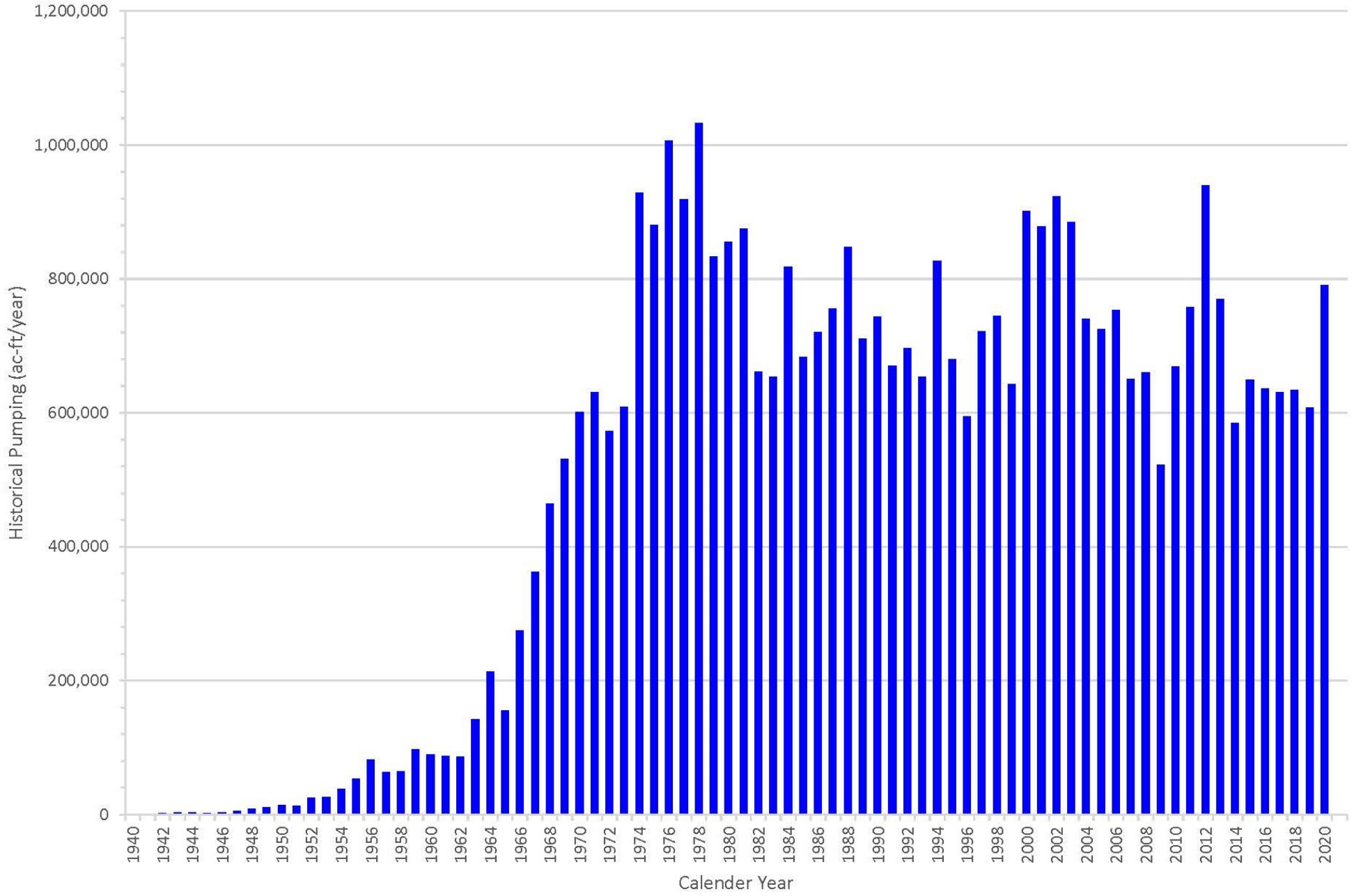


Historical Irrigation Pumping in Colorado

- Period 1940 to 1999
  - Average Pumping = 425,142 acre-feet
  - Maximum Pumping = 1,032,720 acre-feet (1978)
- Period 1940 to 2020
  - Average Pumping = 504,019 acre-feet
  - Maximum Pumping = 1,032,720 acre-feet (1978)
- Period 2000 to 2020
  - Average Pumping = 729,379 acre-feet
  - Maximum Pumping = 940,016 acre-feet (2012)
  - Minimum Pumping = 522,678 acre-feet (2009)

Figure 2 - Historical Irrigation Pumping in Colorado

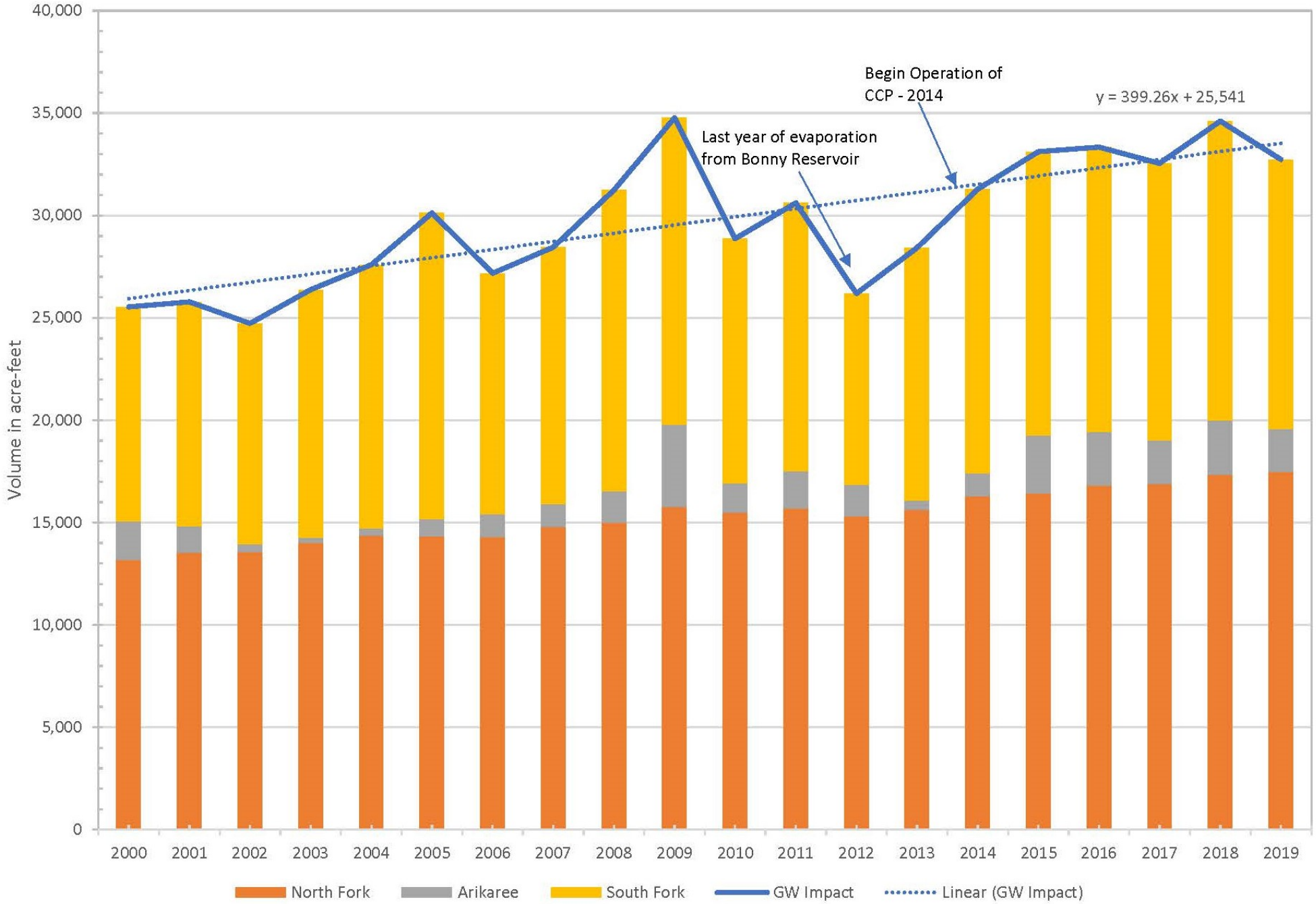
within RRCA Model Domain



Groundwater Impacts of the CBCU

- Colorado CBCU from 2000 to 2019 (Blue solid line)
- Based on the trend from 2000 to 2019 CBCU has increased by 399.26 acre-feet every year. (Blue dotted line)
- Stacked bars represent the three areas as part of the CCP April 2021 Projection: North Fork, Arikaree, and South Fork
  - Orange: North Fork
    - Shows a steady increase as a component of the groundwater CU, part of this increase is a result of operation of the CCP
  - Grey: Arikaree
    - Slight increasing trend to the groundwater CU
  - Yellow: South Fork
    - Increasing trend to the groundwater CU

Figure 3 - Total Groundwater Impacts to CBCU - 2000 to 2019



Anticipated results should conditions remain the same for the next 10 years

- Some farmers would likely stop using their wells due to the wells' static water levels and reduced saturated thickness.
- This is especially true in the W-Y and Plains districts where the water level is decreasing at a rate of approximately 10 feet per year. This reduces the saturated thickness for the well to draw upon.
- Any depletions caused by the wells before the wells stop pumping will still impact the stream in the future and will be included in the groundwater CU component of the CBCU from the GW Model.
- Finally, the CBCU would likely increase from an average of 32,377 acre-feet (2000 to 2019)to approximately 37,500 acre-feet (estimated using trendline in preceding figure 399.26 acre-feet per year * 30 years + 25,541 acre-feet = 37,519 acre-feet). This assumes the 20 years from Figure 3 plus an additional 10 years.
- If future annual allocations are similar to the approximate average allocation of 23,917 acre-feet, then the difference of 13,602 acre-feet will need to be made up by the CCP.

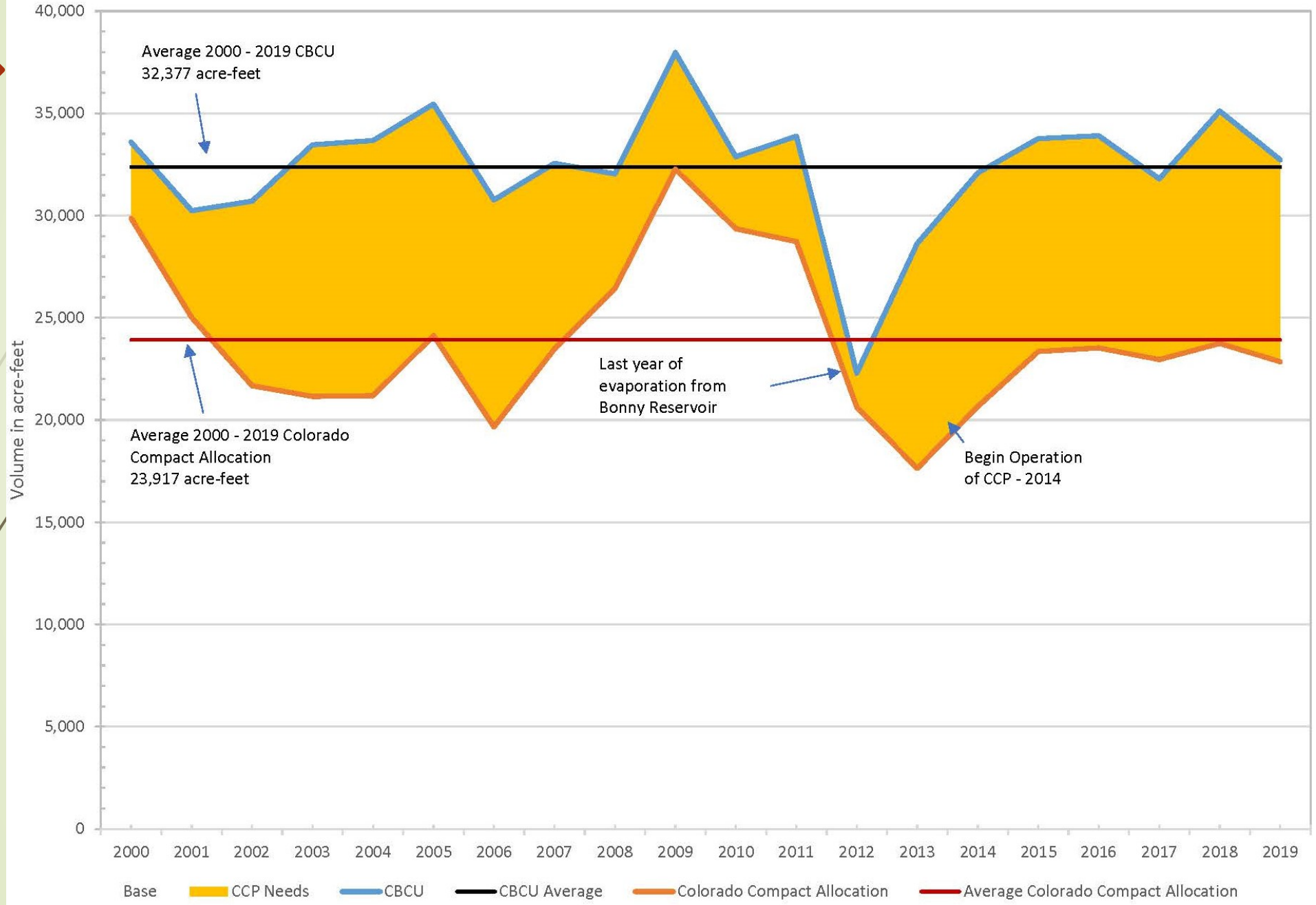
Retirement of 25,000 acres within the South Fork Focus Zone

- Retirement of 25,000 acres within the SFFZ
  - 2,500 acres have been retired per the State Engineer's April 13, 2021, letter.
  - The retirement of 10,000 acres is expected to be accomplished by December 31, 2024, as noted in the State Engineer's Letter mentioned above.
  - The retirement of 25,000 acres is expected to be accomplished by December 31, 2029, as noted in the State Engineer's Letter mentioned above.
  - This is estimated to have a reduction of pumping by 25,949 acre-feet (25,000 acres x 1.04 acre-feet per acre).
- Potential impact if 10,000-acre and 25,000-acre thresholds are not met.
  - Colorado is at risk of being out of compliance with the Compact.
  - Kansas could revoke approval of the CCP and sue Colorado should Colorado be out of compliance with the Compact.

Impact of Colorado being out of compliance with the Compact

- If Colorado is out of compliance with the Compact, Colorado will be subject to a lawsuit by Kansas and Nebraska where all outcomes have significant negative economic impacts for those within the RRWCD.
- Possible outcomes of the lawsuit
  - Colorado be required to curtail SIGNIFICANT or ALL use Basin wide.
  - A river master could be appointed by the Supreme Court. This person would have the authority to shut down all the wells within the basin and stop all surface diversions to get Colorado into compliance.
  - Colorado would be required to continue to find ways to come into and remain in compliance.

Figure 1 - Total Computed Beneficial CU versus Colorado Allocation - 2000 to 2019



Recommend actions by priority to reduce the CBCU or increase Colorado's Allocation

- Priority No. 1 - Retirement of any water rights deemed a surface water diversion in the accounting
  - This reduces the Surface water component of the CBCU by 60% of that rights diversions
  - The District has made significant progress on this priority especially on the South Fork
  - There are still a limited number of surface water rights still available in the North Fork, South Fork and Arikaree
- Priority No. 2 - Buy alluvial wells in the SFFZ and retire the acres.
  - This will eventually reduce the Groundwater impact of the South Fork
  - Add acres to meet the 10,000 acres of retirement by 2024 and 25,000 acres of retirement by 2029.
  - If all alluvial wells in the SFFZ are retired this would result in approximately 3,037 acres and 3,702 acre-feet of pumping.

Recommend actions by priority to reduce the CBCU or increase Colorado's Allocation

- Priority No. 3 - Buy non-alluvial wells in the SFFZ and retire the acres.
  - This will eventually reduce the Groundwater impact of the South Fork
  - Add acres to meet the 10,000 acres of retirement by 2024 and 25,000 acres of retirement by 2029.
  - If 25,000 acres of non-alluvial wells in the SFFZ are retired this would result in approximately 25,949 acre-feet of pumping removed from the GW Model.
- Priority No. 4 - Buy alluvial wells along the Arikaree and retire the acres.
  - This will eventually reduce the Groundwater impact of the Arikaree
  - A live stream on the Arikaree would always be beneficial as it would increase allocation.
  - If all alluvial wells along the Arikaree are retired this would result in approximately 3,293 acres and 3,359 acre-feet of pumping.

Recommend actions by priority to reduce the CBCU or increase Colorado's Allocation

- Priority No. 5 - Buy alluvial wells along the North Fork and retire the acres.
  - This will eventually reduce the Groundwater impact of the North Fork.
  - If all alluvial wells along the North Fork are retired this would result in approximately 300 acres and 255 average acre-feet of pumping.
- Priority No. 6 - Buy groundwater rights that could be included in the CCP
  - Added sources to the CCP to allow for greater pumping from the CCP to meet increased CBCU not met by Colorado's Compact allocation.
- Priority No. 7 - Buy groundwater rights that do not fall under Priorities 2 to 6.
  - The purchase of groundwater rights other than Priorities 2 to 6 will result in reducing the groundwater CU component of the CBCU from the GW Model.

Questions?