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**SOUND SCIENCE LLC**  
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**GCDAMP, TWG Non-Native Fishes Tabletop Exercise**  
**April 12-13, 2022**

**Draft Final Report**

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## Introduction

Sound Science LLC facilitated a “tabletop exercise” as part of an online meeting of the Glen Canyon Dam Adaptive Management Program (GCDAMP) Technical Work Group (TWG) on April 12-13, 2022. The exercise was planned to provide the TWG with an opportunity to learn about and discuss a potential emergency resulting from escapements of non-native predatory fish through Glen Canyon Dam. This potential exists because falling reservoir levels in Lake Powell put warmer surface waters and their biota—including several non-native predatory fish species—in increasing proximity to the intake (penstock) for the dam’s turbines. These conditions may enable escapements of living non-native fish through the dam. Any such escapements potentially could result in these fish becoming established in the Grand Canyon ecosystem in Glen, Marble, and Grand Canyons and their tributaries, threatening endangered native fishes and the existing rainbow trout tailwater fishery.

The exercise focused mostly on potential escapements of two non-native fish species, smallmouth bass (*Micropterus dolomieu*) and, secondarily, green sunfish (*Lepomis cyanellus*). Both are native to eastern North America. Other non-native fishes present in Lake Powell and mentioned during the TWG meeting that have escaped or could escape through the dam and potentially threaten endangered native fishes and the rainbow trout fishery include walleye (*Stizostedion vitreum*) and gizzard shad (*Dorosoma cepedianum*), both also native to eastern North America.

As stated in the final exercise plan and agenda, the specific purpose of the exercise was *to help the TWG identify areas of potential importance to the AMWG [Adaptive Management Work Group], concerning: (a) agency responsibilities for monitoring and responding to such events, (b) possible ways in which these agencies may respond to such events and ways in which these actions may affect the river and its canyons and biota, and (c) possible roles for the AMWG and its TWG in the decision-making process for such actions.*

The TWG meeting and the exercise took place online, on the Webex meeting platform. The Bureau of Reclamation managed the technical aspects of the virtual meeting.

This report describes the exercise and summarizes its results under the three topics identified in the above statement of purpose, summarizes the results of a post-exercise, online survey of participants, and provides an overall summary of findings.

The exercise participants found the exercise—and the presentations that preceded it in the meeting agenda—informative and useful. The participants also expressed concerns about:

- a. Agency capabilities to detect and report on non-native fish abundances and activity both above and below the dam quickly enough to guide management
- b. The identification of levels of abundance and patterns of activity that should be treated as triggering thresholds for reporting warnings or taking other management actions
- c. The processes through which federal agencies will make decisions on preventing or responding to escapements, or make decisions on water distribution and hydropower generation among the reservoirs in the Upper and Lower Colorado River Basins that in turn will affect the potential for escapements through Glen Canyon Dam
- d. The extent to which the federal agencies will consult with the AMWG and its TWG as parts of these decision-making processes
- e. Funding limitations at both the state and federal levels affecting monitoring efforts, potential actions to prevent escapements, and potential actions to respond to escapements
- f. The extent to which federal agencies will be able to consult meaningfully with the tribes on planned actions in the face of potentially urgent needs to respond to escapements
- g. Limitations at both the state and federal levels in the availability of equipment, personnel, and logistical capabilities for responding to escapements
- h. Limitations on the applicability and effectiveness of available mechanical and chemical methods for capturing/removing or killing/removing non-native fishes
- i. A need to prioritize prevention over detection and reaction to escapements.

Exercise participants noted that escapements of non-native predatory fish could erase the hard-won gains of recent decades in conserving the native fish species in the Grand Canyon ecosystem, and that failing to prevent or (as a less-desirable fallback) to contain such escapements would constitute an unacceptable systemic failure. TWG members also spoke about a need for a longer-term, holistic approach to managing the river and its ecosystem. Such an approach would need to consider the likely effects of climate change, continuing introductions of non-native species, and other factors that shape the Colorado River ecosystem.

## Exercise Design and Conduct

TWG Chair Seth Shanahan, TWG Vice-Chair Michelle Garrison, Clarence Fullard with the Bureau of Reclamation (Reclamation), and Emily Zmak with the Colorado Water Conservation Board began planning the Non-Native Fishes Tabletop Exercise in February 2022. David Braun and Robert Unnasch of Sound Science LLC joined the planning effort on April 6 after receiving a task order for the work under Reclamation IDIQ Contract # 140R3021D0010. Attachment I to this report presents the final agenda developed by this planning team, finalized on April 11.

Nine technical presentations on the topic of the exercise preceded the exercise in the TWG meeting agenda. These presentations significantly informed the discussions throughout the exercise:

1. *Basin Hydrology, Operations and Water Quality*, Heather Patno, Reclamation
2. *Lake Powell Water Quality Conditions*, Robert Radtke, Reclamation
3. *Update on Glen Canyon Dam/Lake Powell Dissolved Oxygen State-of-Practice Project*, Steve Hollenback, Reclamation
4. *Smallmouth Bass Management in the Upper Colorado River Basin*, Kevin Bestgen, Colorado State University
5. *Characterizing the Fish Assemblage of the Lake Powell Forebay: Identifying the Potential for Nonnative Fish Escapement through Glen Canyon Dam and into the Lower Colorado River*, Phaedra Budy, Casey Pennock, Barrett Friesen, and Gary Thiede, Utah State University
6. *Hydroacoustic Fish Distribution Lake Powell 2022*, Mike Horn, Reclamation
7. *Glen Canyon Fish Escapement Options*, Connie Svoboda, Reclamation
8. *Near-Term Threat of Smallmouth Bass Establishment below Glen Canyon Dam*, Smallmouth Bass Task Force, presented by Kirk Young, Fish and Wildlife Service (FWS), and Charles Yackulic, U.S. Geological Survey-Grand Canyon Monitoring and Research Center (GCMRC)
9. *NPS Rapid Response Compliance, High Risk Invasive Fish Concerns at Glen Canyon Dam in 2022*, Rob Billerbeck, National Park Service (NPS)

Several of the presenters, other members of the Smallmouth Bass Task Force (see Presentation 8), and other scientists from the GCMRC and NPS also participated in the exercise, contributing further to the deliberations. Their presentations are available through the GCDAMP and are not attached or summarized in this report.

Tabletop exercises such as the one conducted during the April 2022 TWG virtual meeting typically present the participants with a hypothetical but plausible scenario—a specific set of initial conditions—for which they or their organization(s) would need to be prepared, either to prevent it from occurring or to detect and respond to it, if that scenario actually occurred. Such exercises conventionally take place in the setting of a meeting, where the participants think their ways through (or “play out”) the framing scenario and its implications. Alternative types of scenario-based exercises may include or incorporate computer modeling and physical enactments or “drills.” The planning team for the TWG Non-Native Fishes Tabletop Exercise developed its framing scenario based on the most recent two-year forecasts for reservoir levels in Lake Powell and the history of detections of smallmouth bass and green sunfish below the dam as reported by the Arizona Game and Fish Department [AZGFD], FWS, GCMRC, and NPS.

A tabletop exercise consists of a sequence of discussions designed and guided to allow the participants thoroughly to examine and question planned preparations, preventive measures, warning systems, decision-making procedures, and management responses, and develop recommendations for addressing potential weaknesses, conflicts, and other concerns. Such exercises are intended to help the participants: (1) clarify roles and responsibilities, (2) explore additional information and management preparedness levels and needs, and (3) document program plans, procedures, and capabilities as well as logistical hurdles and overall program deficiencies. Such exercises therefore are a useful tool for the TWG: As noted by Reclamation in

its [statement of the roles of the TWG within the GCDAMP](#), “[t]he Technical Work Group is a subcommittee of the Adaptive Management Work Group... [with responsibilities] to develop criteria and standards for monitoring and research programs; provide periodic review and updates; develop resource management questions for the design of monitoring and research by the Grand Canyon Monitoring and Research Center [GCMRC]; and provide information, as necessary, for preparing annual resource reports and other reports, as required for the AMWG.”

The inclusion of the nine technical presentations in the TWG meeting agenda ahead of the exercise affected the exercise in four important ways. First, the presentations covered all aspects of the situation potentially facing the Grand Canyon ecosystem from escapements of non-native predatory fishes through Glen Canyon Dam. This coverage included the ways in which conditions in Lake Powell can affect the potential for escapements (Presentations 1, 2, 3, 5, and 6), the possibilities for preventing escapements through engineering modifications to the dam and its forebay (Presentation 7), lessons learned from efforts to monitor and control smallmouth bass in the Upper Colorado River Basin (Presentation 4), challenges for monitoring and managing non-native predatory fishes in Glen, Marble, and Grand Canyons (Presentation 8), and efforts by the Smallmouth Bass Task Force and its member agencies (AZGFD, FWS, GCMRC, NPS, and Western Area Power Authority [WAPA]) to formulate plans for detecting and responding rapidly to escapements (Presentations 8 and 9). Second, each presentation was followed by time for questions from the TWG. This time for questions and answers provided an advance opportunity for the TWG to begin working on the topic of the exercise, including identifying subjects for which they needed more information to help them understand the situation. Third, as noted above, the participation of the presenters and others from their institutions in the exercise allowed the TWG to continue asking questions of these experts throughout the exercise. Fourth, the inclusion of the presentations ahead of the exercise allowed the exercise to follow a simpler design than is typical of scenario planning exercises. Rather than strictly “playing out” the scenario provided for the exercise (see Attachment I), the exercise could focus directly on the questions and concerns of the TWG about the situation in the water and the planning efforts already underway.

The exercise took place over two days, as shown in the exercise agenda (Attachment I):

- Session 1 on Day 1 mostly consisted of breakout group sessions. Clarence Fullard, Reclamation, with input from David Braun, Sound Science LLC, assigned every TWG member and alternate, along with several GCMRC scientists, to one of the three breakout groups. The assignments ensured that each breakout group included representatives from every category of stakeholder with membership in the TWG (Federal Agencies, Indian Tribes, Basin States, Environmental Groups, Recreation Interests, Federal Power Purchase Contractors, and Other Stakeholders). Additional individuals were added to these breakout groups at the time of the exercise. Attachment II lists the original assignments of individuals to the three breakout groups, including the group facilitators. Some individuals participated in breakout groups other their original assignments. Sound Science LLC prepared guidance for the facilitation; Attachment III provides a copy of that guidance.
- Session 2 on Day 2 consisted entirely of summaries of the breakout group deliberations from Day 1 followed by discussions by the whole group, all facilitated by David Braun, Sound Science LLC, assisted by Christine Wisnewski, Sound Science LLC.

- Session 3 on Day 2 consisted entirely of discussions by the whole group, facilitated by David Braun, Sound Science LLC, assisted by Christine Wisnewski, Sound Science LLC.

Sound Science LLC also developed an online survey for the TWG members and alternates to complete after the end of the exercise. The survey had two purposes: (1) to poll the TWG on their final thoughts about the topic of the exercise; and (2) to poll the TWG on their final thoughts about the structure and conduct of the exercise itself. Attachment IV presents the survey form itself.

Sound Science LLC compiled the written notes from the breakout and full-group sessions, digitally generated transcripts of the Webex session recordings, the digital record of Webex “Chat” comments that accumulated over the course of the exercise, and the results of the online survey. The remainder of this report synthesizes this information and summarizes the results of the exercise under the three topics identified in the exercise statement of purpose. That is, the summary identifies areas in which the TWG expressed concerns relating to: (a) agency responsibilities for monitoring and responding to such events, (b) possible ways in which these agencies may respond to such events and ways in which these actions may affect the river and its canyons and biota, and (c) possible roles for the AMWG and its TWG in the decision-making process for such actions. The summary of TWG concerns about agency responsibilities distinguishes them under the headings of preparations, preventive measures, warning systems, and decision-making.

## Exercise Results: Agency Responsibilities

### Preparations

Discussions during the exercise and in the Webex Chat window did not identify any significant concerns about which agencies should be involved in preparations for detecting and potentially responding to threats of escapements or actual escapements. The presentations and discussions made it clear that these agencies—AZGFD, FWS, GCMRC, NPS, and Reclamation—are already working together on the Smallmouth Bass Task Force. However, TWG members did emphasize the importance of consultations with the Tribes and with the Western Area Power Authority (a member of the Task Force) and Federal Power Purchase Contractors as parts of preparations for responding to actual escapements. TWG members also asked questions about the possible role(s) of the TWG and AMWG in reviewing agency preparations, as discussed below (see Exercise Results: Possible AMWG and TWG Roles).

### Preventive Measures

Discussions during the exercise and in the Webex Chat window did not identify any significant concerns about the central role of Reclamation in efforts to prevent escapements through the dam. Meeting participants appreciated the information presented by Reclamation on its current study of possible options for preventing escapements, and on the need for approvals up to the Secretary of Interior (as well as likely through Congress) for any eventual decisions and actions on installing mechanical preventive measures either in the water or into the dam itself. However, TWG members did ask questions about the possible role(s) of the TWG and AMWG in reviewing the engineering options that Reclamation identifies as potentially physically and financially feasible, as discussed below (see Exercise Results: Possible AMWG and TWG Roles). Concerns about the ways in which dam operations might be managed to prevent non-

native fishes such as smallmouth bass from becoming established below the dam are addressed below (see Exercise Results: Possible Agency Responses).

### Warning Systems

Discussions during the exercise and in the Webex Chat window identified some concerns about the capability of existing monitoring programs in Lake Powell to detect and report promptly on threats of escapements. TWG members understand the importance of data on lake levels, water temperature and water quality profiles, and the horizontal and vertical distributions of non-native fishes in lower Lake Powell for assessing the likelihood of escapements. However, they await information on what species and life stages may remain viable after passing through the dam (part of the Reclamation study noted above). TWG members also asked questions about how quickly information on lake hydrologic, thermal, chemical, and biotic conditions can be translated into near-real-time information on the potential for escapements. The agencies responsible for detecting and potentially responding to escapements, after they occur, all require such information to guide their preparations and actions. Additionally, other stakeholders may require or prefer having such information to enable them to engage in decision making about responses to escapements.

Discussions during the exercise and in the Webex Chat window also highlighted concerns about the capability of existing monitoring programs along the river below the dam to detect and report promptly on actual escapements. The monitoring of fishes below the dam takes place through several programs that are either explicitly designed to detect non-native fishes or capable of detecting them because of the methods they employ. These programs include the long-term, standardized monitoring efforts of AZGFD throughout the Colorado River from Lees Ferry (River Mile [RM] 0) to Pearce Ferry (RM 281). As stated in the recent GCMRC “Fiscal Year 2021 Annual Project Report to the Glen Canyon Dam Adaptive Management Program,” AZGFD conducts this monitoring “... for the combined purposes of tracking the status of native fish as well as identifying new invasive aquatic species. This project also provides detection capability for new warm-water invasive fish which may be entering the Colorado River Ecosystem (CRE) from Lake Powell by passing through Glen Canyon Dam, descending tributaries such as the Little Colorado River (LCR), or swimming upstream from Lake Mead.” Other monitoring programs capable of detecting non-native fishes, mentioned during the exercise or in the preceding presentations, include the Trout Reproductive and Growth Dynamics (TRGD) study and Brown Trout Early Life Stage Survey (BTELSS) (AZGFD, FWS, GCMRC), several activities under the general umbrella of humpback chub population studies (FWS, GCMRC), and several monitoring efforts by Grand Canyon National Park.

Discussions during the exercise and in the Webex Chat window specifically identified concerns that: (1) the existing monitoring programs below the dam are not designed for or capable of detecting “all” or even a large fraction of any non-native fishes that may be present below the dam at any one time or over the course of any single year, with diminishing capabilities downstream of Lees Ferry and even lower capabilities in the tributaries; (2) these existing programs are not designed for or capable of reliably detecting all life stages of these fishes with equal probability; (3) these existing programs are not designed for or capable of reliably detecting spawning or nesting activity throughout the potential reproductive season; (4) the translation of detection counts of fishes (numbers captured by reach by different methods) into estimates of abundance produces estimates with statistical margins of error that may be quite

wide; (5) monitoring specifically aimed at detecting non-native fishes in low-velocity habitats (which smallmouth bass use for foraging cover and reproduction) currently takes place only twice a year, and the frequency and scope of these focused monitoring efforts are tightly limited by budget; (6) it is not clear what levels of detection (numbers captured by reach) or statistical estimates of abundance or spawning/nesting activity would be high enough to warrant a “threat alert” or trigger a response; and (7) it is not clear how, or how quickly, detection data from Glen, Marble, or Grand Canyon or their tributaries can be assimilated among the agencies involved in the monitoring, to identify high-risk situations. The agencies responsible for detecting and potentially responding to escapements all require such information to guide their preparations and actions. Additionally, other stakeholders may require or prefer having such information to enable them to engage in decision making about responses to escapements.

For example, for the sixth of the points listed in the preceding paragraph, Dr. Yackulic, GCMRC, explained during his presentation before the exercise that adult fish density affects the likelihood of reproduction: below some threshold of density for a given species, adults may not encounter each other often enough to reproduce at a rate greater than the rate of population loss to mortality (e.g., from predation). That is, the population growth rate,  $\lambda$ , depends on the density of adults. If the density is too low,  $\lambda$  will be less than 1.0 and population numbers will decline, but if the density is greater than some threshold level,  $\lambda$  will be greater than 1.0 and population numbers will increase. The presentations that preceded the exercise, including the presentation about Upper Colorado River efforts by Dr. Bestgen, Colorado State University, showed that below-dam surveys for an ecologically disruptive non-native species, such as smallmouth bass, therefore need to be capable of detecting either, or both, of two things: (1) an abundance of reproductive-age adults that has a very low probability of being close to or greater than the threshold of density for  $\lambda=1.0$  for that species, or (2) evidence of reproductive activity *per se*. Smallmouth bass seek out specific types of low-velocity habitat, both for foraging cover and for nesting. Monitoring efforts below Glen Canyon Dam survey only a fraction of these types of habitats every year in any river reach, and sampling specifically targeted at non-native habitat occurs only twice a year, as noted above. Dr. Yackulic noted that, based on modeling experiments and detection probabilities, the population threshold for a value of  $\lambda>1.0$  in the Lees Ferry reach for smallmouth bass might correspond to a detection of only 6-7 adult bass in that reach during the Spring system-wide monitoring survey. TWG members noted that the framing scenario for this exercise, which hypothesized the detection of 12 adult smallmouth bass in the same reach, constitutes a “breakthrough” scenario: if surveys find 12 adult bass in that reach during April monitoring, there likely will be several hundred bass in that reach. That is, the bass would already be well established in that reach. Dr. Yackulic indicated that, once smallmouth bass are established in the Lees Ferry reach or, even worse, downstream from Lees Ferry, it will be extremely difficult, time-consuming (over years), and costly to ever bring their numbers under control again.

Discussions during the exercise and in the Webex Chat window also identified a concern, reinforced by comments by experts involved in fish monitoring efforts below the dam, that temperature monitoring along the river does not provide sufficient information about water temperatures in low-velocity habitat along channel margins or in backwaters. These are the settings in which some of the non-native species of interest reproduce (e.g., smallmouth bass, green sunfish), particularly smallmouth bass when water temperatures in these settings exceed 16

°C. Water temperatures in these settings frequently can exceed the temperature of the better-mixed waters in the main river channel.

TWG members noted that recreational anglers and the citizen science efforts of the river boating community might be engaged to report observations of non-native fishes. However, no information was presented, or suggestions offered, on how such observations might be encouraged or assimilated, or which agencies might need to be involved in making this happen.

### Decision-Making Procedures

Discussions during the exercise and in the Webex Chat window identified some concerns about which agencies would be involved in decision making about (1) possible preventive measures to implement above or in the dam forebay, (2) improving detection capabilities and alert systems for threats of escapements or actual escapements, (3) engaging with recreational visitors and citizen science programs to incorporate their observations into detection efforts, or (4) responses to actual escapements. As noted above, TWG members emphasized the importance of consultations with the Tribes and with the Western Area Power Authority and Federal Power Purchase Contractors as parts of preparations for responding to actual escapements. TWG members also asked questions about the possible role(s) of the TWG and AMWG in decision making, as discussed below (see Exercise Results: Possible AMWG and TWG Roles).

### Exercise Results: Possible Agency Responses

Discussions during the exercise and in the Webex Chat window repeatedly identified *prevention* as the top priority for addressing the threat of non-native fish escapements through the dam. This prioritization arose in response to expert statements both during the pre-exercise presentations and during the exercise itself. These statements emphasized that, under plausible future conditions in the lake and the river, smallmouth bass specifically may be able to pass through the dam, begin reproducing before the situation is fully diagnosed, and become established in the river below the dam faster than monitoring and removals can control the threat. The exercise participants also heard from the experts that it was not possible to predict how soon such a “breakthrough event” might occur based on forecasts of lake water levels. Some of this uncertainty results from a lack of information *at the time of the exercise*, about how the Upper Division States, Reclamation, and the Upper Colorado River Commission will implement the 2019 Drought Response Operations Agreement (DROA), including a lack of information about whether their Drought Response Operations Plan will include additional deliveries of water to maintain higher water levels in Lake Powell. Raising water levels in Lake Powell would reduce the likelihood of entrainment of non-native fishes through the turbine intake.

The exercise participants also learned that, even optimistically, it could take several years for Reclamation to complete its process for (1) identifying effective, physically suitable, financially feasible options for preventing escapements, (2) obtaining approvals up to the Secretary of Interior, (3) obtaining funding through Congress, and (4) installing and beginning operating any preventive measures. This information prompted further discussions about what the next lines of defense should be.

Discussions during the exercise and in the Webex Chat window also followed up on ideas presented by the Smallmouth Bass Task Force, concerning the possible use of dam operations to disrupt spawning and nesting behavior of non-native fishes along the first miles of the river

below the dam. The Task Force presentation covered two possibilities: (1) discharging water at high rates (up to 45,000 cubic feet/second [cfs]) to reduce the availability of low-velocity spawning habitat specifically for smallmouth bass along the channel margins; and (2) discharging sufficient volumes of cold hypolimnetic water to maintain water temperatures below the critical smallmouth bass spawning threshold of 16 °C. Both possibilities would require releases through the dam's bypass tubes, removing the released water from the volume available for power generation. The Task Force presentation covered several increments of discharge rate for the high-flow method, and several variations on the timing of releases for the cold-water method. The presentation did not address (a) how the timing of high-flow pulses might affect outcomes or (b) how temperatures within the river channel might affect water temperatures in low-velocity habitat along the channel margins during cold-water releases. TWG members emphasized the importance of consultations with the Western Area Power Authority and Federal Power Purchase Contractors as parts of any discussions about using releases through the bypass tubes to try to disrupt smallmouth bass spawning. TWG members also asked questions about the possible role(s) of the TWG and AMWG in decision making concerning releases through the bypass tubes, as discussed below (see Exercise Results: Possible AMWG and TWG Roles).

TWG members took note of comments in the Task Force presentation that any releases of water through the bypass tubes to disrupt smallmouth bass spawning would be experimental: The ideas are highly plausible based on what is known about smallmouth bass biology in the Colorado River Basin and what is known about the effects of dam operations on downstream flow velocities and temperatures. However, neither approach has ever been tested with the Glen Canyon Dam and neither is anticipated in the Glen Canyon Dam Long-Term Experimental and Management Plan [LTEMP] approved in 2016. Off-screen discussions between TWG member Larry Stevens and Dr. Bestgen during the evening interval between the two days of the exercise also resulted in the suggestion of a third possible experimental approach to disrupting smallmouth bass reproduction: Raising or sustaining the discharge rate through the dam at a moderate level during the spawning season to create spawning habitat at a particular elevation, and then episodically and abruptly dropping the discharge rate (and hence the water surface elevation) very low to expose the resulting nests. This pulsing would either desiccate or flush out the eggs and larvae, resulting in very high (or complete) mortality. TWG members noted that this approach would again require consultations with the Western Area Power Authority and Federal Power Purchase Contractors and noted that extreme low flows would also affect recreational use of the river.

Discussions during the exercise touched on a question of how quickly federal and state agencies might be able to obtain authorization to act, to try to prevent or reverse the establishment of non-native fishes below the dam—other than through adjustments to dam operations. The presentations before the exercise, and comments during the exercise from Rob Billerbeck, National Park Service, made it clear that the Park Service, at least, is authorized to remove non-native fishes as “incidental take” during routine monitoring activities. The Grand Canyon National Park Comprehensive Fish Management Plan (CFMP) and its supplementary Expanded Non-Native Species Plan identify additional response “tiers” for rapidly responding to detections of priority non-native fish species using “mechanical, physical, biological, and chemical” means. Each of these tiers requires a different combination of consultations and permits for compliance with federal and state laws. TWG members questioned whether the Endangered Species Act and the protections it provides for the listed humpback chub might *already* provide the authorizations

that the responsible agencies (FWS, AZGFD, NPS) would need, to respond promptly to incursions of smallmouth bass below the dam that could threaten humpback chub abundance. This last matter was not fully addressed by the time the exercise concluded. (TWG members were informed that all agencies involved in fish monitoring below the dam are covered by “incidental take” permits for removing non-native fishes encountered during that monitoring).

More generally, discussions during the exercise led to questions about whether the planning efforts underway have fully explored all requirements for compliance with federal and state laws and regulations. Bob Billerbeck, National Park Service, explained that the Grand Canyon National Park CFMP and its supplementary Expanded Non-Native Species Plan provide comprehensive information on all aspects of compliance affecting the National Park Service, including for inter-governmental consultations that would be involved under each of its designated response tiers; and that current planning efforts take all that information into account. However, Mr. Billerbeck also noted that the National Park Service would not and cannot undertake all of the rapid response actions described in his presentation, both because the skills, expertise, and equipment needed for such activities are spread among several agencies (AZGFD, FWS, GCMRC, NPS) and because the Park Service does not have sufficient funds to cover all (or even most) of the expenses that would be involved.

Discussions during the exercise and in the Webex Chat window identified concerns about the state of planning for responses to escapements below the dam described in presentations preceding the exercise. TWG members expressed concerns about a perceived focus of this planning on individual labor-intensive interventions rather than on systemic solutions. The presenters clarified that their presentations in fact emphasize the need for *less* labor-intensive, *less* costly, systemic responses. Presenters offered several variations on the idea that “... spending \$1 on prevention now could save \$100 on remediation later.” Dr. Yackulic’s presentation also indicated that, once a species such as smallmouth bass becomes established below Lees Ferry, especially if it becomes established in Grand Canyon and its tributaries, reversing this situation may be physically and financially impossible. Discussions and Webex Chat comments noted that removal by capture or poisoning will work well only in isolated pools such as backwaters and sloughs, and in tributaries.

Discussions during the exercise and in the Webex Chat window identified concerns about the specific methods under consideration for killing and/or mechanically removing non-native fish species such as smallmouth bass. These methods include killing with piscicides and capturing through various combinations of electrofishing and netting and/or seining. TWG members expressed concerns about: (1) the potential costs of such labor-intensive methods, including the costs of monitoring both to guide the removal efforts and to assess their effectiveness; (2) the difficulty of marshaling the logistical resources for such efforts fast enough, among multiple agencies; (3) the difficulty of obtaining permits for such efforts; (4) the complexity of obtaining prior consent from the sovereign tribes, who would need to be consulted through formal channels; and (5) the ethics of killing and removing some fish species in order to conserve others, including the ethics of going against the clearly expressed traditional values of some of the sovereign tribes that are parties to the GCDAMP.

## Exercise Results: Possible AMWG and TWG Roles

As noted above, TWG members throughout the exercise asked about the possible role(s) of the TWG and AMWG in decision making concerning actions being contemplated to prevent escapements, use specialized flow releases to disrupt smallmouth bass reproduction below the dam, or intentionally remove non-native fishes below the dam. These questions led to explanations from representatives from Reclamation and the National Park Service about the strictly *advisory* role of Federal Advisory Committees. Both the AMWG and TWG are Federal Advisory Committees, governed by the rules established in the Federal Advisory Committee Act of 1972 (FACA). Reclamation's Director for the GCDAMP, Lee Traynham, further clarified that meetings of the AMWG and TWG can only take place at regular intervals, and only after a notice for each meeting is approved and posted in the Federal Register a required number of days beforehand. These rules limit the ability of these committees to respond quickly to issues that may arise. TWG members responded to this information with suggestions for making sure that "hot" topics were quickly brought to the attention of the TWG, since it is responsible for looking into technical matters for the AMWG. One member offered the idea that a TWG Ad Hoc Group such as the Steering Committee Ad Hoc Group (SCAHG) could be charged with keeping track of hot topics to bring to the attention of the full TWG or the AMWG.

The exercise facilitator suggested that TWG members who want to learn more about the laws and precedents governing the GCDAMP could refer to the documents listed on Reclamation's home web page for the GCDAMP under the heading "[Law of the River](#)" and to the [LTEMP Environmental Impact Study \(EIS\) and Record of Decision \(ROD\)](#). If the TWG does not already have a briefing book or primer for new members, it also might consider developing one. This primer could discuss federal advisory committee rules and responsibilities, the TWG charter, the Law of the River and other legislation and legal decisions affecting Glen Canyon Dam operations and the decisions of the GCDAMP. One respondent to the online survey (see below) also asked if it would be possible for the TWG to hear presentations on the roles of the federal and state agencies responsible for managing the lake and river water and caring for the biological and cultural resources of the Grand Canyon ecosystem.

## Post-Exercise Survey Results

Twelve TWG representatives submitted responses to the online survey (see Attachment IV). Respondents were asked to answer "Yes," "No," or "Uncertain" about eighteen questions, and submit narrative answers to clarify their answers as they saw fit. The respondents represent one federal agency, one tribe, five basin states, two environmental groups, one recreational interest, a group of five federal power purchase contractor representatives from CREDA and Utah Associated Municipal Power Systems [UAMPS], and AZGFD.

The survey responses to questions about agency plans for monitoring and mitigation (Survey Part I; Table 1) were unanimous in (a) their level of concern about the possibility that non-native fishes or altered water quality conditions in lower Lake Powell could affect the Grand Canyon ecosystem, and in (b) their prioritizing prevention over detection and reaction to such events. The respondents also were nearly unanimous in answering either "No" or "Uncertain" to questions about whether the agencies responsible for managing conditions in lower Lake Powell have adequate plans for preventing the passage of problematic water temperatures, water chemistries, and/or non-native fishes through the dam and are moving quickly to implement these plans; and

whether the agencies responsible for taking action below the dam have adequate resources for mitigation responses, including for monitoring outcomes for adaptive management.

**Table 1.—Survey results Part 1: Plans for Monitoring and Mitigation.**

<b>Part 1 – Plans for Monitoring and Mitigation</b>	<b>Yes</b>	<b>No</b>	<b>Uncertain</b>
1. My nation, community, or agency is concerned about the possibility that non-native fishes or altered water quality conditions in lower Lake Powell could affect the Grand Canyon ecosystem.	12	0	0
2. My nation, community, or agency would prefer that greater priority be given to preventing the passage of problematic water temperatures, water chemistries, and/or non-native fishes through the dam, versus detecting and reacting to such events after the fact.	12	0	0
3. The agencies responsible for managing conditions in lower Lake Powell have adequate plans for preventing the passage of problematic water temperatures, water chemistries, and/or non-native fishes through the dam and are moving quickly to implement these plans.	0	9	3
4. Unless smallmouth bass can be prevented almost completely from passing through Glen Canyon Dam, detecting and removing and/or preventing the reproduction of this species below the dam—in Glen, Marble, or Grand Canyon and their tributaries—will be too costly and/or physically impossible to accomplish.	6	0	6
5. The agencies responsible for monitoring water temperatures, water chemistries, and/or non-native fishes above and below Glen Canyon Dam have adequate resources for conducting this monitoring.	5	2	5
6. The timing and spatial design for monitoring water temperatures, water chemistries, and/or non-native fishes above and below Glen Canyon Dam is appropriate to the need to respond promptly and accurately to potentially problematic conditions.	3	4	5
7. The agencies responsible for monitoring water temperatures, water chemistries, and/or non-native fishes above and below Glen Canyon Dam have adequate plans for alerting the AMWG when potentially problematic conditions are detected.	5	1	6
8. The agencies responsible for mitigating potentially problematic water temperatures, water chemistries, and/or non-native fishes below the dam have adequate plans for deciding how and when to respond, including consulting with the AMWG.	4	6	2
9. The agencies responsible for mitigating potentially problematic water temperatures, water chemistries, and/or non-native fishes below the dam have adequate resources for mitigation responses, including for monitoring outcomes for adaptive management.	1	8	3
10. There appear to be important gaps in knowledge gaps that could affect decision making concerning the potentially problematic water temperatures, water chemistries, and/or non-native fishes below the dam.	4	3	5
11. The mitigation responses under consideration respect the values of my nation, community, or agency with respect to the river, canyons, and its biota.	7	3	2
12. The plans for mitigation responses take into account the possibility of unwanted effects that may require additional attention, including consulting with the AMWG.	5	0	6
13. The plans for mitigation responses take into account the possibility of failures.	4	1	7
14. The agency plans for mitigating potentially problematic water temperatures, water chemistries, and/or non-native fishes below the dam adequately to take into account the need to address possible effects of the agency actions on other aspects of dam operations including water storage and hydropower management.	4	2	6

**Table 2.—Survey results Part 2: Tabletop Exercise Review.**

<b>Part 2 – Tabletop Exercise Review</b>	<b>Yes</b>	<b>No</b>	<b>Uncertain</b>
1. The exercise was a useful way to help me understand the potential for altered water temperatures, water chemistries, and/or non-native fishes introductions below the dam.	11	0	1
2. The exercise was a useful way to help me understand agency plans for monitoring and responding to the potential for altered water temperatures, water chemistries, and/or non-native fishes introductions below the dam.	8	1	3
3. The exercise gave me ample, respectful opportunities to express my views and listen to others’.	11	0	1
4. I would be interested in using this (or a similar) “tabletop exercise” approach to look into other topics of interest to the TWG.	12	0	0

Answers to the other twelve survey questions in Part I were more mixed, indicating a high level of disagreement or uncertainty among the respondents. For example, for Question 10 (“There appear to be important gaps in knowledge gaps that could affect decision making concerning the potentially problematic water temperatures, water chemistries, and/or non-native fishes below the dam”), the answers were almost evenly distributed among “Yes” (4), “No” (3), and “Uncertain” (5).

The survey responses to questions about the tabletop exercise itself (Survey Part II; Table 2) were unanimous or nearly unanimous in finding the exercise useful, agreeing that the exercise gave them ample, respectful opportunities to speak and listen, and expressing interest in using this (or a similar) “tabletop exercise” approach to explore other topics of interest to the TWG. The respondents had the greatest range of responses to the second question in this part of the survey (“The exercise was a useful way to help me understand agency plans for monitoring and responding to the potential for altered water temperatures, water chemistries, and/or non-native fishes introductions below the dam”), with eight saying “Yes,” one saying “No,” and three saying they were “Uncertain.”

Finally, the narrative comments of survey respondents provided explanations and clarifications for several responses. One TWG representative, whose Yes/No answers indicated doubts about current agency preparations and capabilities for responding to escapements, expressed concern that the agencies are proceeding without adequate input from the larger community of stakeholders. This response included an expression of grave concern that these agencies were bypassing the GCDAMP as a long-standing and important forum for fully vetting analyses, plans, and their underlying assumptions with the stakeholders. Another narrative respondent expressed concern about the potential magnitude of uncertainties in the present understanding of the lake and river ecosystems, how they will function at even lower lake levels, and possible ripple effects of new types of management actions.

## Summary of TWG Member Concerns and Responses to Exercise

Discussions during the exercise and in the Webex Chat window, and the responses to the online survey, highlighted several concerns among TWG members, bearing on both the specific topic of the exercise and on TWG activities in general, as follows:

- The exercise participants in general, including the survey respondents, are concerned about the possibility that non-native fish or altered water quality conditions in lower Lake Powell could affect the Grand Canyon ecosystem. The participants therefore prioritize prevention over detection and reaction to such events. Several exercise participants noted that escapements of non-native predatory fish into the river below Glen Canyon Dam could erase the hard-won gains of recent decades in conserving the native fish species in the Grand Canyon ecosystem, and that failing to prevent or (as a less-desirable fallback) to contain such escapements would constitute an unacceptable systemic failure.
- The TWG participants in the exercise expressed concern that, except for the planning to prevent escapements through Glen Canyon Dam, the planning taking place seems to focus on preparations for reacting to escapements once they happen. As noted above, TWG members and participating experts expressed a consensus that prevention should be

the top priority. However, several TWG members also spoke about a need for the GCDAMP to develop a longer-term, holistic approach to managing the river and its ecosystem. Such an approach would need to consider the likely effects of climate change, continuing introductions of non-native species, and other factors that shape the Colorado River ecosystem. A “big picture” approach would provide a framework for proactively addressing individual concerns such as the threat of smallmouth bass escapements. The representative for Zuni Pueblo offered a caution that, in the historical experiences of the Pueblo, governmental actions taken to manage ecosystems across their landscape—including human interactions with these ecosystems—can have considerable harmful effects if they do not rest on a deep understanding of those ecosystems.

- At least judging from the survey respondents, the exercise participants did not leave the exercise convinced the agencies responsible for managing conditions in lower Lake Powell have adequate plans for preventing the passage of problematic water temperatures, water chemistries, and/or non-native fishes through the dam and are moving quickly to implement these plans.
- The TWG participants in the exercise expressed concern that aquatic monitoring capabilities below the dam are not sufficient to detect and report on actual escapements before the new arrivals can begin reproducing and spread downstream into Marble Canyon, the Grand Canyon, and their tributaries. This concern arises from understanding that current monitoring efforts: (a) produce probabilistic estimates of fish abundances, age distributions, and spatial distributions with ranges of statistical error; (b) do not target every habitat type or every life stage in every survey; and (c) have timing gaps between surveys during which escapements could occur.
- The TWG participants in the exercise expressed concerns about what detection levels (thresholds) for non-native predatory fish either above or below the dam will or should be used either to trigger alerts (warnings) for agencies to be prepared for possible escapements or to trigger agency responses to escapements. The Grand Canyon National Park CFMP and its supplementary Expanded Non-Native Species Plan identify some thresholds for triggering rapid responses to detections of priority non-native fish species below the dam, but do not identify warning levels to guide preparations and do not address thresholds of potential concern for fish above the dam.
- The participants in the exercise heard—and expressed concern about—statements from Reclamation, the National Park Service, and the Arizona Game and Fish Department that little in the way of “additional” funding is available for emergency response to incursions of non-native fish below the dam, let alone for any large-scale response in the event of a large or widespread incursion. Federal and state legislation would be needed to obtain funding at the right scale, and an effort to have such funding included in the National Park Service budget request for FY23 was not successful. Participant concern about this matter is also reflected in the survey responses.
- Similarly, the participants in the exercise heard—and expressed concern about—statements from Reclamation that presently there is no budget for installing any preventive measures in the forebay of the dam to prevent species such as smallmouth bass from entering the penstock when the lake level is low enough, let alone for the long-term maintenance of such measures. Funds for such a substantial engineering effort would need to be requested and approved through Reclamation, the Department of Interior, and Congress, a lengthy process—and Reclamation is only at the stage of

compiling information about possible options to consider. Consequently, it will be years before any such measures could be approved, designed, installed, and activated.

- The TWG participants in the exercise expressed concerns that the decision-making process—for planning and obtaining approvals for emergency responses to incursions of non-native fish below the dam—could take weeks or months *absent fully approved plans and logistical readiness among the responsible agencies*. The exercise participants heard that getting permits for some removal efforts (beyond what is already permitted) could be faster than getting approvals for systemic solutions. However, the participants expressed concern that this caveat should not be a reason for the responsible agencies to prioritize those more readily-approved actions over systemic solutions. Rather, the exercise participants voiced concern that the present task force needs to get plans in place and fully approved—including by the Secretary of Interior as needed—and ensure their logistical readiness as soon as possible. This sense of urgency resulted from their understanding that an incursion could occur even in the next year or so, given predicted lake levels in the forebay over the next two years. At the same time, the TWG participants in the exercise expressed concerns that, in working to get plans in place, the federal agencies involved in the planning should not treat the required consultations with the Tribes merely as “box-checking” exercises, but rather as important opportunities to try to identify, understand, and address Tribal concerns.
- TWG members questioned whether the Endangered Species Act and the protections it provides for the listed humpback chub might already provide the authorizations that the responsible agencies (FWS, AZGFD, NPS) would need, to respond promptly to incursions of smallmouth bass below the dam that could threaten humpback chub abundance.
- In discussing the urgency of the situation, further, TWG participants in the exercise heard from at least some of the fishery experts that it is not possible to predict how soon a smallmouth bass incursion might occur. Dr. Yackulic stated that, based on lake level forecasts, it might not occur for another 3-4 years, allowing the task force, TWG, and others to look at both short- and long-term solutions without having to react to any crises. However, Dr. Yackulic also noted that events can get ahead of such forecasts.
- The TWG participants in the exercise expressed concerns that removal of non-native fishes by capture or poisoning will work well only in isolated pools such as backwaters and sloughs, and in tributaries.
- TWG members expressed interest in receiving presentations by the Upper Colorado River Endangered Fish Recovery Program and the Lower Colorado River Multi-Species Conservation Program, to inform the TWG about the activities and lessons being learned by these sister programs. One respondent to the online survey also expressed interest in additional presentations by Grand Canyon National Park on other management actions it has taken along the river in the past.
- Finally, the exercise participants who responded to the online survey mostly found the exercise useful; mostly felt that it gave them ample, respectful opportunities to speak and listen; and unanimously expressed interest in using this (or a similar) “tabletop exercise” approach to examine other topics of interest to the TWG.

## Attachment I. Tabletop Exercise Agenda

### Glen Canyon Dam Adaptive Management Program Technical Work Group

**Statement of Exercise Purpose:** A real possibility exists that future discharges of water from Lake Powell through Glen Canyon Dam could have temperatures, water chemistries (e.g., dissolved oxygen levels), and/or entrained non-native fishes that could affect the aquatic ecosystem below the dam. The purpose of the exercise is to help the Technical Work Group (TWG) identify areas of potential importance to the Adaptive Management Work Group (AMWG), concerning: (a) agency responsibilities for monitoring and responding to such events, (b) possible ways in which these agencies may respond to such events and ways in which these actions may affect the river and its canyons and biota, and (c) possible roles for the AMWG and its TWG in the decision-making process for such actions.

Table 3.—Tabletop exercise agenda.

Time	Topic / Activity
Day 1, 3:15 - 5:00	<p><b>EXERCISE, PART 1 OF 3</b></p> <ul style="list-style-type: none"> <li>• <u>Orientation, Agenda Review, and Goals</u>: Facilitated, 15 minutes               <ul style="list-style-type: none"> <li>○ Explanation of exercise and session purposes, structure, intended outcomes, rules and sideboards</li> <li>○ Note: Exercise is not intended to commit anyone to anything in the event of an actual biotic or water quality threat passing through the dam. Participation is limited to TWG members and invited experts.</li> </ul> </li> <li>• <u>Framing Scenario</u>: 5 minutes               <ul style="list-style-type: none"> <li>○ <i>It's April 12, 2023. AZGFD has captured 12 reproductive-age adult smallmouth bass in Glen Canyon and 25 adult and juvenile green sunfish in the lower slough at RM 12 and observed additional green sunfish in both the upper and lower sloughs. Lake elevation at the dam is 3,510' where it has stood for five weeks; and mid-channel water temperature at Lees Ferry is 10 °C.</i></li> </ul> </li> <li>• <u>Brainstorming Discussion</u>: Virtual breakout rooms, pre-assigned, 30 minutes               <ul style="list-style-type: none"> <li>○ Consider and discuss the following questions:                   <ul style="list-style-type: none"> <li>▪ Is your nation, community, or agency concerned about the possibility that non-native fishes or altered water quality conditions in lower Lake Powell could affect the Grand Canyon ecosystem? Is this a priority concern? What solutions might you</li> </ul> </li> </ul> </li> </ul>

propose?

- Is your nation, community, or agency concerned about the ways in which federal or state agencies may respond to an introduction of non-native fishes or altered water quality conditions from Lake Powell into the Grand Canyon ecosystem? Is this a priority concern? What solutions might you propose?
- What kind(s) of response(s) would you like or not like to see among the agencies responsible for addressing such situations, with what kinds of outcomes?
- What other options would you recommend be considered for responding (or not responding) to introductions of non-native fishes or altered water quality conditions from Lake Powell into the Grand Canyon ecosystem?
- Identify topics you might want to know more about (e.g., technical information gaps, possible technical approaches and their possible outcomes, decision-making processes).
- Full Group Report-Out: Breakout group facilitator summaries, 15 minutes
  - 5 minutes per group
  - Lead facilitator summary; Q&A
- Topic-Specific Discussion: Same pre-assigned virtual breakout groups, 40 minutes
  - Breakout group assigned foci:
    1. Potential remediation responses to unwanted biotic or water quality conditions in Glen and Marble Canyons (Clarence Fullard facilitates)
    2. Decision-making arrangements and their information requirements (Michelle Garrison facilitates)
    3. Detection/alert systems for unwanted biotic or water quality conditions in Lake Powell forebay and/or in Glen and Marble Canyons (David Braun facilitates)
  - Building off the results of earlier brainstorming, consider the following four topics (and others you may want to address) for your breakout group focus:
    - **Highest priority concerns overall** [e.g., what issues or concerns are your highest priority as a stakeholder, including things that are missing in current plans?]
    - **Information gaps** [e.g., what do you need to know to have a better understanding of the situation and possible solutions?]
    - **Management and resources issues** [e.g., what potential gaps do

	<p>you perceive in management arrangements and resources (funds, equipment, staffing, logistics) for addressing the situation?]</p> <ul style="list-style-type: none"> <li>▪ <b>Concerns about potential unacceptable actions or effects</b> [e.g., what potential impacts to the canyons, ecosystem, and other conditions and values are of concern?]</li> </ul> <ul style="list-style-type: none"> <li>• <u>Concluding:</u> Full group, 5 minutes <ul style="list-style-type: none"> <li>○ Final comments for the day</li> </ul> </li> </ul>
<p>Day 2, 10:00 - 11:00</p>	<p><b>EXERCISE, PART 2 OF 3</b></p> <p><u>Full Group Report-Out:</u> Full group, 15 minutes</p> <ul style="list-style-type: none"> <li>○ Breakout room facilitators report out on the discussions from Day One</li> <li>○ Q&amp;A</li> </ul> <ul style="list-style-type: none"> <li>• <u>Full Group Discussion:</u> Full group, 45minutes <ul style="list-style-type: none"> <li>○ Use the WebEx “chat” function to identify topics or issues from the first session seem most important to you for identifying as potentially important to the TWG or AMWG. <ul style="list-style-type: none"> <li>▪ Take two minutes to enter down your comments – just post please, do not comment on each other’s posts in the chat field.</li> <li>▪ Facilitator will lead discussion of a handful of comments.</li> </ul> </li> <li>○ Identify the priority concerns among TWG members that emerged in the Day-One breakout groups. We will start with the following nine topics and expand as needed. Use the WebEx chat input to suggest additional discussion topics: <ol style="list-style-type: none"> <li><b>1. Information gaps</b></li> <li><b>2. Management and resources issues</b></li> <li><b>3. Decision-making process</b></li> <li><b>4. Openness of management and decision-making to TWG or AMWG advice</b></li> <li><b>5. Speed with which decisions need to versus can be made</b></li> <li><b>6. Defining actionable threshold conditions</b></li> <li><b>7. Potential unacceptable effects of agency actions</b></li> <li><b>8. Nimbleness of planned approaches including fallback position(s) if planned approaches do not work</b></li> <li><b>9. Potential for/acceptability of failure</b></li> </ol> </li> <li>○ Final discussion for the session</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>▪ How confident are you that a solution to an emergency could find consensus support from the TWG?</li> <li>▪ When dealing with potential emergencies, do you favor taking a “wait and see approach” or an “act immediately” approach?</li> </ul>
Day 2, 11:00 - 11:15	<p><b>BREAK</b></p> <p>During the break, please think about roles and responsibilities:</p> <ul style="list-style-type: none"> <li>• How can the TWG be a responsive asset and resource to the Glen Canyon Adaptive Management Program in potential emergency situations such as the one examined?</li> </ul>
Day 2, 11:15 - 12:15	<p><b>EXERCISE, PART 3 OF 3</b></p> <ul style="list-style-type: none"> <li>• <u>Full Group Discussion</u>: Full group, 30 minutes <ul style="list-style-type: none"> <li>○ How can the TWG be a responsive asset and resource to the Glen Canyon Dam Adaptive Management Program in an emergency resulting from introductions of non-native fishes or altered water quality conditions from Lake Powell into the Grand Canyon ecosystem?</li> <li>○ What barriers or inhibitors could prevent the TWG from responding effectively to such an emergency?</li> <li>○ Please take two minutes to post a single chat, stating your top takeaway from the exercise – just post please, do not comment on each other’s posts in the chat field.</li> </ul> </li> <li>• <u>Full Group Discussion Wrap-Up</u>: Full group, 15 minutes <ul style="list-style-type: none"> <li>○ Facilitator summaries of key findings and concerns highlighted by the exercise and final discussion</li> </ul> </li> <li>• <u>Concluding Summary</u>: Full group, 15 minutes</li> <li>• <u>Final Instructions</u> <ul style="list-style-type: none"> <li>○ You will be sent a link to an online survey tool, for you to provide further comments on the topic of the exercise and feedback on the exercise itself.</li> <li>○ <b>Please post your response to the survey by April 19 (COB)</b></li> </ul> </li> </ul>

## Attachment II. Tabletop Exercise Breakout Group Assignments

### Breakout Group 1

Facilitator: Clarence Fullard, Reclamation

- Emily Omana Smith, National Park Service - Grand Canyon
- Carrie Canon, Hualapai Tribe
- Daniel Bullets, Southern Paiute Consortium
- Kristen Johnson, Arizona Department of Water Resources
- Emily Halverson, Colorado Water Conservation Board
- Laura Dye, State of Nevada
- Betsy Morgan, Utah Department of Water Resources
- Larry Stevens, Grand Canyon Wildlife Council
- Ben Reeder, Grand Canyon River Guides
- Bill Persons, Fly Fisher's International / Trout Unlimited
- Shane Capron, Western Area Power Authority
- Dave Rogowski / Julie Carter, Arizona Game and Fish Department
- Ted Kennedy, GCMRC

### Breakout Group 2

Facilitator, Michelle Garrison, Colorado Water Conservation Board and TWG Vice Chair

- Chip Lewis, Bureau of Indian Affairs
- Brian Healy, National Park Service - Grand Canyon
- Rob Billerbeck, National Park Service - Glen Canyon
- Jakob Maase, Hopi Tribe
- Chris Harris / Jessica Neuwerth, Colorado River Board of California
- Christine Noftsker, New Mexico Interstate Stream Commission
- Charlie Ferrantelli, Wyoming State Engineer's Office
- Scott McGettigan, Utah Department of Water Resources
- David Brown, Grand Canyon River Guides
- Gary Tallman / Jim Stroger, Fly Fisher's International / Trout Unlimited
- William E. Davis, Colorado River Energy Distributor's Association
- Craig Ellsworth, Western Area Power Authority
- Lucas Bair / Charles Yackulic, GCMRC

### Breakout Group 3

Facilitator, David Braun, Sound Science LLC

- Garry Cantley, Bureau of Indian Affairs
- Kerri Pedersen, Reclamation
- Kirk Young, U.S. Fish and Wildlife Service
- Erik Stanfield, Navajo Nation
- Kurt Dongoske, Pueblo of Zuni

- Shana Rapoport, Colorado River Board of California
- Mel Fegler, Wyoming State Engineer's Office
- Sinjin Eberle, American Rivers
- Kelly Burke, Grand Canyon Wildlife Council
- Clifford Barrett, Utah Associated Municipal Power Systems
- Leslie James / Ted Rampton, Colorado River Energy Distributor's Association
- Ryan Mann, Arizona Game and Fish Department
- Mike Moran, GCMRC

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## Attachment III. Tabletop Exercise Breakout Group Facilitator Guidance

### Background

The function of the Glen Canyon Dam Adaptive Management Program (GCDAMP) Technical Work Group (TWG) is to provide technical assistance to the GCDAMP Adaptive Management Work Group (AMWG). Standing responsibilities of the TWG, as assigned by AMWG, are to consult with the Grand Canyon Monitoring and Research Center (GCMRC) in developing criteria and standards for monitoring and research programs; develop resource management questions for the design of monitoring and research administered by the GCMRC; and provide information, as necessary, for preparing annual resource reports and other reports, for the AMWG. ... The TWG [also] will identify opportunities to increase dialogue among members. Educating each other about our different perspectives is crucial.<sup>1</sup>

### Exercise Purpose

A real possibility exists that future discharges of water from Lake Powell through Glen Canyon Dam could have temperatures, water chemistries (e.g., dissolved oxygen levels), and/or entrained non-native fishes that could affect the aquatic ecosystem below the dam. The purpose of the exercise is to help the TWG identify areas of potential importance to the AMWG, concerning: (a) possible agency responses to such introduced conditions below the dam and (b) possible roles for the AMWG and its TWG in the decision-making process for such responses. The exercise and preceding expert presentations will examine agency roles and responsibilities, and information and management preparedness needs.

### Facilitator Technical Responsibilities

The facilitators for the breakout groups (Michelle, Clarence, David) and the facilitator for the exercise overall (David) are responsible (a) for ensuring that each part of the exercise completes its goals; and (b) for ensuring that the exercise overall provides useful information for communicating to the AMWG. This information will concern the anticipated introductions from Lake Powell and agency responses to these introductions, including (a) plans for monitoring for unwanted biotic or water quality conditions in Lake Powell forebay and/or in Glen and Marble Canyons and alerting decision-makers of findings; (b) plans for remediation responses to unwanted biotic or water quality conditions in Glen and Marble Canyons; and (c) plans for how decisions will be made for responding to these unwanted conditions in Glen and Marble Canyons. The information to be communicated to the AMWG will address at least the following five questions:

1. What issues or concerns are the highest priorities for individual stakeholders and for the TWG, including matters that may be missing in current agency plans for monitoring and response?
2. What information gaps does the TWG see affecting understanding of the situation, and what solutions might it propose to close these gaps?
3. What potential gaps does the TWG perceive in plans and assignments of responsibilities for monitoring, response actions, and decision making, including the openness of decision making to input from the AMWG and its members?

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<sup>1</sup> Quoted from TWG Operating Guidelines.

4. What potential gaps does the TWG perceive in the resources (funds, equipment, staffing, logistics) likely available for monitoring and for response actions?
5. What are TWG concerns about potential unacceptable actions or effects to the canyons, ecosystem, species, and other conditions and values of importance to AMWG members?

The exercise agenda identifies several more specific questions and topics to pursue, including to prompt discussion if needed.

### Facilitator Sociocultural Responsibilities

The TWG is a diverse assemblage of knowledgeable, experienced individuals representing stakeholders with diverse interests, values, and points of view—not only concerning the Glen, Marble, and Grand Canyons and the Colorado River as it flows through these canyons, but also concerning Glen Canyon Dam and its operations, and concerning the effects of visitors and federal and state agency actions on the river and its canyons.

Facilitation of the exercise will allow all TWG members to express their views and concerns without judgement by the facilitators or by other participants and will not try to steer discussions toward “majority” versus “minority” views. The facilitators will encourage the participants to think creatively about the topics of the exercise and share these thoughts with the larger group. If participants disagree on some matter, the facilitators will make note of these differences but not take time from the overall discussion to have these differences debated. If participants raise topics or concerns that do not seem to be germane to the subject of the exercise, the facilitators will ask that they be held aside for separate discussion outside the exercise. Our intention is to foster open, thoughtful, mutually respectful dialogue.

### Reporting

Please take notes or have a colleague take notes during the breakout group discussions. And please provide the lead facilitator with a copy of your notes from each day, to assist with the preparation of the final report.

## Attachment IV. Tabletop Exercise Online Survey Form

### April 2022 TWG Tabletop Exercise: Information & Management Gaps

Please complete this survey to provide your final thoughts as a TWG representative, on the results of the tabletop exercise conducted as part of the April 2022 TWG virtual meeting.

Please submit your responses by COB April 19, 2022.

The exercise concerned the possibility that future discharges of water from Lake Powell through Glen Canyon Dam could introduce problematic water temperatures, water chemistries, and/or non-native fishes into the aquatic ecosystem below the dam.

\*Required

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Email\*

Your email:

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### Plans For Monitoring & Mitigation

Please rate the following statements (Yes/No/Uncertain)

1. My nation, community, or agency is concerned about the possibility that non-native fishes or altered water quality conditions in lower Lake Powell could affect the Grand Canyon Ecosystem.
  - Yes
  - No
  - Uncertain
2. My nation, community, or agency would prefer that greater priority be given to preventing the passage of problematic water temperatures, water chemistries, and/or non-native fishes through the dam, versus detecting and reaction to such events after the fact.
  - Yes
  - No
  - Uncertain
3. The agencies responsible for managing conditions in lower Lake Powell have adequate plans for preventing the passage of problematic water temperatures, water chemistries, and/or non-native fishes through the dam and are moving quickly to implement these plans.
  - Yes
  - No
  - Uncertain

4. Unless smallmouth bass can be prevented almost completely from passing through Glen Canyon Dam, detecting and removing and/or preventing the reproduction of this species below the dam—in Glen, Marble, or Grand Canyon and their tributaries—will be too costly and/or physically impossible to accomplish.
  - Yes
  - No
  - Uncertain
  
5. The agencies responsible for monitoring water temperatures, water chemistries, and/or non-native fishes above and below Glen Canyon Dam have adequate resources for conducting this monitoring.
  - Yes
  - No
  - Uncertain
  
6. The timing and spatial design for monitoring water temperatures, water chemistries, and/or non-native fishes above and below Glen Canyon Dam is appropriate to the need to respond promptly and accurately to potentially problematic conditions.
  - Yes
  - No
  - Uncertain
  
7. The agencies responsible for monitoring water temperatures, water chemistries, and/or non-native fishes above and below Glen Canyon Dam have adequate plans for alerting the AMWG when potentially problematic conditions are detected.
  - Yes
  - No
  - Uncertain
  
8. The agencies responsible for mitigating potentially problematic water temperatures, water chemistries, and/or non-native fishes below the dam have adequate plans for deciding how and when to respond, including consulting with the AMWG.
  - Yes
  - No
  - Uncertain
  
9. The agencies responsible for mitigating potentially problematic water temperatures, water chemistries, and/or non-native fishes below the dam have adequate resources for mitigation responses, including for monitoring outcomes for adaptive management.
  - Yes
  - No
  - Uncertain

10. There appear to be important gaps in knowledge that could affect decision making concerning the potentially problematic water temperatures, water chemistries, and/or non-native fishes below the dam
- Yes
  - No
  - Uncertain
11. The mitigation responses under consideration respected the values of my nation, community, or agency with respect to the river, canyons, and its biota.
- Yes
  - No
  - Uncertain
12. The plans for mitigation responses take into account the possibility of unwanted effects that may require additional attention, including consulting with the AMWG.
- Yes
  - No
  - Uncertain
13. The plans for mitigation response take into account the possibility of failures.
- Yes
  - No
  - Uncertain
14. The agency plans for mitigating potentially problematic water temperatures, water chemistries, and/or non-native fishes below the dam adequately to take into account the need to address possible effects of the agency actions on other aspects of dam operations including water storage and hydropower management.
- Yes
  - No
  - Uncertain

### **Narrative Responses Concerning Monitoring & Mitigation**

If you would like to explain or elaborate on your response to any of the fourteen statements above, please use the space provided here. Please number your responses to correspond to the ten [sic] numbered statements above.

### **Tabletop Exercise Review**

Please rate the following statements (Yes/No/Uncertain):

1. The exercise was a useful way to help me understand the potential for altered water temperatures, water chemistries, and/or non-native fishes introductions below the dam
- Yes
  - No

- Uncertain
- 2. The exercise was a useful way to help me understand agency plans for monitoring and responding to the potential for altered water temperatures, water chemistries, and/or non-native fishes introductions below the dam
  - Yes
  - No
  - Uncertain
- 3. The exercise gave me ample, respectful opportunities to express my view and listen to others'.
  - Yes
  - No
  - Uncertain
- 4. I would be interested in using this (or a similar) "tabletop exercise" to look into other topics of interest to the TWG.
  - Yes
  - No
  - Uncertain

**Narrative Responses Concerning Tabletop Exercise Review**

If you would like to explain or elaborate on your responses to any of the four statements above, please use the space provided here. Please number your responses to correspond to the four numbered spaces above.

End Survey