CASCADE RESERVOIR OPERATIONS PILOT BULLETIN

Evaluating Operational Alternatives to Reduce Harmful Algae in Cascade Reservoir, Idaho

BUREAU OF RECLAMATION

Figure 1. Photo of algae bloom at Cascade Reservoir on September 26, 2019, courtesy of Friends of Lake Cascade.

Introduction

Cascade Reservoir, also known as Lake Cascade, located in west-central Idaho and operated by Bureau of Reclamation (Reclamation), often experiences excessive algae growth capable of producing harmful algal blooms (HABs; Figure1). The wide and shallow shape of the reservoir (Figure 2), combined with high temperatures, can result in warm waters in the late summer and early fall that are favorable for rapid algae growth. Although algae are an important part of reservoir habitats, some algae can produce toxins that at certain concentrations are harmful to animals. People, pets, and livestock should avoid consuming and contacting the affected waters, and precautions should be taken when processing fish and game when a HAB is occurring. HABs may form clumps, mats, foam, and streaked patterns ranging in colors from green, brown, or red and accumulate on the lake surface and shoreline.

This study considered several operational changes to Cascade Reservoir to evaluate whether HABs could be decreased and was funded through Reclamation's Reservoir Operations Pilots program. Reclamation's Snake River Area Office and Columbia-Pacific Northwest Regional Office in Boise, ID partnered with Portland State University's Water Quality Research Group, led by Dr. Scott Wells, to develop a water quality model for calendar years 2018 through 2022. The selected water quality model, CE-QUAL-W2, simulates how water moves through a reservoir and considers environmental factors (such as water temperature) that lead to harmful algae growth. The model was developed and calibrated

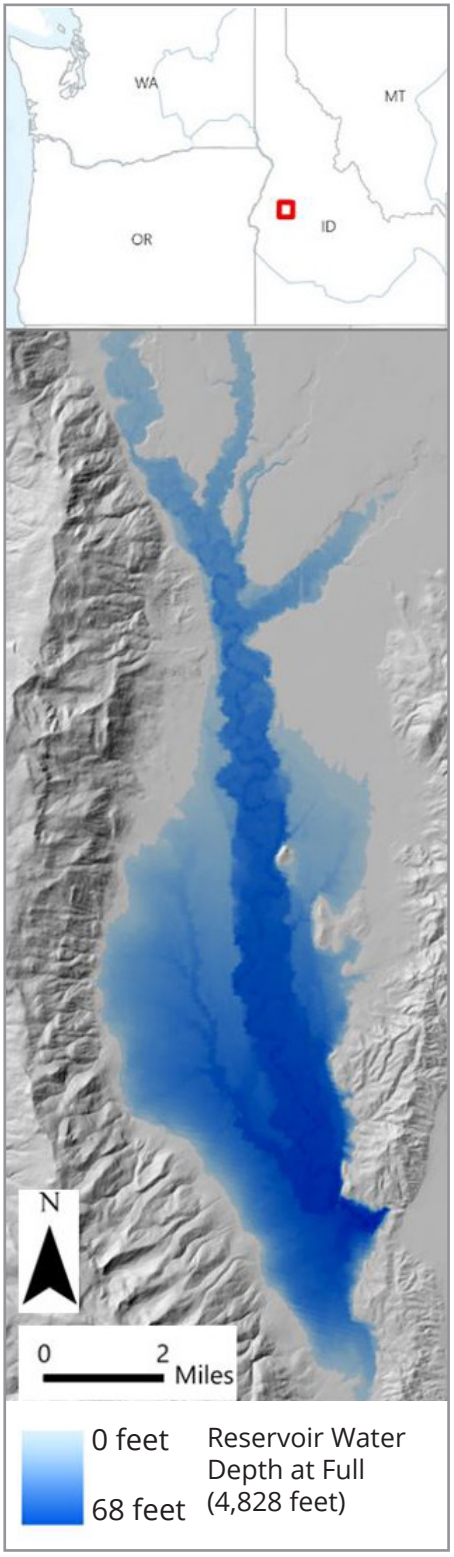

Figure 2. Map of water depth for Cascade Reservoir

using historical river flows into and released from the reservoir; weather data (wind, air temperatures, cloud cover, and sunlight); reservoir geometry; historical water levels; and water quality data acquired from Idaho Department of Environmental Quality and Reclamation. The model simulated complex reservoir dynamics including the movement and heating of water and chemical and biological processes that produce algae growth and harmful toxin production. This study focused on understanding whole-reservoir dynamics and did not consider local variations in harmful algae (variability within the reservoir and along shorelines).

Researchers with Reclamation used the model to evaluate alternative reservoir operations that could reduce HABs within Cascade Reservoir. Four theoretical operating alternatives considered how Cascade Reservoir could be operated to reduce HABs and continue to meet water supply commitments and authorized purposes. Each operating alternative included changing the structures that were used to release water, shifting the timing of certain releases, and changing how the releases from Cascade are balanced with releases from the other Reclamation reservoir in the upper Payette River basin, Deadwood Reservoir. A river-reservoir operations model first simulated each operating alternative and the results were then input into the water quality model to assess and document the change in the amount of harmful algae within the reservoir. It is important to note that the selected operational alternatives were theoretical, and actual operational changes could have significant impacts within the basin that would require further study before being considered for implementation.

Study Findings

A report summarizing the study and findings can be accessed at www.usbr.gov/watersmart/pilots/studies.html. The water quality model simulated annual cycles of harmful algae growth, with concentrations typically peaking in September in all five years modeled (Figure 3). However, the theoretical changes in operations resulted in small net changes in the amount of harmful algae and were not considered statistically significant.

Balancing operations between the two Reclamation reservoirs revealed limited operational flexibility (Figure 4). Rebalancing releases from Cascade and Deadwood Reservoirs were only able to change water levels in Cascade Reservoir by up to around four feet. Changing the release location, either through the powerhouse or through the spillway, also had little effect on changing reservoir temperatures at-large.

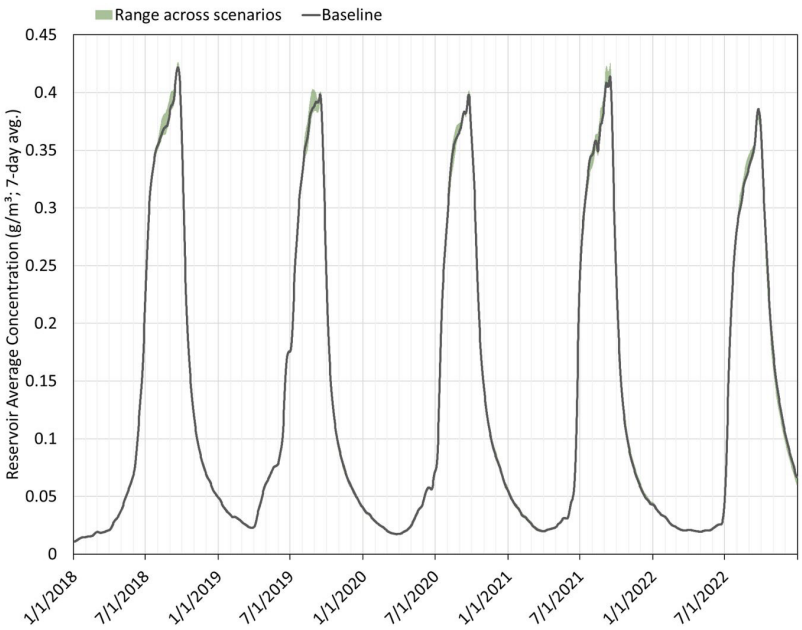

Figure 3. Simulated harmful reservoir average algae concentrations in the 'Baseline' alternative (black solid line) and the range in concentrations across all of the theoretical operational alternatives (green shaded area)

"The results suggested that the harmful algal growth is not sensitive to water levels and operations for Cascade Reservoir, at least within the selected theoretical alternative operational ranges."

– Michael Poulos, Study Lead

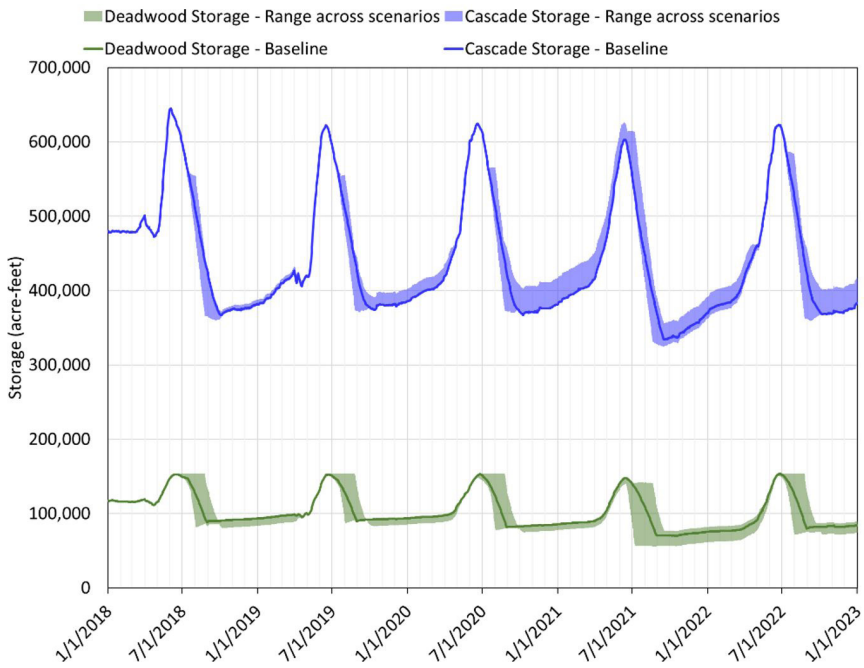

Figure 4. The simulated range in reservoir storage across the operating alternatives at Cascade Reservoir (blue) and Deadwood Reservoir (green)

Project Benefits and Future Applications

Although a potential operational solution for alleviating HABs was not identified, the study successfully simulated and analyzed several theoretical changes in operations and documented those effects on water quality. The study characterized the limited operational flexibility of the Upper Payette River basin reservoir system due to the primary operational commitments. This study advanced our understanding of how adjusting reservoir operations alone may not be a viable solution for alleviating HABs at Cascade Reservoir, allowing future studies to incorporate or focus on other potential solutions, such as nutrient reductions. The water quality model could be useful for additional HABs analyses or other water quality investigations within Cascade Reservoir. Data collected for additional years could be used to improve model calibration and expand the model simulation to include additional years.

Additional Information and Useful Links

Final Report

WaterSMART Reservoir Operations Pilots program

CE-QUAL-W2 software and Water Quality Research Group

Idaho Department of Environmental Quality
Information on HABs, recent status of reservoirs in Idaho, and algal bloom reporting

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