Adapting to low Colorado River flows and low reservoir storage

David E. Rosenberg | July 16, 2022

As Colorado River flows and reservoir levels decline, users rely more on river flows than reservoir storage. This adaptation is difficult because it takes us outside our familiar zone. Over the past 2 years, I have explored ideas to manage the river based on flow and storage rather than just storage. I want to share lessons from 3 research projects that give me hope that we can manage a river that continues to offer low flow.

Live within our means

When reservoir storage declines, we live with what the river offers. Starting in Spring 2020, my colleague Jian Wang and I considered a rule that capped basin depletions to equal average flow over the prior 10 years. The rule triggered when Lake Mead drew down below 1,060 feet (which did happen this spring). We implemented our proposed rule in a free, downloadable model that simulated the worst flows of the Colorado River from current day back to 1416 AD, when records come from tree rings. We compared depletions and reservoir drawdown for the current rules and new rule. We found that current operations drew down Lake Powell and Lake Mead to critical levels in a few years whereas the rule that lived within our means sustained both reservoirs above their critical levels for long periods of time.

Adapt Lake Mead Releases to Inflows to Slow Drawdown

Another approach is set a target level for Lake Mead and withdraw water to sustain that level. The amount of water released depends on the inflow, lake level, and lake evaporation. In a second free, downloadable model, I set the target level for Lake Mead at 1,060 feet, about 20 feet higher than the current level. For that level, I created a chart that showed releases to raise, stabilize, and lower lake level for different inflows (Figure 1). For example, at a Lake Mead annual inflow of 8 maf—corresponding to a Lake Powell release of 7 to 7.4 maf—a withdraw of 7.5 million acre-feet (maf) will maintain the elevation of 1,060 feet. Knowing how much inflow and storage are available each year allows us to see how much more to reduce use (pink fill in Figure 1). This approach explored two methods to split reductions among parties: a) let parties negotiate, or b) convert historical allocations and mandatory reductions into percent shares.

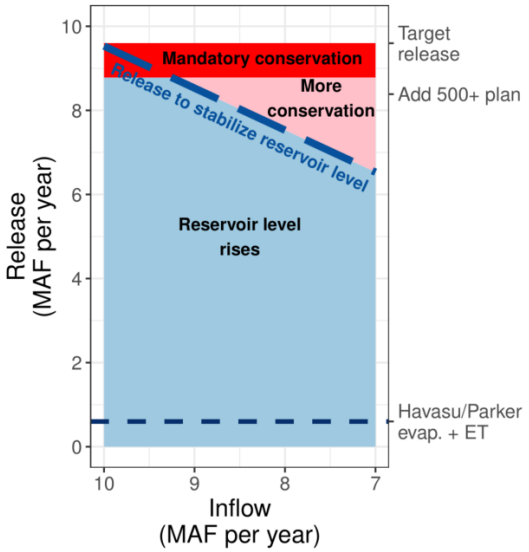

Figure 1. Lake Mead releases to stabilize at elevation 1,060 feet for different inflows.

Colorado River Basin Accounts: Provoke discussion about more adaptive operations

This past year, I invited 26 Colorado River managers and experts to allocate water for all regions of the Basin, including for First Nations and the Colorado River delta. Using a Google Sheet, they set the annual flow, and then entered how much water to consume, save, or trade for their account. Next, they decided how much of their combined remaining account balances to leave in Lake Powell and Lake Mead before they moved to the next year.

The activity evoked constructive feedback to improve the activity plus lots of discussion about equity, sustainability, reliability, affordability, protecting endangered, native fish, and other issues. I invite you to virtually manage a Colorado River basin account. Open the repository, download the Excel file, move into Google Sheets, and invite people to start.

These three examples are some of the numerous ways to adapt to low flow and low storage. All the examples faced challenges such as how low a flow to consider and how to divide the sometimes large cutbacks among users. Another challenge is how to turn the annual analyses into monthly operations where it becomes important to forecast and hedge against a forecast that overestimates actual flow—like happened this year.

I am hopeful about the future of the Colorado River because prior generations had the foresight to plan and build the two largest reservoirs in the United States that were nearly full in 2000 and helped the basin weather this 22-year drought. We now face an era of aridity—low soil moisture and low flows—that may continue for several more years until we reach or surpass the longest droughts in the tree ring record. This aridity poses a multitude of hydrologic, economic, managerial, social, political, and other difficulties and uncertainties. I believe we can adapt by sticking to our shared principles of collaboration, experimentation, joint learning, plus attention to technical soundness and inclusive process. I hope we are the generation that plans, builds, and strengthens the social infrastructure that will support us to adapt in the face of low flows and low storage.

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