Glen Canyon Dam Adaptive Management Program
Adaptive Management Work Group Meeting
February 15-16, 2023

Wednesday, February 15, 2023

Start Time: 8:35 AM Pacific Standard Time (PST); 9:35 Mountain Standard Time (MST)
Conducting: Wayne Pullan, Acting Secretary's Designee to the Adaptive Management Work Group (AMWG) and AMWG Chair
Facilitator: Terra Alpaugh, Kearns & West, Inc.
Meeting Recorder: Carliane Johnson, SeaJay Environmental, LLC

Welcome and Administrative

- Introduction and Opening Remarks: **[Wayne Pullan, AMWG Chair]** Provided opening remarks.
- Introductions and Determination of Quorum: **[Terra Alpaugh, Kearns & West]** Quorum reached with 23 members represented.
- **Approval of August 17-18, 2022, Meeting Minutes: [Terra Alpaugh, Kearns & West]** Minor edits received were word changes on pages 9 and 23 from Leslie James, Colorado River Energy Distributors Association (CREDA), and a spelling correction submitted by Larry Stevens, Grand Canyons Wildlife Council (GCWC). **August minutes approval moved by:** Larry Stevens, GCWC; **Seconded by:** Sara Price, Colorado River Commission of Nevada (CRCN). The August meeting minutes were approved by consensus.
- **Review of August Meeting Evaluation: [Terra Alpaugh, Kearns & West]** August meeting evaluation was based on 14 respondents.

Administrative Updates

- **AMWG Charter [Wayne Pullan, AMWG Chair]** The charter will need to be renewed by September 2023. Information will be provided following this meeting.
- **AMWG Membership Status [Tara Ashby, Bureau of Reclamation (Reclamation)]**. Committee leadership remains the same, but many new AMWG members have been approved. A new call for nominations closed on Monday. New nominees of the Technical Work Group (TWG) and newly appointed TWG members were also announced.
- **Action Item Tracking Report [Clarence Fullard, Reclamation]** Open items: Several monitoring metrics were presented at the Annual Reporting Meeting. There will be a Department of the Interior (DOI) meeting to get approval, then they will be posted on a new page of the Glen Canyon Dam Adaptive Management Program (GCDAMP) website. The DOI bureaus have developed a table of high priority items in the Triennial Work Plan (TWP). Reclamation will be working with the Budget Ad Hoc Group (BAHG) to present that table to AMWG members as part of the next Triennial Work Plan process. Closed items: The Non-native Fish Strategic Plan has been drafted and provided to the AMWG by the TWG as directed by the Secretary's Designee. Reclamation has developed 2-4 operational alternatives to prevent invasive fish establishment. Reclamation staff are still tracking the other three of the five proposed action items from the Secretary's Designee.

- **Fiscal Year (FY) 2023 Program Funding Status** **[Kathy Callister, Reclamation]** FY2023 was on a continuing resolution through December, which means a percentage of the money was received. Reclamation is now awaiting appropriated funding for the program for the year.
- **Triennial Work Plan Timeline** **[Wayne Pullan, AMWG Chair]** The current TWP covers FY2021-2023. Typically, Reclamation would spend FY2023 working on the next TWP, but there are other processes in motion impacting Reclamation and Grand Canyon Monitoring and Research Center (GCMRC) staff's availability which will affect what work is considered in the TWP. As a result, Reclamation plans to extend the FY2023 budget into FY2024, ask the BAHG to consider how the budget might be adjusted to apply to FY2024, and then work on a new TWP in FY2024 to apply to FY2025-2027. **[Larry Stevens, GCWC]** This next TWP budget will cross the centerline of the 20-year Long-Term Experimental and Management Plan (LTEMP). It is concerning that the goals of the program are still not known. Some progress has been made with the metrics, but the goals and objectives still need to be clearly defined. The next TWP needs to more clearly define where we are in the program and how we know where we are.

Basin Hydrology and Operations

[Heather Patno, Reclamation] Provided the status of the Upper Basin storage, which mostly indicates decreasing storage prior to spring runoff. Lake Powell is at its lowest since its first filling and expected to continue to decrease over the next few months. February has been very dry, but the water year (WY) precipitation from October to January has been good, resulting in above median snowpack. The short-term forecast includes precipitation in lower totals coming from the north. Both the maximum and most probable forecasts for unregulated inflows at this point are above average. Balancing releases are expected for Lake Powell, but the actual release amount will be determined in April. Projections do not show Lake Powell going below minimum power pool, with a spring elevation at 3,525 feet; snowpack has greatly improved the Powell forecast resulting in an expected elevation of 3,537 feet at end of December 2023. **[Robert Radtke, Reclamation]** Model runs in January 2023 for projected temperatures below the dam showed a minimum temperature of 8 degrees Celsius (^{o}C) in February, two degrees cooler than last year because of greater outflows from the dam. Temperature projections for the forebay show 8 ^{o}C with 7 ^{o}C at the bottom of the reservoir. High spring inflows are when low D.O. occurs. If there is a big spring inflow this year, will probably again see low D.O. levels at the penstock that could be a potential issue.

Q&A and Discussion

[Ed Keable, National Park Service (NPS)] What will be the availability of timing of warm water releases? **[Robert Radtke, Reclamation]** Generally warm water is released through November until the reservoir starts turning over. The temperature peaks about mid- to the end of September. There might be a month in the fall of the highest temperatures being discharged. The timeframe above 16 ^{o}C for humpback chub reproduction occurs from the middle of summer until November. **[Leslie James, CREDA]** With the 1 maf increase in February, has Reclamation modeled that change to look at temperatures? If there are more and higher inflow volumes, does that mean warmer temperature water going through? Or would it raise elevations and cool the water? **[Robert Radtke, Reclamation]** Generally, with higher flows and higher volumes at low elevations, there would be the potential for warmer discharges than might be seen otherwise. It is already a warmer water mixture and there is less volume to pull from cold water. By the time it gets to the dam, the warmer water will go straight through. There is less residence

time in the reservoir with low elevations and high flows. **[Scott VanderKooi, GCMRC]** It is counter-intuitive and has to do with the volume of water that is already there. If the water were to stay there, it would mix with the cooling water. In 2012, it was a big water year, and the releases were larger, but the warm water just pushed through near the surface of the reservoir, resulting in warmer releases. The threshold temperatures will be important for discussion of the smallmouth bass EA.

2023 GCDAMP Annual Reporting Meeting Update – Part 1

[Ted Kennedy, GCMRC] provided updates on Lake Powell, riparian vegetation modeling, and bug flows. When Bug Flows were restarted in 2022, there was a tremendous increase in both midges and caddisflies suggesting that Bug Flows support aquatic insect populations, but smallmouth bass flows should take precedence over the testing of Bug Flows.

[Eric Stanfield, Navajo Nation] presented on the Navajo Nation's new monitoring program and a discussion on how to maintain tribal values, which emphasize maintaining all things in balance (or Hozhó). A key element of the program is community-based participatory research. That will include ethnographic decision-making, which is not always about the data, but about the experiences and the relationships that inform those decisions. Scientists often focus on data and discount the value of the experiential. Diné/Navajo Natural Law that says Mother Earth and Father Sky is a part of the Diné and vice versa. This sacred bond must be treated with love and respect without exerting dominance; creating more balance in the natural world can help reorient these relationships between plants, animals, and humans. The Natural Processes Metrics are in line with tribal values and the Navajo Nation plans to collaborate on that.

Q&A and discussion

[Brian Sadler, Western Area Power Administration (WAPA)] During the Tribal River trip in July, one discussion was to consider 2-3-day periods when fluctuations were greater than current operations. Has Reclamation looked at 2-day periods rather than daily? **[Ted Kennedy, GCMRC]** When averaging over 3 days and 7 days, the load following flows are still below the pre-dam stage. **[Brian Sadler, WAPA]** Caddisflies lay eggs in the prior year and then hatch the following year. How does this fluctuation work with bug flows? **[Ted Kennedy, GCMRC]** It is believed that steady, low flows can enhance all life stages and that's how you can get this big jump. The biology of caddis flies is not well known. There was an assumption that they laid eggs once each year, but some of these taxa can have multiple generations in a year (i.e., they lay eggs in May but then hatch in July or August).

[Ed Keable, NPS] How do the Navajo values resonate with other tribal perspectives? **[Martina Dawley, Hualapai Tribe]** Eric Stanfield's presentation is a very Western approach. There is still a long way to go in terms of metrics. The human connection can mean so much. By now, there should be some understanding of the different knowledges and experiences of indigenous people. Individual tribes need to be acknowledged because one tribe does not speak for all of "The Tribes." Hualapai have a different perspective with respect to the metrics. Developing tribal resource goal metrics was impossible because certain things can't be measured, but Hualapai community members also have scientific knowledge (e.g., when there is an overabundance of arrow weed); science is also observation and experimentation when using certain plants. **[Jakob Maase, Hopi Tribe]** Each tribe has different values, while some overlap. Some metrics can be counterproductive. It is hard for Hopi Tribe to measure some of these effectively and whether they meet the needs of this program. **[Daniel Bullets, Southern Paiute Consortium]** A lot of this needs to be brought out. We do try to support each of the tribes and try to do

many of the same things. [**Edward Wemytewa, Pueblo of Zuni]** Agree that the tribes try to support each other. One issue is where reports are submitted for federal laws and mandates. Also need to look at the consultations and what the tribes need to contribute. We have to take control of our narratives and make sure the conversations are balanced between the federal agencies and tribal peoples. We don't have our elders anymore. We have to assume our own narrative. Our language is not a simple translation. We need to start looking at and recording concepts in modern terms. Time and funding are needed to make sure that the elders are tasked to articulate our world views with our own values. Even a hundred years ago, reports were sent to Washington that the rivers were dying (e.g., the Little Colorado River (LCR) in 1930, when no more wetland aquatic species were seen). Now is the time to write this up.

Potential Water Year 2023 Experiments

[Bill Stewart, Reclamation] LTEMP flow experiments described in the 2016 Record of Decision (ROD) are intended to take an adaptive management approach rather than be prescriptive. Bill described the potential experiments for 2023. In current spring accounting period, the cumulative sand load is little more than 27 metric tons, not a lot of sediment in the system at this point. Reclamation will continue to monitor conditions for a Spring HFE.

Q&A and discussion

[Larry Stevens, GCWC] The sediment accounting process is broken. Is there a mechanism to correct the flow-triggering criteria to have Spring HFEs? **[Rod Smith, DOI Solicitor's Office]** The principal purpose for sediment accounting windows in the protocol and LTEMP was for beach building to prevent mining sand out of the system. The current menu does not necessarily work**,** but it is important to know how we got here. The challenge now is how to tweak the accounting windows. A discussion is needed to decide what that will look like in the future. **[Larry Stevens, GCMC]** Is there a mechanism for how that can be changed? There is good science on the need for pulses of sediment, and there is plenty of sediment, but the accounting window needs to be adjusted. **[Rod Smith, DOI Solicitor's Office]** The problem has been identified, so the next thing is identifying potential solutions and whether NEPA will be needed.

[David Brown, Grand Canyon River Guides (GCRG)] Maybe there are opportunities now with the other NEPA documents in process. The accounting period is broken. It does not reflect how nature works. There is plenty of sediment into the system. This is also going to be a hard year for 20,000 people in the system who will have nowhere to camp. Not having HFEs for five years now is astonishing. **[Jim Strogen, FFI/TU]** The Science is telling us we need to make a change. We need to find a way to get this done as quickly as possible. **[Leslie James, CREDA]** It was not just the accounting window. There are other reasons why HFEs were not done; for instance, the slough could potentially cause problems during an HFE. Can an HFE be taken care of at the same time as washing non-natives down the system? That is what needs to be addressed if HFEs occur at a different time. **[Wayne Pullan, AMWG Chair]** Will convene with Reclamation staff this evening and address this at tomorrow's meeting.

August AMWG 5 Proposed Actions

[Wayne Pullan, AMWG Chair] At the August AMWG meeting, the group identified five actions (list below). Everyone who is working on these items are commended. The Nonnative Fish Strategic Plan, in particular, required a lot of work. Thanked Laura Dye, CRCN, and Emily Higuera, Arizona Department of Water Resources (ADWR), for their work to deliver that plan, which will serve as a guide for this program and help protect the fishery resources of the Grand Canyon ecosystem.

1. ***Evaluation of High-flow Experiments under Low-elevations/Low-flows*** **[Paul Grams, GCRMC]** This was presented to the TWG last fall and will be covered later in the meeting. It includes riparian vegetation, cultural resources, Lake Powell water quality, smallmouth bass, sediment, and recreation, which are all being evaluated as part of the SEIS.

2. ***Evaluation of Downstream Resource Impacts under Low-Elevations/Low-flows*** **[Scott VanderKooi, GCMRC]** Charles Yackulic has been working on this in support of the smallmouth bass EA and the SEIS.

3. ***NEPA Compliance for Operational Flexibilities to Address Nonnative Fish*** **[Terra Alpaugh, Kearns & West]** This will be discussed as part of NEPA updates on day 2 of this meeting.

4. ***Planning to Evaluate Exclusion Projects*** **[Clarence Fullard, Reclamation]** described the process Reclamation used for evaluating options from Connie Svoboda's Fish Exclusion report. There will be a trip to the dam and forebay with the subject matter expert (SME) panel to further consider the engineering design. A net/thermal curtain hybrid is being considered, but it has engineering challenges. One concern is related to the amount of biofouling. **[Sara Price, CRCN]** Is there a scale on cost and effectiveness? **[Clarence Fullard, Reclamation]** It will be upwards of $10 to $15 million for installation and $1-2 million yearly for maintenance. The engineering team will refine those costs. The timeline is to deploy by 2024-2025, but no decision has been made yet on whether to move forward. If the sides of this net can be sealed, effectiveness would be high, but there's no data on that yet.

5. ***Nonnative Fish Strategic Plan*** **[Laura Dye, CRCN]** presented on the development of this plan. The draft plan was submitted for TWG's review at their January meeting. There is a common understanding of the problem, but there are differences of opinion on the best solutions. **[Seth Shanahan, Southern Nevada Water Authority (SNWA) and TWG Chair]** It was no small feat to develop this plan. The TWG passed a motion in January 2023 to provide the plan to AMWG. There was an objection from the Zuni representative, particularly objecting to the taking of life and other items. Other representatives voted for the plan, but they did not endorse certain elements. The plan should be considered as guidance to get to a decision.

Non-Native Fish Strategic Plan Recommendation

[Wayne Pullan, AMWG Chair] This plan is different from what AMWG ordinarily does and bigger than putting together a resolution. Reclamation asked the group to come together to develop a document to address the important and time-sensitive issues. The plan will be used by Reclamation to provide advice and recommendations to the Secretary. There are a variety of agencies that have an interest and responsibility for the river and its facilities, and the federal agencies will make use of the advice and recommendations as they undertake individual actions, such as the smallmouth bass EA being led by Reclamation. The smallmouth bass rapid response effort is an example of a collective action that will use the strategic plan to inform and assist in those decisions. **[Heather Whitlaw, U.S. Fish and Wildlife Service (USFWS)]** This Strategic Plan is an important document. Rather than being prescriptive, it provides advice and recommendations and thereby, flexibility into the future for decision making and management actions. The USFWS is very supportive of this document. **[Jakob Maase, Hopi Tribe]** The taking of life is not taken lightly. This plan contains many options, some acceptable to Hopi and some that are not. **[Wayne Pullan, AMWG Chair]** Are Hopi concerns adequately addressed in the document? **[Jakob Maase, Hopi Tribe]** There are many options open in the plan and too many variables. **[Ed Keable, NPS]** It is important to understand this document is a framework to provide advice to the federal agencies. By approving it, AMWG members are not consenting to any particular element in the

framework, but the general framework itself. It pulls together a broad set of interests and perspectives and places it in a context that provides a structure for advice.

[Wayne Pullan, AMWG Chair] Proposes to have a small group reconvene to review the motion and the preamble to determine if they can be improved to better address the concerns that Martina expressed. Then the document will be presented to the group on Day 2.

2023 GCDAMP Annual Reporting Meeting Update – Part 2

[Paul Grams, GCMRC] provided details and highlights about Projects A (streamflow), Project B (sandbar and sediment storage monitoring and research), and Project L (remote sensing overflight). Also discussed the status of sand mass balance and sandbars: long-term trends are mixed but four out of five sandbars have not done well. Need to consider what adjustments are needed to follow the HFE guidelines under low flow and low Lake Powell elevations to minimize effects to hydropower. A revised sediment accounting period is proposed under low winter releases. The HFE window could be extended any time between October and July, or possibly over the whole year, which could allow HFEs to be optimized for other resource considerations (i.e., hydropower, natural processes, etc).

Q&A and discussion

[Brian Sadler, WAPA] WAPA is interested in a more natural spring HFE. Where does that water come from? A fall HFE decision is usually decided in early October and then the HFE occurs a few weeks later. In a spring HFE scenario, if that decision is made a few weeks earlier, then the water would be taken out during the summer months. WAPA would prefer a proposal to make the decision early and mitigate the impacts. **[Paul Grams, GCMRC]** We could know by the fall if there is enough sand for a spring HFE, which would give a lot more time to consider how to move the water. It gets more complicated if there are high water releases and sand is not stored over the winter. **[Daniel Picard, Reclamation]** Regarding the accounting window, how many HFEs might be seen with the adjusted window as opposed to the current LTEMP process? **[Paul Grams, GCMRC]** The winter releases won't matter, and would need more details to get an answer to that. The number will change depending on the specifics. **[Ted Kennedy, GCMRC]** As examined in the brown trout report with a spring and fall accounting window, there could be 21 HFEs. If only looking at a spring HFE, then it would be 16, which is fewer than LTEMP under a single accounting window.

Archaeological sites eroding in the Grand Canyon

[Helen Fairley, GCMRC] Presentation on NPS and USGS monitoring and research on effects of human and natural processes on archaeological site conditions, which includes looking at historical photographs to see how sandbars are changing over time. Many sites are eroding, and many are no longer connected to sediment sources. The project was informed by tribal partners to consider natural resources to minimize impacts on the sites.

Q&A and discussion

[Larry Stevens, GCWC] The photos are not very promising for LTEMP to reach its goals. There are disappointing results coming out of this program and larger uncertainties than previously recognized.

Public Comment

[Lynn Hamilton, GCRG] Was struck by the Secretary's Designee's comment this morning about the nation's call to protect Grand Canyon. He read out the key segment of the Grand Canyon Protection Act of 1992. It is now 30 years later. This call to protect the Grand Canyon is all the more challenging and

critical today. Before the act had a name it was known as the Beach Bill because of the impacts of Glen Canyon Dam on downstream resources. The current state of those beaches is woeful. They have been devastated and conditions continue to deteriorate without an HFE since 2018. The sediment accounting periods that are part of LTEMP are no longer relevant for our low water future. We cannot wait to make these changes and adapt to the flexibility needed in the future. We need to conduct HFEs in a way that benefits multiple resources. This is a new time. We need to do it now.

Adjourned at 4:32 PST (5:32 MST)

Thursday, February 16, 2023

Start Time: 9:01 AM PST (8:01 AM MST)
Conducting: Wayne Pullan, Acting Secretary's Designee to the AMWG and AMWG Chair.
Facilitator: Terra Alpaugh, Kearns & West, Inc.
Meeting Recorder: Carliane Johnson, SeaJay Environmental, LLC.

Welcome and Administrative

- **Introductions and Determination of Quorum [Terra Alpaugh, Kearns & West]** Quorum reached with 21 members represented.
- **Federal Agency Updates:**
  - **ESA Update: Humpback chub, Razorback sucker [Heather Whitlaw, USFWS]** In March 2018, USFWS Region 6 finalized the Species Status Assessment (SSA) and five-year review for humpback chub. In October 2021, humpback chub was reclassified from Endangered to Threatened. The recovery team has been assembled, and the status review will be up to a two-year process. In July 2021, the razorback sucker was proposed for downlisting from Endangered to Threatened. The re-classification was on hold until recently, but the USFWS is now moving forward with the proposed downlisting. In April 2022, the Colorado pikeminnow's SSA was finalized. At the end of November, the notice of draft recovery plan was issued. Four comments were received. **[Larry Stevens, GCWC]** Are there species in the pipeline that are under consideration for listing in the Colorado River Basin? **[Heather Whitlaw, USFSW]** No.
  - **Smallmouth bass rapid response charter [Kathy Callister, Reclamation]** Interior agencies have been meeting about the charter text. A draft is expected by the end of February. Part of the delay has been waiting to get the Nonnative Fish Strategic Plan in place to integrate it.
  - **Staffing Updates [Scott VanderKooi, GCMRC]** Still working to fill the GCMRC Chief position. Hope to make an announcement soon. **[Helen Fairly, GCMRC]** Monitoring metrics draft is expected by end of February. There will be an internal review, and then plan to bring that to the April TWG meeting.
  - **Non-native Aquatic Species Management [Ed Keable, NPS]** The NPS perspective is that national parks are traditionally homelands of indigenous people. The NPS mission is to preserve the parks for recreational enjoyment. Impacts of drought are making NPS mission increasingly challenging. Lower water levels are causing water quality issues including low D.O., air quality concerns, and exposure of cultural resources. It is getting harder to find the funds for the facilities to respond to drought conditions. Smallmouth bass invasion is creating a clear and present danger to the recently downlisted humpback chub. Eroding beaches continue to degrade fish habitats, decrease recreational sites, and expose cultural sites. The Grand Canyon Protection Act and the LTEMP ROD provide the legal framework for

the NPS. The AMWG has had a spirit of compromise for decades, and the challenges keep getting more complex. It is hoped that this collaboration continues to face these challenges.

- **LTEMP Litigation [Rod Smith, DOI Solicitor's Office]** This litigation was filed in the fall of 2019. It is now resolved. This was challenging LTEMP NEPA on climate change grounds. Many states and districts intervened on the same side of the federal government. The effect right now is that LTEMP can continue to be used as a foundation for actions.

NEPA Update: Development of EA for Glen Canyon Dam/Smallmouth Bass Flow Options & SEIS for the 2007 Interim Guidelines

[Genevieve Johnson, Reclamation] The SEIS Notice of Intent (NOI) was published in November 2022. Reclamation has completed scoping and is starting to develop the alternatives as well as the impact analysis. More than 1,300 public comments have been received, which have been posted. Reclamation is currently analyzing those comments. Expect to have a draft ready for public review by April. Also considering how to release the draft alternatives before April. **[Candice Hasenyager, UDWR]** What is the number of alternatives being considered? **[Genevieve Johnson, Reclamation]** Won't have that number until the analysis is complete.

[Bill Stewart & Genevieve Johnson, Reclamation] Presentation on the smallmouth bass EA operational alternatives. The best opportunity during an invasion to prevent establishment is early on. The temperature threshold for when smallmouth bass begin to spawn is an important number. The current elevation at Glen Canyon Dam is 3,522 feet. Minimum power pool level is at 3,490 feet, at which point the bypass tubes would be used to cool the water. As the water level drops, these warmwater, nonnative fish, which generally spend their time in the upper layer, become entrained through the dam. As warmer water flows to the dam, more nonnatives can get established. The flow option alternatives are focused on keeping the water cold (below 16 ^{o}C) to prevent spawning. The draft EA will be released soon for a 14-day review period. Hope to get a decision by mid or end of April at the latest.

Q&A and Discussion

[Leslie James, CREDA] On the cost estimates for hydropower, what datasets were used in the additional analysis for Option A for medium bypass, which was the most probable scenario? Were the actual summer volumes much higher so that would have greater impacts when bypass is implemented? **[Charles Yackulic, USGS]** Those estimates were based on the August Colorado River Mid-term Modeling System (CRMMS). Two things have happened since then: 1) the amount of predicted runoff has increased, which would mean less bypass; and 2) Reclamation held back water, which should lead to more bypass. There is a tradeoff with higher elevations at the beginning of the summer, but then the water will need to be moved in the summer, which could increase the costs. The CRIMS traces assume water will be moved based on what should be moved over the course of the year even though the releases right now are set through April.

[Leslie James, CREDA] When generation is not occurring due to a bypass, that is less total energy in the interconnected system. WAPA has contracted obligations to make up that difference on the market. The rate paradigm is also affected. The analysis needs to look at impacts to the actual operating utilities that have to serve 4.5 million customers from this resource, and whether there will be resources available in the market. Did the analysis address reliability and resource availability in the Southwest given how tight the reserve margins are right now? **[Bill Stewart, Reclamation]** Yes. **[Ed Keable, NPS]** This group is here

to address the interests of the Grand Canyon Protection Act, which does not exclusively address hydropower. This is why it is so challenging. For the cost analysis, the range of potential cost to hydropower from an SMB flow could also be less than $40 million because it depends on the need to use bypass or the temperature of the water. Is it correct that it could be less than $40 million? **[Bill Stewart, Reclamation]** What has been analyzed so far is impacting temperature all the way down to the LCR. Would like to get the most recent modeling efforts and temperature projections between the draft and final EA. Will look at different temperature distances downstream. If other river miles are measured, it will require less bypass/less mixing. **[Charles Yackulic, USGS]** The biggest factors will be the temperatures near the penstock and deeper. The amount of gain from targeting a less distant area depends also on the monthly volume. If there is a ton of water in July, that water is not going to cool quickly. There will not be as big a change as during a lower volume month. The two key factors are the inflows and outflows, particularly in July and August. Costs will be higher in the summer months. Only signs of reproduction have been seen in the Glen Canyon area and a single adult fish was seen downstream, but it was not reproducing.

[Leslie James, CREDA] Market price issues in the analysis are an additional uncertainty such as what happens during extreme weather in the summer. The importance is to understand the assumptions and what the modeling shows. **[Charles Yackulic, USGS]** In the modeling so far, prices are important in that variability (such as what happened last year in September), but the impact of water hydrology is huge. There are some months when the cost is zero because there was no need to do the bypass option. In the best case, it would be somewhere in the scale of $5-10 million to do bypass.

[Wayne Pullan, AMWG Chair] What is the percentage reduction of power generation in the summer months? **[Brian Sadler, WAPA]** That information is available, but the range is great between the four options. Option B would be most expensive (1.6 maf would be bypassed at 570,000 megawatts per hour (MW/hr) of energy). Option C would be the less impactful (850,000 af; 293,000 MW/hr of energy). **[Wayne Pullan, AMWG Chair]** Do the considerations include how long the options are considering the "Radtke effect" that pushes water to the dam? **[Charles Yackulic, USGS]** That is in the model and is one of the things that creates great variability depending on hydrology. It is a remarkably linear effect between inflow and depth to 16 ^{o}C. One interesting effect is that it disappears in the second year. This makes it challenging in year 1. Costs tend to decline over time. If elevation is higher, then next year will be much less in cost and it may not even be necessary. For Option B, that was based on analyzing a single hydrology similar to the initial analysis in Option A. The way to think about it, is that difference between Option A and Option B are additive to get to the secondary analysis under Option A. Options C and D were analyzed as 20-week experiments, but they could be done in 12 weeks and that would lower costs. **[Ed Keable, NPS]** Of the various options, is Option B the most expensive, but also the most effective? **[Bill Stewart, Reclamation]** Yes, it allows the cold water to stay in marginal areas where there might be reproduction.

[Brian Sadler, WAPA] The Basin Fund will be at $129 million at the end of this year to operate the utility. The costs to operate are around $80 million, which are going up. Last year's carryover money was helpful. Also received $85 million from the Bipartisan Infrastructure Law. These funds are included in the balance. WAPA would be at risk of not operating if these funds had not been available. $100 million additional is available in the current appropriation, but those funds must be returned to the Treasury after the drought crisis is over. Using bypass is an experiment by this program with multiple impacts between $40 to $80 million and a lot of unknowns. The model can only be looked at based on what is

known now, including prices. Taking away the resource this summer and not generating 500,000 MW/hr means less energy on the market. These prices could go much higher. Last summer, California had to call emergency operations because they could not find the energy to avoid rolling blackouts. There are huge risks. The Nonnative Fish Strategic Plan discusses triggers and off ramps. An off ramp would be important if there are skyrocketing prices. Also need to find mitigation options during high prices. **[Ed Keable, NPS]** As noted, this is the start of the invasion. This is the time for the federal government to act. If we don't succeed and water has to be managed to save the humpback chub, the future of power is going to be even more complicated.

[David Brown, GCRG] Now is the time to act and it will get harder in the future. Appreciates the power challenges. California had it rough in September and it would have been even worse if they had not bought a bunch of batteries. Assume the EA will include WAPA's cost assumptions per MW/hr? **[Erik Stanfield, Navajo Nation]** Support Leslie's comments about having more data. It is very important to Navajo, too. The cost estimates seem much larger than the exclusion devices. Are they being measured against each other? Having an exclusion device would seem to mean that these other options become less necessary. **[Bill Stewart, Reclamation]** An exclusion device would be several years out versus operational options that could be implemented in June to catch that early invasion curve. **[Matt Rice, American Rivers]** This is the moment when tough decisions are needed and all need to accept there is going to be some pain. If action happens now, then maybe this does not need to be a regular occurrence. The recovery of humpback chub is a remarkable story. If decisions are made for the benefit of short-term interests at the expense of hundreds of millions of dollars in recovery, this would create massive challenges, expense, and conflicts in the future.

[Kevin Garlick, Utah Municipal Power Agency (UMPA)] UMPA is one of the power customers of WAPA. Glen Canyon is a critical resource. Supports a solution and the need for an immediate response. Just have a lot of questions about the costs and the analysis. More information is needed. There are transmission constraints. Glen Canyon is a hub for many utilities. If that supply is reduced, then it must be met by other sources and there may be other issues that need to be addressed. UMPA is trying to understand the analysis so it can be prepared to deal with it in the coming months.

Consider Changes on the Nonnative Fish Strategic Plan and Propose a New Motion

[Laura Dye, CRCN] Revisions that were made last night were displayed. The preamble references what has been stated by tribal members. Chapter 3 adds more background on tribal member concerns of the GCDAMP. Attachment H includes comments received from Hopi and Zuni during the review period.

> **Motion:** *"The AMWG recommends the Secretary of the Interior adopt the Nonnative Fish Strategic Plan to serve as a framework to prevent, detect, and respond to invasive fish establishment below Glen Canyon Dam."*

[Larry Stevens, GCWC] Moves to adopt the motion. **[Jim Strogen, FFI/TU]** Seconds the motion. The motion passes with consensus.

Stakeholder Updates

States:

- **[Kristen Johnson, ADWR]** The director of ADWR was reappointed. ADWR also signed off on the six-state letter to Reclamation. A new Arizona water management area was recently approved by voters, and a new irrigation non-expansion area was approved by the director.

- **[Ryan Mann AZGFD]** AZGFD continues to work as cooperators to conduct long-term fish monitoring both downstream and at Lees Ferry. Have a number of trips planned this spring. This monitoring program is important for detection of high-risk, nonnatives, to look at status of native fish communities, and get the status of the rainbow trout fishery. AZGFD remains concerned about low D.O. and high temperature releases. Work funded outside GCDAMP continues at Pearce Ferry rapid to look at potential fish barrier between Lake Mead and Grand Canyon; that project will be finished this summer but looking at opportunities to continue that work.
- **[Shana Rapoport, CRBC]** New chair and vice chair were recently appointed to the CRB. California also submitted its own letter to the SEIS modeling scenarios and is actively involved in negotiations with the other states on that topic.
- **[Jon McClow, State of Colorado]** The Colorado Water Conservation Board (CWCB) and some regional water conservation districts are reviewing applications for the System Conservation Pilot Program. Colorado put significant resources into drafting the six-state SEIS and continues to discuss the challenges with all seven states. CWCB continues to evaluate the feasibility of its Demand Management program, which is part of the five-point program proposed by the Upper Colorado Basin states. Senator Hickenlooper convened a Colorado River Caucus of the seven basin states to meet the challenges of the current drought.
- **[Ali Effati, New Mexico Interstate Stream Commission (NMISC)]** Governor was re-elected so no changes in leadership. New Mexico is involved in the five-point planning effort and one of the six-states that drafted a modeling alternative. Also working with federal and non-federal partners to finalize funding for the Colorado River, Upper Colorado River, and the San Juan recovery programs. Working on legislation language for reauthorization.
- **[Sara Price, CRN]** Nevada was one of the six states that submitted the consensus modeling alternative to Reclamation. CRN is one of the agencies tackling evaporative loss in the lower basin and including that in the alternatives. Made significant headway on reducing water use (such as turf restriction and evaporative coolers). CRN is engaged in analyzing hydropower issues from low lake levels and low flows and developing mitigating alternatives.
- **[Charlie Ferrantelli, State of Wyoming]** Wyoming was one of the members of the six state letter as part the SEIS. Working on the five-point plan. Have three parallel processes going on, one of which was the DROA for 2023, which may result in releases from the upper Colorado River Storage Project (CRSP) unit. Also reviewing applications for the System Conservation Pilot Program (deadline extended to March 1). Conducting studies under the five-point plan in the Upper Basin to understand the amounts of water that could be contributed to projects related to system conservation or demand management to understand consumptive uses. Will be working on the 2026 planning guidelines.
- **[Candice Hasenyager, UDWR]** Utah has 150% of snow water equivalent statewide and expects more storms next week. Soil moisture is above normal, but reservoirs are 50% of capacity so still a long way to go. Utah is participating in the five-point plan pilot project and getting good response from water users. Pursuing legislation with the Upper Basin Demand Management Program to make it more feasible in Utah when that program is stood up. The Continued Strict Water Management Administration is another part of the five-point plan. Utah is in the middle of its legislative session with a lot of interest in water. There is currently proposed $450 million

toward water conservation and water infrastructure programs including $200 million for irrigation optimization projects, and $10 million for turf buyback.

Tribes:

- **[Jakob Maase, Hopi]** Hopi is interested in a herpetology/amphibian monitoring project. Next river trip is August 2023.
- **[Martina Dawley, Hualapai Tribe]** Have a new chairperson. Two river trips are planned in June to look at sandbars, and another trip in October. If anyone is interested in visiting or contacting the Hualapai regarding consultations, please contact Martina at 520-440-7449. It may be hard to contact tribal members, but please keep trying.
- **[Erik Stanfield, Navajo Nation]** New leadership was elected in the Navajo Nation Government Council including the president, vice-president, and 13 new council members so a lot of new learning will be happening. Can help facilitate any visits. Also concerned about low water at Lake Powell with a number of issues around cultural resources, sediment, and invasive species that have been part of the work with NPS. River trip is in May.
- **[Edward Wemytewa, Pueblo of Zuni]** Zuni Tribal Council is new, taking office on December 25. Have invited Chair Wayne Pullan to visit, which is scheduled on March 15.
- **[Daniel Bullets, Southern Paiute Consortium]** Annual monitoring trip is scheduled for June.

Environmental Non-Governmental Organizations (NGOs):

- **[Matt Rice, American Rivers]** In addition to reviewing the SEIS and providing comments on the smallmouth bass EA, American Rivers is helping to direct federal money to resilience projects, supporting Colorado to advance projects such as alternative forages that use less water, focusing on state priorities in Colorado and Arizona, and supporting efforts to protect the LCR and to document the returning river and rapids in Lower Cataract Canyon. River trips are at end of March on the San Juan River and May for Upper Basin stakeholders.
- **[Larry Stevens, GCWC]** GCWC is similarly providing comments on various documents. Also involved in restoration at Paria Beach to reintroduce native trees to that sandbar with lots of work planned next month. This is probably the most visited point along the river in the park. GCWC has a recent paper on groundwater and springs.
- **[David Brown, GCRG]** An in-person guide training seminar will be held in Hatch River. Planning a river trip with the superintendent. The Adopt-A-Beach program is in its 27th year and continues to document the evolving state of the beaches.

Recreation:

- **[Jim Strogen, FFI/TU]** Reflects on others' comments about hydropower, CRSP groundwater issues, and water conservation efforts, which all point to the need to engage strategies outside of the AMWG. As AMWG members, we need to be advocates to help the river.

Federal Power Purchasers:

- **[Leslie James, CREDA]** The board is working on the SEIS and the smallmouth bass EA. WAPA is in the middle of another rate case and is also considering participating in the Regional Transmission Organization (RTO) with the Southwest Power Pool (SPP). Conducting outreach to newly elected and existing members of Congress about the drought. It is very challenging to explain how electricity is generated. Can provide anyone interested in having a field trip with the utilities to see how the grid works.

- **[Kevin Garlick UMPA]** Drought has been financially challenging for utilities as they need to replace the reduction from WAPA. In addition to cost, is the issue of reliability: many utilities are struggling to meet the growing demands. UMPA has added 85 MW of solar power, and customers can sign up to be 100% renewable. UMPA is trying to be sustainable, affordable, and reliable.

2023 GCDAMP Annual Reporting Meeting Update – Part 3

[Maria Dzul, USGS] Presentation on USGS fish studies in Glen Canyon, Grand Canyon and the tributaries. Rainbow trout monitoring showed good recruitment early on and then started to decline in later years; there are not many young fish to replace the older population. The opposite is occurring with brown trout, which seem to be doing better under warm water conditions. Over the past few years, warm water fish composition is changing, and brown trout are becoming more prevalent in Lees Ferry. The catch in the Brown Trout Incentivized Harvest Program had been far below the target removal number of 210 per month to be effective but that was exceeded for the first time in December 2022, and January 2023 also had very high numbers. Smallmouth bass removal efforts (electrofishing) targeting juveniles in Glen Canyon started in September 2022, but it is not clear if removal is effective at preventing establishment. Abundance of humpback chub in the western Grand Canyon and near the LCR confluence has been high and there is rapid growth as the water warms, particularly in eastern Grand Canyon, but it's too early to tell if warm water is affecting survival rates. NPS has been translocating humpback chub into the tributaries and removing trout in Bright Angel Creek; USFWS are moving humpback chub above Chute Falls.

Q&A and discussion

[Jim Strogen, FFI/TU] What is the reason for the effectiveness of translocations at Chute Falls? **[Maria Dzul, USGS]** The water is clear and there is a lot of primary production with speckled dace as a food base. **[Larry Stevens, GCWC]** There are two big backwaters at Paria River and at River Mile 2. Would these be good places to start monitoring for smallmouth bass? **[Maria Dzul, USGS]** Yes, that would be a good idea as an area to target. **[Erik Stanfield, Navajo Nation]** Would like to hear more about the ethical issues related to the smallmouth bass predator study. **[Scott VanderKooi, GCMRC]** USGS works under an Animal Care and Use Committees. USGS is standing these up across the science centers; in the past they had been part of the research universities. **[Leslie James, CREDA]** Any evidence of reproduction of smallmouth bass? How is establishment defined? **[Charles Yackulic, USGS]** NPS caught some very small fish in July (likely a couple of weeks old at most). At that size of 18-20 mm, we know there has been reproduction in Lees Ferry. The question is what proportion was reproduced versus passed through the dam. This is a question for Kevin Bestgen who is looking at their otoliths. Establishment is defined as having enough reproducing individuals that have overcome the Allee effect. How many fish is needed to get over that effect is one of the questions that the task force debated as to. Little fish have lower survival rates so even hundreds of them might not be enough. The amount seen, however, is not a good sign. Another year and they might be over the Allee effect.

Comments about HFEs from Yesterday's Conversation

[Wayne Pullan, AMWG Chair] Wants to discuss WY 2022 and the accounting window, in general. Reclamation started 2022 at a 7.0 maf in Lake Powell and withheld 523,000 af in the first half of the year that will need to be released in the second half of the year, though there is uncertainty about the total amount that will be released. Balancing is also probably needed, but there are ongoing discussions with

the states about that. Question for the AMWG: Given the planning for those releases and Reclamation's mission, is there a possibility for an HFE during that period? It will be too late to discuss this in May. The SEIS concerns flows during the summer and their effects on smallmouth, but Reclamation needs to consider all the potential resource impacts from the decisions on flows. Requests that AMWG members make recommendations about HFEs in WY 2023. **[Rod Smith, DOI Solicitor's Office]** In providing comments, be mindful that there is some amount of water that needs to be released in 2023. Reclamation wants to know if there is some resource that can benefit from that release.

ACTION: The Technical Work Group (TWG) was directed to review the sediment accounting window and provide feedback to Reclamation. The following is intended to provide a guidance for this directive:

- Consider the information developed by GCMRC in response to the Secretary's Designee's August 18, 2022 request to evaluate high-flow experiments under low-elevations/low-flows and any other pertinent information to evaluate the accounting window.
- The TWG is directed to work with GCMRC to draft a proposal for amending the HFE protocol. The proposal should consider the science, approach, and compliance elements that may be needed to make changes to the protocol.
- The elements of the proposal are requested by the May AMWG meeting, and the full proposal is requested by the August AMWG meeting.

Perspective Sharing: Navajo Tribal Utility Authority (NTUA)

[Arash Moalemi, NTUA] Presentation on NTUA, which was created by the Navajo Council in 1959 to cover a service area within Utah, New Mexico, and Arizona. NTUA was created after the Rural Electrification Act of 1935 was passed, which benefited rural lands but did not benefit tribal lands. NTUA's. goal is to provide affordable utilities to those who cannot afford them and services to those who still do not have them. There are still 14,000 homes without electricity, many in the high desert. NTUA's currently provides 58% clean energy, supported by CRSP hydropower. Hydropower allows the Navajo Nation to keep rates affordable and benefits other tribes that are allocated this hydropower but who don't have a tribal utility company that can benefit from it, since the Benefit Credit Arrangement allows NTAU to compensate them for their share.

Q&A and Discussion

[Christina Noftsker, NMISC] Is the Navajo Nation building a new solar array in New Mexico? How much renewable resources will be coming online? **[Arash Moalemi, NTUA]** Have built a 72 MW solar plant in Utah that will go online in April. The revenue from these projects must be used to connect homes to the grid. There are other projects being considered, but it is a longer process on tribal lands. **[Ed Keable, NPS]** Is that project in the area of the former Navajo Energy Station (NES), and can it use that infrastructure? **[Arash Moalemi, NTUA] The** NES never benefited Navajo communities. Looking to develop any area but doing those sorts of things won't benefit the 14,000 homes needing to be electrified. It will provide a more reliable system for current customers. **[Ed Keable, NPS]** One of the challenges AMWG has discussed is the availability of energy if Glen Canyon Dam is diminished. Is there capacity in the solar or wind community to pick up some of that loss? How quickly could NTUA come up to speed to supplement this loss? **[Arash Moalemi, NTUA]** From the tribal perspective, there is currently 58 MW in Arizona, another 72 MW will be available by April, and a 200-MW plant is being built. Not all of the energy will be used within the CRSP system. NTUA is considering other options for power in CRSP

and other federal projects that may offset that loss. One of the challenges is the timeframe for these projects. On Navajo Nation lands, the process takes a little longer. **[Cliff Barrett, UMPA]** How much water comes from CRSP to the Navajo Nation? Is NTUA also getting water benefits from CRSP? **[Arash Moalemi, NTUA]** Don't know how much, but that is correct; NTUA gets that benefit as well. **[Sheri Farag, Salt River Project]** What other firm generation is in NTUA's portfolio if it were to lose 20% of hydropower? **[Arash Moalemi, NTUA]** Would have to go to the market for that loss. Solar and other renewable energy is not always reliable, and it would also be more expensive. NTUA has contracts for firm generation, but it would not cover loss from hydropower. **[David Brown, GCRG]** Do you have a 10-year Integrated Resource Plan (IRP)? Given the lack of firm generation, what kind of planning do you have for future needs? **[Arash Moalemi, NTUA]** NTUA has a 10-year IRP and certain funding opportunities through U.S. Department of Agriculture and U.S. Department of Energy. NTUA has firm energy contracts but is currently looking at a number of options (including from loss of hydropower and offsets from natural gas resources). **[Erik Stanfield, Navajo Nation]** What is the actual impact at the household level from these costs? If NTUA's rates have not gone up in 14 years, what would be the effect of a $40 to $80 million experiment? **[Arash Moalemi, NTUA]** NTUA has other resources to ensure rates do not need to go up such as revenues raised go back to the utility. Have also established a communication business that has kept rates low. Looking at the effects now on hydropower costs.

GCDAMP Tribal Liaison Report

[Jamescita Peshlakai, Tribal Liaison] Presentation on tribal liaison activities. The five tribal AMWG and TWG members are independent, individual, diverse, and sovereign. Some are federally recognized and may include more than one tribe such as the Southern Paiute Consortium. There are communications and visits to keep everyone updated. Also working with the tribes on river trips, budgets, and internships, as well as different projects and documents. The next LTEMP Programmatic Agreement (PA) annual meeting is scheduled for April 10. The LTEMP PA Annual Report will be submitted for comments 45 days before that meeting. There are also meetings held every quarter on the fourth Monday of that month. Cultural sensitivity training is required in LTEMP, and training funding is part of the TWP.

Public Comment

[Jen Pelz, Grand Canyon Trust] Appreciates all the work of AMWG members on these challenging problems and the Secretary's Designee's comments on the importance of the Grand Canyon Protection Act. The Secretary's Designee mentioned that the SEIS will need to first figure out the annual volume limits released from Glen Canyon Dam before the monthly release volumes can be addressed. There is concern about that because the monthly volume limits need to be known to analyze the impacts of that action on resources.

[John Dillon, Grand Canyon Outfitters] Represents 16 commercial small business outfitters that have concessions with the NPS. Generally, these are 10-year contracts. Grand Canyon Outfitters also take about 22,000 people each year through the Grand Canyon with an 18 to 24-month waiting list. These trips are one of the most influential things these individuals will ever do and might be endangered if the beaches are not available for both their experiences and to educate them about this system. The outfitters also pay an annual franchise fee back to the NPS of around $5 million. Please move the water in a spike flow.

[Alicyn Gitlin, Sierra Club] There are both legal and ethical requirements to protect the Grand Canyon. The AMWG charter says it will advise the secretary in meeting environmental and cultural

commitments. This group is not mandated to advise on hydropower, yet it does consider it as an additional impact. The time to protect the canyon is now. What is the cost of delayed action or inaction or losing a species? The sediment accounting window and the process used to decide upon experiments need to change, and there also needs to be a more natural hydrograph. Why does there even need to be a sediment accounting window? Stop talking about fall HFEs and fix LTEMP for the long-term.

[Miché Lozano, National Parks Conservation Association (NPCA)] NPCA protects National Parks. The Grand Canyon National Park is at risk from invasions of smallmouth bass because of lower water levels. Ultimately, Reclamation needs to act to remedy the situation. NPCA insists that the park does not become an ecological sacrifice zone. We must take action to stop invasive smallmouth bass, we need lower temperatures in the LCR, and we must have HFE(s) to restore the beaches.

[Lynn Hamilton, GCRG] Appreciates everyone's effort to move this forward. Sees there is movement in doing something this spring and setting a framework for future HFEs not restricted by seasonality.

WRAP-UP

[Wayne Pullan, AMWG Chair] The management of this group is the gold standard in DOI. This has been one of AMWG's best days. The framework was a heavy lift to achieve a unanimous recommendation.

Next AMWG meeting dates:

- May 17, 2023 (webinar)
- August 16-17, 2023

Meeting adjourned at 3:24 PST (4:24 MST)

AMWG Members, Alternates, and Leadership

Kelly Burke, GCWC
Kathy Callister,
Martina Dawley, Hualapai Tribe
Laura Dye, Colorado River Commission of Nevada
Charlie Ferrantelli, State of Wyoming
Kevin Garlick, UMPA
Michelle Garrison, Colorado Water Conservation Board
Candice Hasenyager, Utah Division of Water Resources
Leslie James, CREDA
Edward Keable, NPS
Arden Kucate, Pueblo of Zuni
Charles "Chip" Lewis, Bureau of Indian Affairs
John McClow, State of Colorado
Scott McGettigan, State of Utah
Daniel Picard, Acting Designated Federal Officer
Sara Price, CRCN
Wayne Pullan, Acting Secretary's Designee
Shana Rapoport, CRBC
Matt Rice, American Rivers
Brian Sadler, WAPA
Larry Stevens, GCWC
Jim Strogen, FFI/TU
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Laura Tennant
Scott VanderKooi
David Ward
Charles Yackulic

Other GCDAMP Members and Interested Persons

Terra Alpaugh, Kearns & West
Jeff Arnold, NPS
Eric Balken, Glen Canyon Institute
Jan Balsom, NPS-GRCA
C Lochhead
Brandon Loomis, Arizona Republic
Miché Lozano, National Parks Conservation Assn.
Jakob Maase, Hopi Tribe

Raymond Benally, Bureau of Indian Affairs
Rob Billerbeck, NPS-GLCA
Mateo Boneo
Mark Braden, Cetera
David Braun, Sound Science
D Broffitt
David Brown, Recreation Interests
Kevin Bulletts, Southern Paiute Consortium
Daniel Bulletts, Southern Paiute Consortium
Shane Capron, WAPA
CareForNature
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Colleen Cunningham, NM Interstate Stream Commission
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Laura Dye, Colorado River Commission of Nevada
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Erin Bragg
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Joe Giddens,
Alicyn Gitlin, Sierra Club
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Lynn Hamilton, GCRG
Sky Hedden, AZDFD
Emily Higuera, ADWR
Steve Hogseth
Carliane Johnson, SeaJay Environmental
Kristen Johnson, AZDR
Matt Kaplinski, Northern Arizona University
Trent Keller, Western River Expeditions Inc.
Hunter Kennedy, University of Chicago
Samantha Kepley, Brown & Caldwell
Michelle Kerns, NPS
Mark Lamb, USFWS
Sara Larsen, Upper Colorado River Commission
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Tony Mancuso, State of Utah
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JoJo Matson
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Emily Omana Smith, NPS-GRCA
Jenny Pelz, Grand Canyon Trust
William "Bill" Persons, FFI/TU
Harold Peterson
Brittany Peterson, AP News
Zak Podmore, Salt Lake Tribune
Amanda Podmore, Grand Canyon Trust
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Annalise Porter, Southern Nevada Water Authority
Brent Powers, Navajo Dept of Fish and Wildlife
Ted Rampton, CREDA
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Justin Salamon, Canyon Explorations
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Gary Tallman, FFI/TU
Melissa Trammell, NPS
Richard Turner
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Edward Wemytewa, Pueblo of Zuni
Pilar Wolters-Rinker, USFWS
David Wooten, Bureau of Indian Affairs
C Zielinski

Acronyms and Abbreviations

°C – degrees Celsius
ACUC – Animal Care and Use Committee
ADWR – Arizona Department of Water Resources
af – acre-feet
AMWG – Adaptive Management Work Group
AZGFD – Arizona Game and Fish Department
BAHG – Budget Ad Hoc Group
CRBC – Colorado River Board of California
CRCN – Colorado River Commission of Nevada
CREDA – Colorado River Energy Distributors Association
CRMMS – Colorado River Mid-term Modeling System
CRSP – Colorado River Storage Project
CWCB – Colorado Water Conservation Board
CY – calendar year
DFO – Designated Federal Officer
D.O. – dissolved oxygen
DOI – (U.S.) Department of the Interior
DROA – Drought Response Operations Agreement
DWR – (Utah) Department of Water Resources
EA – environmental assessment
EIS – environmental impact statement
FFI – Fly Fishers International
GCDAMP – Glen Canyon Dam Adaptive Management Program
GCMRC – Grand Canyon Monitoring & Research Center
GCRG – Grand Canyon River Guides
GCWC – Grand Canyon Wildlands Council
HFE – High Flow Experiment
IRP – Integrated Resource Plan
LCR – Lower Colorado River
LTEMP – Long-Term Experimental and Management Plan
maf – million acre-feet
mg/l – milligrams per/liter
MST – Mountain Standard Time
NEPA – National Environmental Policy Act
NES – Navajo Energy Station
NGOs – non-governmental organizations
NMISC – NM Interstate Stream Commission
NOI – Notice of Intent
NPCA – National Parks Conservation Assn.
NPS – National Park Service
P&I Team – Planning & Implementation Team
PA – Programmatic Agreement
PST – Pacific Standard Time
Reclamation – Bureau of Reclamation
ROD – Record of Decision
RTO – Regional Transmission Organization
SEIS – supplemental EIS
SMBAHG – Smallmouth Bass Ad Hoc Group
SME – subject matter expert
SNWA – Southern Nevada Water Authority
SSP – Southwest Power Pool
SSA – Species Status Assessment
TU – Trout Unlimited
TWG – (GCDAMP) Technical Work Group
TWP – Triennial Work Plan
UDSR – Utah Division of Water Resources
UMPA – Utah Municipal Power Agency
USFWS – U.S. Fish & Wildlife Service
USGS – United States Geological Survey
WAPA – Western Area Power Administration
WY – Water Year