



Colorado River District

Protecting Western Colorado Water Since 1937

MEMORANDUM

12/31/2018

TO: BOARD OF DIRECTORS
ANDY MUELLER, GENERAL MANAGER
PETER FLEMING, GENERAL COUNSEL

FROM: JOHN CURRIER, P.E., CHIEF ENGINEER

SUBJECT: RISK STUDY PHASE III UPDATE

ACTION: *No Board Action Required – Update only*

STRATEGIC INITIATIVE(S):

4. C. The River District will continue to study mechanisms, such as a Compact Water Bank and Contingency Planning that include demand management, drought operations of CRSP reservoirs, and water supply augmentation to address the risk of overdevelopment.

6. A. The River District will continue to study the concept of a voluntary and compensated compact water bank in collaboration with other stakeholders to best preserve western Colorado agriculture.

This memorandum provides a brief review and status update on Phase III of the Risk Study. A more detailed report and initial findings will be available for presentation at the January meeting. In short, after a slow start Phase III is fully underway and the majority of the scoped work should be completed in Q1 of 2019.

Background and Scope Review

The purpose of Phase III of the Risk Study is to build on Phases I and II and continue to answer Colorado River system risk questions asked by the West Slope roundtables in the context of Colorado's Water Plan and the development of the IBCC Conceptual Framework. The Scope of Work (attached) includes four tasks which are very briefly paraphrased here:

Task 1: “Bookend” the risk of Lake Powell dropping below elevation 3525’ under two Upper Basin development scenarios: 1) today’s (2018) level of development, and 2) a future condition level of development defined by full use of the Programmatic Biological Opinion (PBO) allotments (or a proxy amount in basins that do not currently have a PBO) in Colorado plus an assumed amount of additional growth in other UD states. **The goal is to clearly quantify and portray the risk associated with a defined amount of additional development in Colorado.** (The study does not make any assumptions about the remaining legal entitlement of the UD states. The assumptions are simply for the purpose of helping to quantify risk at certain levels of

development). This will be done with and without implementation of Drought Contingency Plan (DCP) measures consisting of: 1) the proposed LB DCP, and 2) UB CRSP reservoir reoperations.

Task 2 – Refinements to Linked StateMod model for Compact Administration modeling:

This task will review the linked StateMod model provided by CWCB, and recommend and implement, as needed, updates to the model/database to better reflect intra-basin differences in administrative numbers and adjudication dates.

Initial work has been conducted to quantify the West Slope water rights with pre-compact appropriation dates but post-compact adjudication dates (water rights in which the appropriation date and adjudication date “straddle” the Compact date) and the estimated depletions associated with these rights. These “straddle rights” are summarized in this **DRAFT** table prepared by Hydros Consulting:

Table 1. Straddle Rights Summarized by Basin

<i>Basin</i>	Count of Straddle Rights	Sum of Straddle Right Decried Diversion Rates (cfs)
<i>Yampa</i>	285	1,276
<i>White</i>	118	667
<i>Upper Colorado</i>	208	2,414
<i>Gunnison</i>	472	4,401
<i>San Juan</i>	54	521

While the initial results are **DRAFT** and subject to refinement Hydros Consulting has estimated the average annual depletion under these rights at approximately 119,000 acre-feet.

A meeting with CWCB staff is set for January 3 to address some of the administrative issues with the linked Statemod model. Staff will update the Board at the January meeting. As we wish to be very transparent with all entities in the state, and work towards a common technical understanding, technical representatives from the Front Range Water Council will be involved in this meeting.

Task 3 – Evaluate Impacts of Increasing Levels of Post-Compact water right curtailment

In the unlikely need for mandatory curtailment for compact compliance, the purpose of task 3 is to determine which post-compact water rights would be curtailed under varying levels of annual consumptive use reduction and with several different hypothetical administrative protocols.

Task 4 – Evaluate 100,000 AF/Yr and 200,000 AF/ Yr contributions from the 4 UD states to a 1 MAF non-equalized demand management account. The purpose is to determine how much reduction in risk of Lake Powell dropping below El: 3525 is achieved by filling the non-equalized account at different rates.

Attachment: Risk Study Phase III Scope of Work

Risk Study, Phase III Scope of Work

Introduction

The purpose of Phase III of the Risk Study is to build on Phases I and II and continue to answer Colorado River system risk questions asked by the West Slope roundtables in the context of Colorado's Water Plan and the development of the IBCC Conceptual Framework. Most notably the Risk Study Phase III will continue to address the IBCC Conceptual Framework Summary Point No. 4 which states: *An insurance policy that protects against involuntary curtailment is needed for existing uses and some reasonable increment of future development in the Colorado River system, but will not cover a new TMD.*

This SOW is intended to demonstrate the general concepts of the matters to be analyzed under Phase III of the Risk Study. The actual work tasks assigned may differ than the specifics described herein. This SOW and the results of Phase III do, and will, contain numerous factual and legal assumptions. Nothing in this SOW or in the Phase III study should be interpreted as the adoption or endorsement of any such factual or legal assumptions by the State of Colorado, the Colorado River District, the Southwestern District, or any other entity.

Scope

Task 1 - Develop Baseline Information

The primary purpose of task 1 is to compare the risk of Lake Powell dropping below elevation 3525 under two Upper Basin development scenarios; 1) today's (2018) level of development, and 2) a future condition level of development defined by full use of the PBO allotments (or a proxy amount in basins that do not currently have a PBO) in Colorado plus defined additional growth in other UB states. The goal is to quantify and clearly portray the risk associated with a defined amount of additional development in Colorado.

The secondary purpose of task 1 is to quantify, for the two Upper Basin development scenarios described above, the reduction in risk of Lake Powell dropping below El: 3525 achieved by implementing drought contingency planning (DCP) measures consisting of; 1) the proposed LB DCP, and 2) UB CRSP reservoir reoperations. The goal is to quantify the remaining risk that can be further reduced by UB demand management (voluntary reduced consumptive use).

At least two different hydrologic assumptions will be used, the "stress test" period and the longer term record (from the CRWSAS). The CWCB, in releasing the "compact compliance" version of StateMod, implied that they had used a hydrology dataset other than the above historical data. If possible, we will obtain and use this third dataset. Compatibility of this dataset with CRSS will have to be determined and addressed when the data are obtained.

- A. Baseline Simulations: Today's (2018) situation – model current level of consumption within Colorado and the UB states:
 - 1. 2 CRSS runs
 - i. First, without implementation of DCPs.

- ii. Second, with implementation of DCPs (lower basin DCP and UB CRSP Reservoir drought operations).

These two CRSS runs would build on previous Risk Study runs and quantify the duration and frequency of Lake Powell dropping below 3525' under a no DCP scenario and a DCP scenario. A key difference from previous runs is that we are fixing the demands in CRSS to current levels. Previous CRSS runs utilized either 90%D1 or A demand schedules, which escalate over time.

We do not expect changes to in-state consumptive use due to implementation of the CRSP Drought Operations. Only Blue Mesa would be impacted by these operations within Colorado, and our working assumption thus far has been that there would be no change to existing consumptive uses due to those activities.

2. StateMod run outputs: In order to ensure the comparability between CRSS and StateMod, we will review the depletions modeled by CRSS above and compare to the baseline (current condition) StateMod model. The objective is to cross-validate the modeled depletions, and make model adjustments if necessary.
- B. Future Conditions – model future level of demand within Colorado as defined by full use of the existing or proposed PBO allotments where available (note – this would include additional depletions from the growth in demands/firming of existing TMDs). For the San Juan – Dolores basins an amount will be determined by the technical advisor for those basins. Similar consultation will occur in the White River basin. We will prepare summary tables of current and future demands with targeted users for new additional CU (e.g., ALP, full buildout of TMDs, etc.)
1. 2 CRSS runs
 - i. First, without implementation of DCPs.
 - ii. Second, with implementation of DCPs (lower basin DCP and UB CRSP Reservoir Re-operations).

These CRSS runs would provide a comparison to Task 1 (A) of the duration and frequency of Lake Powell dropping below 3525' under a no DCP scenario and a DCP scenario.

2. 1 State-mod runs:
 - i. with demands increased to PBO buildout levels and other projects

These state-mod runs would provide a comparison to Task 1 (A) and determine state line flows and flows at key nodes within every major Colorado River basin river basin tributary under the no DCP and DCP scenarios. Again, it is expected that these two scenarios would be very similar with the exception of occasional CRSP reservoir re-operations to deliver water to Powell and then the subsequent refill of those reservoirs.

- C. Data document: develop database and report outlining assumptions made in implementing PBO development limits in both CRSS and StateMod.

Task 2 – Refinements to Linked StateMod model for Compact Administration modeling

This task will review the linked StateMod model provided by CWCB, and recommend and implement as needed updates to the model/database to better reflect intra-basin differences in administrative numbers and adjudication dates. Items to be addressed include:

1. Quantify water rights with pre-compact appropriation date but post-compact administration dates.
 - a. Determine total number of rights and depletions associated with these rights
 - i. West slope wide
 - ii. Within individual basins
 - b. Compare and evaluate appropriation date compared to administrative date basin by basin to determine impact of varying general adjudication dates between basins.
 - i. (Note: this issue exists within the individual basins to some extent but has, for the most part, been dealt with since implementation of the 1969 Act)
2. Evaluate and devise mechanism for splitting and administering calls separately between in-basin water rights and trans-mountain water rights.
 - a. The issue is that StateMod has no mechanism for administering one set of water rights within a basin differently than the balance of the water rights within the basin.
3. Evaluate, understand and verify calculation of pre-compact depletions within StateMod.
 - a. Initial runs of the linked model suggest long-term average pre-compact depletions are ~1.5 MAF. This is contrary to the conventional understanding that pre-compact depletions are ~1.2 MAF.

Task 3 – Evaluate Impacts of Increasing Levels of Post-Compact water right curtailment

The purpose of task 3 is to determine which post-compact water rights would be curtailed under varying levels of annual consumptive use reduction and under several different hypothetical administrative protocols. The task would also determine how much additional water will be produced at the state line from each of the basins over several years.

It is anticipated that task 3 would be completed using the state's recently released linked StateMod model with the enhancements / edits from Task 2.

Levels of annual curtailment to be modeled are 50,000 AF, 100,000 AF, 200,000 AF, 300,000 AF, 400,000 AF, 500,000 AF and full curtailment of all post-compact rights. Initially, we will define post-compact as 1922, and will use the StateMod administrative record number as the basis for identifying water rights. Future simulations may modify those assumptions. Hydros will provide modeled call priorities for all CU in each basin, and identify/modify pre/post compact rights.

Hypothetical administrative protocols to be modeled for each level of annual curtailment include:

1. Priority administration on a basin-wide basis.
 - i. Water right priorities assumed to be based on administrative number.
2. Each Basin contributes an amount in the same proportion as that basin's depletions are to the total State-wide depletions.
 - i. Within each basin the contribution would then be made in order of priority.

For each of these assumptions, and for each volume defined above, we will develop an average call date that yields a given prescribed volume. These average call dates will be supplemented with dates for specific drought periods (2000-2003; 2013-2014; etc). The objective is to develop a general understanding of depth of call vs yield, but also evaluate how the call level may need to change under critically dry hydrology in order to achieve the same yield.

An additional administrative protocol will be modeled to help inform potential future demand management alternatives:

1. Assume that annual curtailment is split on a pro-rata basis between the East Slope and the West Slope (e.g. if the average annual trans-mountain diversion volume equals 50% of the total post-compact depletions then the TMDs would provide 50% of the annual curtailment volume).
 - a. Curtailment of West Slope post-compact water rights would be modeled under the two methodologies outlined in (1) and (2) above with the following modification to methodology (2).
 - i. Each Basin contributes an amount in the same proportion as that basin's West Slope depletions are to the total West Slope basin-wide depletions.
 - b. Curtailment of West Slope and trans-mountain water rights are assumed to occur on a priority basis within the respective pro rata allocations.

Simultaneous simulation of two different calls within StateMod is not possible, so we will need to figure out how to quantify the yields from TMDs vs in-basin consumptive uses. This may need to be evaluated on the basis of decreed rights or by utilizing a post-processing approach.

Additional basic assumptions for Task 3:

1. Assume pre-existing reservoir storage is not delivered downstream (but would likely be required to replace post compact direct flow rights that would be curtailed)
2. In addition to developing "average" yields for different priority calls, simulate yields during an assumed repeat of critical period droughts (e.g., 2000-2003, 2012-2014) and during wet years (2011, late 1990s)
3. Assume that vacant storage space cannot be refilled if the storage right would be out of priority under the curtailment scenario being modeled.

Outputs:

1. Look at differences in hydrology during and after call periods. What do flows look like during "rebound" when post-compact reservoirs are refilling? Is there a "buffer" needed before refilling begins? Example: if Powell deficit is 1.0maf, do we need to deliver 1.2 maf before recovery begins? This task may also involve CRSS simulations in order to understand rebound effects on CRSP reservoirs in other upper basin states.
2. Analysis of changes in state line flows and in-basin CU across different hydrology sequences (building off of phase II, but with attention to call and rebound periods)

- 3 Determine flows at the state line and at key nodes within every major Colorado River basin river basin tributary (San Juan, Dolores, Gunnison, Colorado, Yampa, and White). Key nodes will be determined with input from representatives from each basin.

Should budget allow, additional scenarios may be modelled, as appropriate, based on findings of the scoped model runs, and input from West Slope basin roundtable technical committee members.

Task 4 – Evaluate 100,000 AF/Yr and 200,000 AF/ Yr contributions from the 4 UB states to a 1 MAF non-equalized demand management account to compare the reduction in risk of Lake Powell dropping below EI: 3525 achieved under each annual rate of contribution to the account.

Assume Colorado contributes either 50,000 or 100,000 AF/year to the 1 MAF account.

Run CRSS scenarios using the “stress test” period and the longer term record (from the CRWSAS) to determine the relative risk to Lake Powell. Also use these model runs to evaluate how rapidly the demand management account storage can be recovered and how rapidly UB CRSP storage used for re-operations can be recovered. This task will explore percentage or pro-rata splits in voluntary demand management between east and west slope users. Details TBD later.

Task 5 - Outreach and Deliverables

Assume bi-weekly check in and progress report with River District and Southwestern staff.

Assume 6 webinars for basin-wide technical team members to report on progress and seek input.

Assume attendance and presentation at:

- Joint River District and Southwest board meeting
- CWCB staff
- West Slope 4 –basin Roundtable meeting
- East Slope joint Roundtable meeting

Deliverables:

- Interim and final power point presentation(s)
- Summary report clearly documenting the study procedures, assumptions, limitations and results.