United States Department of the Interior
NATIONAL PARK SERVICE
Interior Regions 6, 7 & 8
12795 West Alameda Parkway
Lakewood, CO 80228

IN REPLY REFER TO:
IMDO-RSS-EQ (1248)

Memorandum

To: Wayne Pullan, Regional Director, Upper Colorado Basin, Bureau of Reclamation
Jacklynn Gould, Regional Director, Lower Colorado Basin, Bureau of Reclamation
Carly Jerla, Senior Water Resources Program Manager, Bureau of Reclamation

From: Kate Hammond, Acting Regional Director, Interior Regions 6,7,8, NPS
Frank Lands, Regional Director, Interior Regions 8,9,10 and 12, NPS

Subject: NPS Comments in response to July 2022 Federal Register Notice for Development of Post-2026 Colorado River Reservoir Operational Strategies for Lake Powell and Lake Mead Under Historically Low Reservoir Conditions

Date: August 31, 2022

The National Park Service (NPS) appreciates the opportunity to comment on the Bureau of Reclamation's (Reclamation) "Development of Post-2026 Colorado River Reservoir Operational Strategies for Lake Powell and Lake Mead Under Historically Low Reservoir Conditions," announced in the Federal Register Notice of June 24, 2022. The following comments represent the views of the National Park Service. We coordinated closely with the US Fish and Wildlife Service (USFWS) at the staff level while preparing these comments.

We believe this is an important and timely process that must address many challenges related to future management and use of Colorado River resources across the western United States and thus look forward to working with you collaboratively.

Potential Impacts to NPS Resources

As mandated by the Organic Act of 1916, the NPS manages and protects resources in nine park units that collectively contain almost one thousand miles of river and shoreline that may be impacted by project alternatives. These park units are Dinosaur National Monument (NM), Curecanti National Recreation Area (NRA), Black Canyon of the Gunnison National Park (NP), Canyonlands NP, Arches NP, Glen Canyon NRA, Rainbow Bridge NM, Grand Canyon NP and Lake Mead NRA. The alternatives to be considered in this planning process may affect resources we are legislatively mandated to protect, including most notably threatened or endangered fish and wildlife, water quality, vegetation, wildlife habitat, geological features, geomorphic processes, cultural, paleontological, and ethnographic resources, among others. Recreational opportunities in these park units draw over 27 million visitors annually to the seven basin states, creating over $2.3 billion dollars of revenue. For these reasons, and given NPS expertise, the NPS requests cooperating agency status for the forthcoming National Environmental Policy Act (NEPA) review pursuant to 40 CFR 1501.8.

One of the most serious resource issues identified in the current low water situation is at Glen Canyon Dam (GCD) where we are documenting an increase of invasive warmwater non-native fish passing through GCD. The Post 2026 alternatives will affect this situation with important differences between alternatives. Currently, dramatically increased release temperatures are creating suitable habitats for reproduction of these warmwater non-natives in the Colorado River below GCD. As of July 2022, there have been monitoring observations supporting the occurrence of breeding smallmouth bass below the GCD. Smallmouth bass is a particularly voracious predator that has impacted native and federally listed fish in the upper basin. If smallmouth bass and additional high-risk, warmwater, non-native predators establish below the dam, this may greatly impact native fish communities, presenting risk to the status of the federally listed humpback chub in the near future. The NPS sees a need for specific modeling of this risk to humpback chub populations (including minimums and maximums) and habitat modeling over time that considers the potential establishment of these non-natives as well as great potential variations in water quality and water quantity in the Grand Canyon with lower Lake Powell elevations. This modeling would allow for comparison between alternatives, possibly showing very different trajectories for between the alternatives that may be important for communicating to decision-makers the risk to humpback chub populations over time. We are concerned that past processes have prioritized annual hydropower costs/revenue over important environmental concerns. We are now in a time of major changes in river temperatures and flow regimes when it is vital to prioritize federally listed fish in alternatives analysis. Modeling should consider annual and multiyear impacts to fish and consider prioritizing those over impacts to hydropower. While hydropower revenue may adjust from year to year the industry has more resilience than federally listed species with regard to major changes in temperature, water quality and predators that could create permanent and irreversible effects to these species. Federal agencies have a legal obligation to protect the environmental and other resource interests on the Colorado River in the Grand Canyon pursuant to the Grand Canyon Protection Act (GCPA), the Endangered Species Act and the NPS Organic Act.

Recent lower levels of Lake Powell have prevented the High Flow Experiments (HFE) from being carried out in the Grand Canyon. HFE's represent the only tool to rebuild sandbars and beaches in the canyon, critical for the protection of cultural resources and for providing recreational access for river rafters through the canyon. The Post 2026 alternatives will affect this issue and may determine how well agencies can protect these resources and comply with the GCPA, the National Historic Preservation Act (NHPA) and the NPS Organic Act for the future. The Hualapai Tribe has expressed significant concern to the NPS that the lack of HFE's is promoting the buildup of sand in the river in Grand Canyon West, which is both creating an increasing safety threat to river visitors and to the Tribe's commercial recreational interests. Grand Canyon National Park has similar concerns.

To further highlight the urgency of the Post 2026 process, we summarize the types of impacts we have experienced within our park units over the last few years as a result of rapid decreases in water level in Lake Powell and Lake Mead. NPS units have experienced dramatic changes to recreational access and patterns at our reservoir parks. Starting in the spring of 2021, Glen Canyon NRA virtually overnight went from having 11 major boat access points on Lake Powell to 2. We have made major investments to maintain these 2 remaining boat ramps. The alternatives in this process will affect Lake Powell elevations and therefore recreational revenue and have regional economic effects to gateway communities around Glen Canyon NRA. Lake Mead NRA has gone from having 8 boat ramp launch locations to only one in just over a decade and is undergoing similar impacts and planning for major infrastructure investments. At both parks, the shoreline recedes several feet horizontally for every vertical foot drop in lake level. This has created issues for our recreational infrastructure and utilities. Reduced lake surface area has led to changes in wakeless areas and changes to traffic patterns and

travel time. Large boat launching and travel through narrower channels has become more time consuming and complicated. Smaller watercraft traffic has increased in some areas. The increasingly exposed shoreline has presented concerns ranging from exposure of cultural and paleontological resources that require survey and protection to increased weed management concerns, while changes to off-road vehicle use in these areas have led to increased erosion, dust and air quality concerns. The dropping water tables have impacted water wells and are altering vegetation that may impact authorized grazing and unwanted access of livestock into closed areas. All of these resource, recreation, and operational issues may be affected by this planning process.

Like all NPS sites along the Colorado River, Lake Mead has also seen dramatic impacts in recent years due to changes in water levels resulting from climate change induced drought. These changes have had a dramatic impact on recreation in the park and on the local businesses that support recreation. Additionally, lower lake levels have had a profound impact on industries that rely on Lake Mead as a water source, and which may be at risk of not being able to draw water directly from the lake in the future. In some locations, park infrastructure, such as campgrounds and marinas, are increasingly at risk of not being able to get access to water in the event of structural fire and for access to drinking water. Of growing concern is the re-emergence of cultural resources that have been protected by the water inundation since the 1930s. These resources include sites of cultural and historic significance to indigenous communities as well as cultural resources that document the early history of the area and even more modern objects such as a WWII-era B-29 bomber. As lake levels drop, these objects will be exposed to looting, as well as damage from environmental conditions. Much of the area now inundated with water was not surveyed in great detail prior to 1936; the NPS thus has a great interest in surveying these lands as they re-emerge and monitoring, mitigating and managing these resources as appropriate for their protection. Accurate modeling of future water levels, socio-economic impacts from declining water, and impacts to tourism will be critical to managing these issues going forward as well as communicating the implications of different alternatives to decision-makers.

Participation in the Process and Need for Close Coordination

The NPS staff notes the need for interagency coordination in this process given the effects throughout the system to different governments, tribal nations and stakeholders. In addition to participating as a cooperating agency pursuant to NEPA, due to the cultural and ethnographic resources that may be impacted, the NPS hopes to participate as a consulting party in any Section 106 Consultation under the NHPA. We urge Reclamation to initiate 106 government-to-government consultation with tribes early in this process so that there is time to resolve any adverse effect in this complex environment. We would also urge coordination with the many environmental organizations and academics that are studying and publishing on this process. We believe their inclusion from the start will lead to more creative solutions and more optimal outcomes.

Urgency of the Timeline for Analysis and Modeling of Resource Impacts

We expect a higher level of resource impacts to all nine park units if reservoir levels continue to fall; these impacts are likely to be either mitigated or worsened with respect to the different alternatives that are developed. Consequently, it is imperative that this planning process start soon, include affected stakeholders, include the data and science that has been collected on many different reaches of the river for difference agencies and scientists, include detailed resource analysis, and consider full adjustment to ongoing and continued climate change conditions in order to recover the system. Analysis of resource impacts that differ between alternatives using resource-impact models that reflect the synthesis of the best available science will be critically important. Given the desire for a Record of Decision (ROD) in 2026, development of these models needs to be started in the fall of 2022 to be ready for use during the relevant time period.

NPS would like to participate as soon as possible in discussions regarding science synthesis and modeling of resource effects. We anticipate the need for specific models for considering water quality (most specifically temperature in rivers and at outlet depths for reservoirs), native, non-native and federally listed fish (including food base, population minimums and maximums, and short- and long-term habitat), vegetation and channel structure/geomorphology and sediment, and cultural and paleontology resource exposure. As was stated in the cumulative impacts section of the 2016 Long Term Experimental and Management Plan (LTEMP) Environmental Impact Statement (EIS) carried out several years ago, alternatives with variation in annual release patterns will affect many resources. We would like to work closely with Reclamation and a small technical group on the development and peer review of models that would be beneficial for establishing the analysis of resource effects needed for the NEPA review. We have learned from past processes the importance of using the best available science in a set of models that aid in evaluating the effects of management and climate scenarios on resources and recreation, providing clear, quantitative results that can be used to compare alternatives. These models will require budget allocation and expenditures starting in October 2022 to be ready for resource impact analysis within the next two years and optimal usefulness in the preparation of the NEPA document and ultimately a decision by 2026. NPS staff have started some projects with USGS to begin building the models related to vegetation and sediment/channel dynamics and would welcome the chance to understand Reclamation's overall approach to this impact analysis and then work closely with Reclamation on the resource impact models needed to fully assess the impacts of alternatives.

Geographic Scope of the Process

NPS suggests Reclamation look beyond the operation of Hoover and Glen Canyon dams for the geographic scope of this process because actions under the Drought Response Operations Agreement (DROA) appear to be affecting resources across the basin and we expect those actions to either continue or similar actions to be considered under this planning process. NPS recommends inclusion of analysis of the Flaming Gorge Dam (FGD) to fully consider multiyear actions. Including FGD in this process may reveal opportunities to optimize basin-wide effects for resources, recreation, and water delivery that would otherwise be missed. We do not recommend the Aspinall Unit operations be reconsidered for this process and the current Record of Decision (ROD) should remain in place. We defer to the US Fish and Wildlife Service (USFWS) at Navajo Dam as to whether consideration of any alterations to Navajo dam operations should or should not be included with the scope of the Post 2026 process. NPS has concerns for the management of the federally-listed fish downstream that extend into Glen Canyon NRA.

Alternative Development Process: Considerations and Alternative Concepts

NPS respectfully asks that these issues be considered in the process:

- Consider working closely on alternative development with all DOI bureaus to optimize the meeting of all bureau mandates.
- Include operations of Flaming Gorge Dam (FGD) that consider multiyear impacts from DROA operations; consider using any DROA operations for maximum environmental benefits by including larger spring peak flows; consider hydrological patterns that conform to the Upper Basin Recovery Program Green River Evaluation and Analysis Team (GREAT) report recommendations.
- Consider alternatives that set a goal of maintaining Lake Powell well above 3525' to minimize non-native fish passthrough at GCD and reduce the warming of the river below the dam. This would also minimize the effects to recreational access and to cultural and paleontological resource exposure on shorelines.
- Include an alternative concept for a combined volume approach of management between Lake Powell and Lake Mead as has been suggested by Dr. Jack Schmidt and the Future of the Colorado River Project. This option that could allow for better management of environmental

flows through the Grand Canyon that could provide more benefits for fish, sediment and cultural resource protection without impacting water storage or delivery if it was framed in this way.

- Include consideration of a temperature control device with both warmer and cooler water release options to better manage river temperatures below GCD within a suitable range to benefit native and federally listed fish and to maintain the recreational rainbow trout fishery.
- Include options to prevent or reduce non-native fish passage through GCD and FGD such as screens, barriers, nets, and bubblers in order to protect native and federally listed fish throughout the system.
- Include an option for adjusting the GCD High Flow Experiment sediment windows and operational timing for spring HFEs to adjust to climate change and lower water levels. This would allow for smaller HFEs to be considered in June when the reservoir level is at its highest, making use of sediment accrued throughout the year, so that agencies may continue to comply with the Grand Canyon Protection Act. This would result in better protection of cultural resources that will be exposed without this sediment redeposition and would protect the recreational camping in the canyon.
- If not already accomplished via other compliance processes, consider flows out of GCD that would disadvantage non-native fish such as smallmouth bass and green sunfish and/or lower river temperatures via bypass use.
- Include the concept of tying annual flow volume out of GCD to multiyear inflows to Powell so there is a better tie to actual water availability rather than just reservoir elevations, which may be a concept similar to what has been suggested by former Assistant Secretary Anne Castle.
- Consider formulas with continuous functions rather than step functions for annual releases so there are not bigger changes on either side of a tier brought about by a few feet of difference in reservoir elevation.

Consideration of Climate Science and Demand Levels

NPS understands that the best available climate science is indicating that there will likely be less water availability in the future and that the total water available in the system may move as low as 10-11 million acre feet (maf) on average by 2050. Given that the average use of water was approximately 14 maf annually from 2000-2020, and that water into the system was significantly less in this time span, it is clear why Lake Powell and Mead went from 95% full in 2000 to ~25% in 2022. As temperatures have risen and monsoonal precipitation has declined, increasingly drier soils soak up more runoff, further reducing river inflows. Drier soils are also more susceptible to erosion, increasing dust deposition that melts snow sooner and faster. Such climate change driven conditions may represent a new normal of aridification, as opposed to a temporary drought. We recognize the excellent work in the 2020, "Colorado River Basin Climate and Hydrology: State of the Science" (Lukas and Payton 2020) and applaud Reclamation for planning to use it as part of the 2026 process. We understand and commend the fact that subsequent work is being performed by Reclamation's University of Colorado Boulder Climate Science staff.

However, recent studies suggest that climate change feedback loops, that are likely operating in the Colorado River Basin, may produce complex interactions that may not be fully captured in current models for estimating water availability. The heat waves and resulting decreases in soil moisture throughout the Colorado River Basin in 2020-2022 demonstrated how new dynamics can suddenly become important environmental factors. New dynamics of this type have been predicted in studies such as Cheng et al. 2019. These recent conditions have also led to scientific questioning of using environmental projections based on the past 30 years (Wang et. al, 2022). Current science is seriously questioning whether or not the past is the best predictor of the future. The potential for feedback loops

is also of concern with dust and ash. While it has been known for many years that dust can impact snowpack and lead to earlier runoff and drier soils (Painter et al. 2010, He et al. 2019), recent studies highlight the relationship between fallowed lands and dust storms and suggest there should be consideration and modeling of how policy changes may impact the acreage of fallowed lands particularly in the lower basin (Joshi 2021). Similarly, the relationship between ash from wildfires in the region and earlier snowpack melt has also been well studied (Gleason et al 2019, Smoot and Gleason 2020). But the feedback loop created as warmer temperatures lead to more wildfire, leading to more ash and charcoal which exacerbates early snowpack melt, are of great concern as they increase to the regional scale with worsening conditions over time. Modeling the scale of fallowed land over time, and modeling increased wildfire and ash and estimating the resulting potential for more rapid snowmelt may be an important consideration for this process. We hope these dynamics can be considered for inclusion in worst case modeling scenarios. In summary, we urge Reclamation to consider the potential for these inter-related climate effects on water availability in the Post-2026 planning process.

Finally, we recommend full consideration and modeling of changes to water demand levels. If supply and demand are not brought into alignment within the next few years, we are concerned we will continue to experience serious resource impacts across the whole system, some of which could be permanent and irreversible. Clearly, it is both supply and demand that affect the entire system. There are additional feedback loops that should be considered and modeled in this process if possible – for example, increased and compounding impacts created as demand/usage for both agriculture and municipal uses increases as heatwaves increase (Brown et al. 2019, IPCC 2021, Vahmani et al. 2021). We suggest that an appendix to the plan, including an overall summary update to the 2011 Basin Study, or some other way to show both supply and demand scenarios together as they are affected by different alternatives, be included in the NEPA document in order to show the projected levels of all the reservoirs in the system per alternative. Because demand levels are a critical part of the management of the system, we commend Reclamation for beginning this difficult and complex planning process, and for spearheading discussions of reducing demand in the basin by 2-4 maf this year. Recent papers about the risk of compact violation (Castle and Fleck 2019) and the broad range of resource impacts beginning to occur in the Colorado River system (Wheeler et al. 2021) suggest there is limited time to avoid major impacts for all of the seven basin states and the whole Southwestern US.

Thank you for the opportunity to comment on this important process. We hope the Post 2026 planning process formal scoping starts soon and that it fully considers the complex effects of climate change and temperature increases, resulting in the establishment of plans and agreements that address these long-term conditions. If near-term actions or plans are developed (as were referred to in the federal register notice), we would also be interested in participating in those processes. We understand the overwhelming nature of this expansive planning process and appreciate the time and close coordination with Reclamation staff that has occurred over the past year. We look forward to many more discussions and closer working groups on these issues over the coming year to ensure all needed resource impact models are developed in a timely way for consideration in the EIS. Please contact Rob Billerbeck, NPS Colorado River Program Coordinator, at 303-987-6789 or rob_p_billerbeck@nps.gov if you have any questions on these comments or wish to discuss them further.

Kate Hammond
Acting Regional Director
National Park Service Interior Regions 6, 7, & 8

Frank Lands
Regional Director
National Park Service Interior Regions 8, 9, 10 &12

Literature Cited

Brown, T. C., Mahat, V., Ramirez, J. A. (2019) Adaptation to Future Water Shortages in the United States Caused by Population Growth and Climate Change. Earths Future Vol. 7, Iss. 3. https://doi.org/10.1029/2018EF001091

Castle, A. and Fleck, J. (2019) The Risk of Curtailment under the Colorado River Compact. Available at SSRN: https://ssrn.com/abstract=3483654 or http://dx.doi.org/10.2139/ssrn.3483654

Cheng, L., Hoerling, M., Zhiyong Liu, Z., and Eischeid, J. (2019) Physical Understanding of Human-Induced Changes in U.S. Hot Droughts Using Equilibrium Climate Simulations in: Journal of Climate Volume 32 Issue 14 DOI: https://doi.org/10.1175/JCLI-D-18-0611.1

Gleason, K. E., McConnell, J. R., Arienzo, M. M., Chellman, N., & Calvin, W. M. (2019). Four-fold increase in solar forcing on snow in western US burned forests since 1999. Nature communications, 10(1), 2026.

He, C., Liou, K,, Takano, Y., Chen, F., Barlage, M. (2019) Enhanced Snow Absorption and Albedo Reduction by Dust-Snow Internal Mixing: Modeling and Parameterization. Journal of Advances in Modeling Earth Systems, https://doi.org/10.1029/2019MS001737

IPCC, (2021) Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New
York, NY, USA, pp. 3−32, doi:10.1017/9781009157896.001

Joshi, J. R. (2021) Quantifying the impact of cropland wind erosion on air quality: A high-resolution modeling case study of an Arizona dust storm. Atmospheric Environment Vol. 263, Iss.15
Lukas, J., and Payton, E., eds. (2020) Colorado River Basin Climate and Hydrology: State of the Science. Western Water Assessment, University of Colorado Boulder. DOI: https://doi.org/10.25810/3hcv-w477.

Painter, T. H. , Deems, J. S. , Belnap, J. , Hamlet, A. F. , Landry, C. C. , & Udall, B. (2010). Response of Colorado River runoff to dust radiative forcing in snow. Proceedings of the National Academy of Sciences USA, 107(40), 17125–17130. 10.1073/pnas.0913139107

Smoot, E. and Gleason, K. (2020). "Forest Fire Effects on Snow Storage and Melt". Available at: http://works.bepress.com/kelly-gleason/10/
Vahmani, P., Jones, A. D., Li, D. (2021) Will Anthropogenic Warming Increase Evapotranspiration? Examining Irrigation Water Demand Implications of Climate Change in California. Earths Future Vol 10, Iss 1. https://doi.org/10.1029/2021EF002221

Wang, J., Udall, B., Kuhn, E., Wheeler, K., and Schmidt, J. (2022) Evaluating the Accuracy of Reclamation's 24-Month Study Lake Powell Projections/ White Paper 7, Future of the Colorado River Project, Center for Colo-rado River Studies, Utah State University, https://qcnr.usu.edu/coloradoriver/files/WhitePaper_7.pdf

Wheeler, K., Kuhn, E., Bruckerhoff, L., Udall, B. (2021) Alternative Management Paradigms for the Future of the Colorado and Green Rivers. White Paper 6, Future of the Colorado River Project, Center for Colo-rado River Studies, Utah State University, https://qcnr.usu.edu/coloradoriver/files/WhitePaper_6.pdf