

Glen Canyon Dam Technical Work Group Meeting
October 18-19, 2016

Summary of Actions Taken

1. Draft Minutes approved by consensus.
2. Motion (proposed by Kevin Dahl, seconded by Vineetha Kartha): The TWG has reviewed the Triennial Budget and Work Plan Process as required by the Assistant Secretary for Water and Science (May 7, 2014), and recommends that the AMWG approve the document, as revised at the October 18, 2016, TWG meeting as the GCDAMP budget guidance.

Action Item: TWG members need to submit any topics they want considered for the Annual Reporting Meeting (Jan 24-25, 2017) to Scott VanderKooi by Friday, November 4, 2016.

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**Date: October 18, 2016**

**Start Time: 9:30 a.m.**

**Conducting:** Seth Shanahan, TWG Chair  
Vineetha Kartha, TWG Vice-Chair

**Committee Members/Alternates Present:**

Melinda Arviso-Ciocco, Navajo Nation  
Carlee Brown, State of Colorado  
Charley Bullets, Southern Paiute Consortium  
Chris Budwig, Int'l Federation of Fly Fishers/TU  
Shane Capron, WAPA  
Kerry Christensen, Hualapai Tribe  
Kevin Dahl, National Parks Conservation Assn.  
Bill Davis, CREDA  
Kurt Dongoske, Pueblo of Zuni  
Craig Ellsworth, WAPA  
Katrina Grantz, U.S. Bureau of Reclamation

Paul Harms, State of New Mexico  
Brian Healy, NPS/GRCA  
Ken Hyde, NPS/GLNRA  
Jeffrey Inwood, State of Arizona  
Robert King, State of Utah (phone)  
Jessica Neuwerth, State of California  
Ben Reeder, Grand Canyon River Guides  
Peggy Roefer, UCRC/Nevada  
Michael Yeatts, Hopi Tribe  
Kirk Young, U.S. Fish and Wildlife Service

**Committee Members Absent:**

Jan Balsom, NPS/GRCA  
Cliff Barrett, USAMPS (phone)  
Chip Lewis, Bureau of Indian Affairs

Larry Stevens, Grand Canyon Wildlands Council  
Steve Wolff, State of Wyoming

**Grand Canyon Monitoring and Research Center:**

Helen Fairley, Program Manager  
Kyrle Fry, Communication

Scott VanderKooi, Center Director

**Interested Persons**

Mark Anderson, NPS/GLNRA (phone)  
Cliff Barrett, UAMPS (phone)  
David Braun, Sound Science LLC  
Winkie Crook, Hualapai Tribe  
Jennifer Crandell, State of Nevada  
Marianne Crawford, Bureau of Reclamation (phone)  
Jessica Gwinn, U.S. Fish and Wildlife Service  
Craig Ellsworth, WAPA  
Chris Harris, State of California (phone)

Joseph Holway, member of the public  
Dawn Hubbs, Hualapai Tribe  
Leslie James, CREDA (phone)  
Ryan Mann, Arizona Game & Fish Department  
Theresa Pasqual, DOI Federal Tribal Liaison  
Randy Seaholm, State of Colorado  
Perry Shirley, Navajo Nation  
Rosemary Sucec, NPS/GLNRA (phone)  
Gloria Tom, Navajo Nation

**Meeting Recorder:** Linda Whetton

**Welcome and Administrative:** Mr. Shanahan welcomed the members and the public.

1. Introductions were made and a quorum determined.
2. Approval of June 14-15, 2016, Meeting Minutes. Motion to approve proposed by Ben Reeder, seconded by Kerry

Christensen. Pending one edit, the minutes were approved by consensus.

3. Review of Action Items ([Attachment 1](#)).
4. Status on Deputy Chief GCMRC Position. Mr. VanderKooi announced that Dr. Michael Moran has been selected and will report in late November. He comes from the USGS Nevada Water Science Center where he was a supervisory hydrologist and has led their desert studies work and prior to that worked with USGS in the national water quality assessment program in South Dakota. He's somewhat familiar with Colorado River issues and has over 20 years USGS experience.
5. Annual Reporting Meeting. The meeting will be held January 24-25, 2017, at Arizona Department of Water Resources in Phoenix. More information to follow.
6. Next Meeting Date: January 26, 2017, at ADWR in Phoenix. Ms. Grantz requested that if anyone knows of good venues to hold meetings, they should provide those to Linda.
7. TWG Ad Hoc group Updates ([Attachment 2](#)) – Mr. Shanahan.
  - Admin History AHG – Ms. Crawford announced that a contract was awarded to Dr. Paul Hirt with ASU and will be starting work on that shortly. Ms. Kartha reminded people that Larry Stevens and Craig Ellsworth serve as co-chairs and that should be reflected on the TWG AHG List.
  - TWG Operating Procedures AHG – Mr. Shanahan will serve as the new chair.
  - Socioeconomics AHG – This is currently chaired by Leslie James. She has conveyed her desire to stop down from the chair position. Mr. Shanahan thanked her for her service. Mr. Capron proposed that Clayton Palmer (WAPA) assume the chair role. Mr. Reeder indicated he would like to serve as the chair but needs some direction. Mr. Reeder will serve as the new SEAHG chair.
  - Steering Committee AHG – As the new TWG Chair, Mr. Shanahan will chair this group.
  - Trout AHG – Chris Budwig is the new chair of this group.
8. Science Advisor Program Update - Dr. Braun.
  - Regarding the FY17 budget, they have a task order to support the state of knowledge work.
  - At some point they'll re-engage on the SA Program Protocols. The SA review is currently tabled pending results of negotiations between Reclamation and the tribes.
  - Dr. Braun will be working with the TWG to make sure to fill in the rest of the archives of the SA Program on the wiki site.

**Wiki Update** ([Attachment 3](#)) – Mr. Ellsworth. He is feeling more comfortable editing the GCDAMP wiki site ([gcdamp.com](http://gcdamp.com)) and has been making the wiki site more user friendly. He demonstrated how to navigate through the website and recommended an historian be assigned to keep the site current. It was suggested that each TWG ad hoc group have its own web page. Administrative rights can be assigned to the individual ad hoc group chairs which will allow them to post photos, meeting agendas, proposed motions, and individual assignments. Mr. Shanahan encouraged everyone to consider other ways in which the wiki site can be more fully utilized.

**Linkages Between Lake Powell Reservoir and the Colorado River Below GCD** ([Attachment 4](#)) – Mr. Anderson. It's a huge process to run the limnological monitoring program because Lake Powell is so long, deep and presents significant monitoring challenges. Beginning in 1964 through the present, sampling sites have increased to now include inflow and tailwater monitoring. Currently some oxygen is being taken from the inflow that removes the oxygen from the water, scoots across the lake, and then right out the penstocks. In each case there was concern that the RBT were wiped out down there and may need to take some kind of action to get them back. There's uncertainty with the work going forward due to Bill Vernieu's retirement, the contract moving the work from GCMRC back to Reclamation, and replacement of the Unflight boat which sank last year. Reclamation is looking into replacing the boats but that doesn't help them with current monitoring needs. GCMRC is doing monthly forebay monitoring while Reclamation is doing quarterly lake-wide monitoring. There's a lot of uncertainty moving forward and people need to think as a group to ensure that adaptive management program needs are being met and secure the future of monitoring at Lake Powell. He reviewed the linkages of concern:

- Dissolved Oxygen - Drawing from mid-column, GCD can pass water from which oxygen has been depleted. Low oxygen levels can kill aquatic organisms, especially trout. Low oxygen that can pass through the dam is created at the inflow. Steps can be taken to mitigate the effects on the river – aeration (in forebay or at turbines), cavitation, or other.

- Fish – Dams are imperfect barriers to downstream fish movement. Many species that could be problematic exist above the dam. (GSF, SMB, Walleye and Northern Pike). Fish populations of Lake Powell are fairly well understood, but the specific information needed to address issues in the river is not included. What fish use the dam area? What fish survival occurs through the dam? How do HFEs effect fish passage through the dam? What is the fate of surviving fish?
- Sediment – The big issue that will only get bigger is monitoring at Hite, San Juan Marina, and Waterfalls. Generally trapped by the lake, most sediment is near inflows. There are contaminants locked up or released based on flows, oxygen demand and turbidity.
- Mercury – There was a Lake Powell Striped Bass Consumption Advisory from Dangling Rope Marina south to the dam. Cautions were put in place how much children and women could eat.
- Since Quagga mussels were found in Lake Powell, other things are being affected which connect downstream: water clarity, Phytoplankton/Zooplankton, fishery, waterfowl, aquatic vegetation, harmful algal blooms, dissolve oxygen and Dreissena polymorpha

Looking to the future, GLCA issues are more esoteric, especially when making a distinction between dam existence and dam operation. Understanding of the river will be poor without looking at the source; holistically considering the lake and the river may provide management opportunities beyond the current approach.

Ms. Roefer expressed concern about the data gap in the amount of monitoring data that's been collected on Lake Powell. In her 30 years working for SNWA, her group was responsible for the monitoring on Lake Mead and they were out there every week. She doesn't think monitoring once a quarter is provides enough information to detect changes. It took considerable monitoring to detect the effects in Lake Mead with the presence of Quagga mussels. She asked if the science panel could be tasked to look at the monitoring in Lake Powell and determine the best course of action for that monitoring.

Mr. Shanahan reminded the TWG that there's a project one element in the sampling of Lake Powell. The sampling work that Reclamation has committed to do is not funded by the GCDAMP but through salinity control funds that were sent down to GCMRC and are now staying in the UC region. With that transition, he has talked with Mr. VanderKooi about doing a scaled-down PEP similar to the Fish PEP to look at whether the monitoring procedures are adequate, the analyses are the right and a number of other things for approximately \$20K. He opened the floor for discussion.

#### Q&A, Comments:

- *Are there things that could be done to dam operation changes that will actually make a difference? The monitoring piece is an important thing to see if what happens in the lake comes through the dam and what's downstream of the dam, but would like to see extensive focus on changes to dam operations that actually could help minimize the problem.*
  - *From Reclamation's standpoint, it would be very informative to determine whether monitoring be quarterly as Peggy pointed out, if quarterly sampling is meeting the needs, or if something/someone needs to be done to bridge that gap.*
- *Regarding the Gold King Mine river spill and you mentioned a couple of scenarios being possible, one of them was any contaminated sediments would flow into Lake Powell and then be trapped within the sediments there in the lake. Another scenario was other activities could cause turbulent and disruption of the sediments contained within the river itself beginning from the point that it enters into the Animas and then further downstream to the San Juan River. Related to your inflow monitoring activities that you're doing with respect to the San Juan River, can you elaborate on what it is that you're doing as far as monitoring the inflow and then if there's any collaboration between the Park Service or perhaps EPA or any other agency that you're currently working on?*
  - *The work is very different in Lake Powell and needs to be done where typically the agencies involved with that aren't so capable of doing that. UDWR is organizing that work and serving as the clearinghouse for information.*

**Hualapai Tribe's Native Fish Rearing Facility ([Attachment 5](#))** – Ms. Theresa Pasqual introduced Mr. Winky Crook who is the manager of the Hualapai Department of Natural Fisheries and Parks and has worked for the Hualapai for nine years and at the facility for six years. The facility addresses the immediate need for rearing Razorback suckers, HBC, and other endangered and/or native species. They design and implement plans to recover native species in Grand Canyon and other areas. Based on a Reclamation-funded feasibility study for construction of such a facility, the Hualapai have received approximately \$860,000 from other federal agencies and the Hualapai Wildlife, Fisheries, and Parks Office to build and maintain it. He provided the following results:

**FISH DATA (Non-intensive Rearing of Fish)**

- ▶ 2000 Received ~2,000 3" – 5" and distributed equally to two ponds.
- ▶ 6/2003 Sampled one pond. Fish lengths average 310mm and average weight 280.
- ▶ 2/2006 Received ~5,000 juvenile razorbacks ranging between 3"-6". Distributed equally to ponds #3 and #4.
- ▶ 10/2008 Removed more than 500 razorbacks from pond #8 and taken to Bubbling Pond for conditioning and study. Fish average length was 320 mm.
- ▶ 2/2012 USFWS Parker office removed remaining to stock into back waters of Lake Havasu Lake. Average fish length 450 mm.

Based on data collected and validated information the facility is capable of rearing 2,500 fish annually with a growth rate of 30-50 mm a year. It costs \$45,000/year for one full-time employee and \$20,000 for pond maintenance. Mr. Crook is actively trying to obtain other fish and fully utilize the facility.

**Update on Fisheries Protocol Evaluation Panel** – Mr. VanderKooi. A draft of the panel's report was requested from the PEP Chair (Jim Peterson) but hasn't been received as yet. Mr. VanderKooi and Dr. Braun were able to get a few details and are preparing a short summary which they will distribute to the TWG along with any concerns. They will also be checking to determine if the charges given were met or if further clarification is needed.

**Programmatic Agreement Update** – Ms. Kathy Callister. Meetings have been held with the LTEMP PA group and progress is being made. She addressed specific discussion areas:

- Inclusion of a Preamble. This will focus on the importance of the Colorado River corridor in Glen, Marble, and Grand canyons to the tribes. This will appear in the version of the PA and possibly ready later this week.
- Area of Potential Effect. The "whereas clause" was modified to recognize the National Register of Traditional Cultural Properties in response to tribal concerns.
- National Historic Properties. Because Reclamation is the lead federal agency, it's their responsibility to make any determination of adverse effects caused by the actions that are selected in the LTEMP ROD. That determination is done through consultation with all the parties. Reclamation's first course of action will always be avoidance and will only consider if avoidance is not a workable solution.
- National Park Service is responsible for Section 110 within the GCNP and need to work closely with NPS so that Reclamation is not overlapping with their Section 110 responsibilities.

The PA is just the first step in a 20-year process to ensure compliance with Section 106. The PA signatories will meet on an annual basis to make certain that stipulations under the PA are being developed, implemented, and if necessary, add amendments to the PA. They're targeting an in-person meeting with all the consulting parties in early November and hope to have the PA signed by the end of the year.

Mr. Seaholm expressed concern about funding any actions that occur within the area defined by the LTEMP and asked if Reclamation will fund all actions in the PA. Ms. Callister told him the PA group hasn't gotten to the point of planning any actions and will consult with all parties involved in the LTEMP. Even if the states aren't a part of the PA process, she assured him that Section 106 requires consultation with any interested parties.

**Fall 2016 High Flow Experiment and Status of Green Sunfish (Attachment 6a)** – Ms. Grantz.

Because there isn't an LTEMP ROD in place, HFE planning for this year will be under the HFE EA Protocol. She reviewed the structure of getting to a decision point to conduct an HFE and said there are only two time frames when they can be done – in the spring or in the fall. Sediment inputs from July 1 – Oct 30 are considered for possibly contributing to a potential HFE. If sufficient sediment inputs into the Grand Canyon, an HFE would be done during the October-November timeframe. It makes sense to do an HFE in November versus October because of the planning and logistics involved. The HFE Protocol extends through 2020 but with an LTEMP ROD, it would be extended further. HFE durations run from one hour up to 96 hours, or 1.5 days or up to 6.5 days depending on ramp rates. There are currently two hydropower units out for regular maintenance and therefore releases can't exceed 45,000 cfs. There's compliance to go up to that range but may not be able to do that in any given year. The threshold for having enough sediment coming was passed on September 20, which kicked off the HFE planning process. There have been several other storms resulting in over 900,000 metric tons of sand in the system and that's enough to support a 96-hour HFE. The modeling results showed that an HFE in November would move sand downstream and bring the sand mass balance down for a 96-hour HFE and there would still be a positive sand mass balance of about 150,000 metric tons.

The Technical Team has evaluated all the other resources and a recommendation will be made to the Leadership Team on Thursday but based on sediment inputs, they would propose moving forward with an HFE starting on November 7. The provisional pattern the Technical Team is considering is to begin ramping up on November 7 at 7 a.m. up at 4,000 per hour until the bypass are opened and then there would be full capacity on November 7 at 1 p.m. That would be a maximum release of 36,000 cfs because six of the eight hydropower units would be available at Glen Canyon Dam. The ramping down would be at 1500 cfs per hour. Taking into consideration the trout fishery and concerns about fluctuations pre- and post-HFE and how low those flows could or should go as well as hydropower considerations, they worked out that it makes sense to fluctuate between 6,500 cfs up to 9,000 cfs. The 2014 HFE cost was about \$2.9 million and this year's HFE could be around \$1.4 million. Notification letters were sent to the tribes, AMWG, and other stakeholders.

- Sandbars and Campsites: 2012-2015 – Mr. VanderKooi. The last three HFEs (2012, 2013, 2014) yielded good results with overall sandbars larger now than at the start of the HFE Protocol. There were a lot of changes in non-critical reaches but did see increases from 2012 to 2014 in critical reaches. The first three years of the HFE Protocol were periods in which there were relatively low annual release volumes and very good tributary sand supply.
  - Some of the key resources looked at related to the Non-native Fish Control EA were the status and trends of HBC populations as well as conditions in the river including temperature and trout abundance. Non-native fish control triggers haven't been met with less than 7,000 adult HBC, RBT numbers at 760, and it's unknown if BT exceeded above 50. As a result, they're nowhere near reaching any of the levels that require non-native fish control. There were questions around the effects of HFEs on the foodbase. In 2008 there was a big response in the aquatic foodbase and a decline in New Zealand mudsnails and some increases in midges and blackflies. But in HFEs done in 2012 and 2013, there hasn't been much of a response.
  - Rainbow Trout in Glen Canyon results: (1) Fall growth in HFE intervals slightly negative in 2012 and 2014 and slightly positive in 2013. Growth positive in fall interval with no HFE in 2015. Suggests temporary weak negative effect on trout growth during HFE intervals, and (2) Any HFE effect is temporary, growth increases starting December or January. Late winter/spring growth increase was at similar levels in 2015 (post 2014 HFE) and 2016 (no 2015 HFE).
- Green Sunfish Update. A timeline provided information as to when the GSF were detected and the treatment to eradicate them from the river. The GSF will never be completely removed but plans are moving forward to apply ammonia as an experimental piscicide. Some of the GSF will go the tribal aviaries for beneficial use.

### Q&A, Comments:

- *Mr. Budwig said a letter ([Attachment 6b](#)) was sent from John Jordan to Katrina Grantz on Oct. 13, 2016, opposing the HFE. The Federation isn't convinced that the fall HFEs are causing the problem, but their constituents are. They want the Technical Team to fully consider that the Lee's Ferry trout fishery continues to struggle with poor angle catch rates which are impacting local businesses and angler satisfaction. The letter listed several areas of concern supporting their belief that it's premature to conduct another HFE until those uncertainties and unresolved issues are addressed.*
- *Mr. Vanderkooi: GCMRC has provided updates on a regular basis to the GCDAMP on progress in resources, two papers were published on sediment on initial responses from HFEs, and overall they're seeing positive signs in beach response. He's attended some fishery meetings and knows the frustrations from fishermen and business owners. There are signs of recovery with recruitment up in the last few years and they've seen large numbers of young trout in the system. They are seeing recovery in the system.*
- *Maybe we should be handling beach slope as well so the beaches made are actually usable. What's deposition of post-ammonia treatment?*
  - *GCMRC will collect and dispose of the fish as they can't be put to beneficial use.*
  - *There is a lot of human contamination for people camping at the same beach every night and HFEs actually help cleanse the canyon.*
  - *What's going to happen when we continue to do HFEs when we haven't resolved what's going on with regard to non-native coming through the system? We have a lot of questions about the biological resources that are not available to us right now and yet we're trying to make a decision to do HFEs.*
  - *One additional resource that should be reported, and it's in the LTEMP, is air emissions and needs to be included in all HFEs.*
  - *If fluctuations kill foodbase and HFEs are major fluctuations, we need to figure out the effects.*
  - *How many are too many non-natives to not do an HFE because the risk is too high?*
  - *Regarding cultural resources: (1) Zuni wants access to not just archaeological sites but to the entire canyon, shrines, springs, and collection areas, (2) Reclamation should COME to the tribe and not wait for the tribe to request consultation regarding the effects of the HFEs, (3) The treatment for GSF is one of reactionary rather than a proactive attempt to manage and the reactionary methods of dealing with the GSF are involving management actions that are offensive to Zuni sensibility because they involve the actual taking of life.*

**LTEMP FEIS** – Ms. Grantz, Mr. Billerbeck. The Final LTEMP EIS was published on October 7 and Reclamation is preparing the Record of Decision. She doesn't feel anyone will be surprised with what's in the ROD and anticipates it will be signed in mid-December.

**LTEMP Science Plan** ([Attachment 7](#)) – Mr. Vanderkooi. The science plan was structured around the different operations that were proposed. The flow actions identified in the Preferred Alternative are: (1) Fall and spring HFEs, (2) Proactive spring HFEs, (3) Extended-duration HFEs and (3) Trout management flows. The LTEMP is broken into two 10-year periods with a stopping point in the middle, both on the physical resources and the biological resources after a decade. If things aren't working out as expected, it goes into another series of decisions to change things.

- The remote camera sites provide valuable technical data to managers and stakeholders in near real time to facilitate management decisions.
- Remote sensing will also be important moving forward in doing aerial surveys, lidar satellite imagery, and some just supports data collection efforts and looking at big scale change detection in backwater and near-shore habitats.
- Current monitoring related to HFEs is a lot less than was done in some of the early HFEs (1996, 2004, 2008). Moving into the LTEMP there are two different types of HFEs and they don't necessary understand they'll work which will require more intensive work previously.
- Some of the actions that have been proposed in the Preferred Alternative include trout control, macroinvertebrate production flows, low summer flows and non-flow vegetation treatments. There is a two-tiered approach to addressing this issue, the first step is if there some decline in HBC, there would be efforts to benefit chub and then if conditions didn't improve, then there would be mechanical removal.
- Nonnative/Invasive fish monitoring is becoming a larger issue. Both BT and GSF are more prevalent in Glen

Canyon is a great concern to the scientists and the managers. Need to look to emerging technology to help improve with monitoring methods.

- With respect to riparian vegetation, NPS will help lead on removal and restoration activities. There are bigger scale changes with tamarisk and tamarisk beetles in the system and continued vegetation expansion onto sandbars.
- Project Element 4.2 will deal with geomorphic processes and the future of archaeological sites.

Q&A Comments:

- *If the science plan has TMF it in and they don't work, do you stop doing?*
  - *It's an adaptive management program and if we find out something isn't working, then we stop doing it. It's perceived as a mid to high level document that outlines areas where to focus the work. Getting into the details will be in the 3-year work plans.*
- *There is no mention of what aquatic resource monitoring is related to an HFE and that should be an element in the HFE monitoring program.*
- *The science can determine what the impacts are, but it's more of a policy level recommendation at the AMWG level as to what is unacceptable. The only exception would be those identified in the BO.*
- *Mike Yard talked to me about the change in the aquatic plant life particularly with cladophora and said that could affect the invertebrate total mass and distribution. Mike thought that this may have something to do with the shift to the blackfly being the dominate food source for the trout versus the midges. I didn't see any discussion on aquatic plant life and is there any plan to do work on the plant life and diatoms and the basic food sources for the invertebrates.*
- *Need to have a discussion on integrating the science plan with chapter two of the workplan.*
- *Attaching the science plan to the ROD seems like it would become a static science plan. We need to be able to make adjustments to the science plan and having it connected to chapter two is a good bridge.*
- *The core monitoring ad hoc group needs to be reactivated immediately.*
- *Concerned that the science plan and the EIS contains elements that will disproportionately negatively impact one group of people and that's being adequately considered or dealt with. .*
- *It will be interesting to see how bug flows will affect the foodbase.*
- *Need to include combine past and new information and get the monitoring done on a consistent basis.*

**Integrating LTEMP into GCDAMP Process (Attachment 8)** – Mr. Shanahan. With publication of the FEIS and pending signage of the ROD, this agenda item was added to begin dialogue on what the TWG's role will be moving forward. Recognizing past assignments (Strategic Plan, MRP, Knowledge Assessment, etc.), he wants to engage the TWG on their future roles and responsibilities moving forward and offered what he perceived what those would be in two categories:

| Explicit                                                                             | Potential ??                                                   |
|--------------------------------------------------------------------------------------|----------------------------------------------------------------|
| DOI to seek TWG consensus on annual hydrograph (§ 2.2.4.1)                           | Advice on implementing the condition-dependent adaptive design |
| DOI to host annual reporting meeting (ARM) for stakeholders (§ 2.2.4.4)              | Advice on annual implementation considerations                 |
| DOI to meet with TWG to discuss contemplated annual experimental actions (§ 2.2.4.4) | Advice on long term off-ramp conditions                        |
|                                                                                      | Advice on work planning and budgeting                          |

Mr. Shanahan asked if the ARM could serve other purposes and received the following responses:

- *A key component of the workplan guidance document is the ARM and what was captured in that vision was the ARM and the cycle of the first year where you're developing the TWP serves the addition of not only looking at an annual basis of what we researched but what we're going to do, what did we learn, and what does that mean for the next year's budget but also the additional knowledge assessment of synthesizing longer term body of science to better understand larger guidance for developing the TWP. The vision in that budget process is that every 3 years we do more of a knowledge assessment synthesis and then the off years, the second and third years, it would be more of an ARM. One thing to keep in mind is the most critical things that were encapsulated into the need for the ARM was so that everybody would be offering from the same playing field with knowledge, that everyone would have the same*

*information to work with and that's a really critical component of that ARM.*

- *You could include all those and then we start out with the resource and then under the resource identify the workplan projects, goals, and DFCs that apply to each of the resources. Each of those are very critical.*
- *If we all sit and watch presentations from Ted Kennedy, we'll all get something different based on our educational backgrounds.*
- *I don't know if there's a need to see what the LTEMP is putting in place to what we're currently operating under. In the past we had the SCORE report, but is there some way to measure if we are moving forward*
- *Sometimes the resource perspective is missing when we're just talking about science and not pulling together stakeholder viewpoints especially when talking to the AMWG.*
- *We gone to great lengths to make each stakeholder happy and have comprised to come up with the FEIS. Maybe it's up to each of us on what our preferred goals are so we've got something to work for and have a number to hit that's still balances resource needs.*
- *There's inadequate time to report on all the resources. It would be easy if the presentations are clear and the scientists make a concerted effort to not blow through the scientific part of their presentations and make them easy to understand.*
- *Maybe there's a role for a modified ARM saying in year 1 or year 2 of the 3-year workplan to discuss some of the philosophical issues.*

Moving into a discussion of annual experiments, Mr. Shanahan asked the following questions: Should this occur in January? Does the TWG want additional check-ins? Should we be talking about the outcomes? The following responses were captured:

- *It would help if we knew which projects are ongoing, which projects will be completed, and when a report will be available.*
- *Appreciate the opportunity to look at the proposals and be involved, and like the idea of having a visible response by giving a thumbs up or down when hypotheses are presented.*
- *From a practical standpoint, we'll also be able to look at the experiments we perceive coming and be able to time with the TWP process.*
- *I don't know what Interior is thinking but with regard how much we can put from this body on experiments. Are you thinking of a model of "Interior gets together, decides what experiments will be done, and then do you want to come to TWG to get input or are we talking more of an adaptive management process. Maybe we have a standing agenda item on every meeting where we talk about adaptive management and experimentation because it's going to be constantly changing. We might really want to get input I would think early on because some of us like to think that next year might be a great year to bug flows and other folks might be thinking that next year would be the worst year. I think there's a lot of information and expertise in this group working with Interior through this process and talking early and often about these things rather than just one meeting in January or I would propose that Interior thinking of and then bringing it to us for input, maybe at the last minute, maybe not. I propose it something we do at every meeting, maybe every January is a major check-in with the knowledge assessment and then we'll have a standing agenda item to talk about what are the outcome of the experiments that are possible. What are some key inputs we want you to think about? What are some key concerns we might have with one of these experiments that might be on the table and have that be an evolving conversation?*
  - *Ms. Grantz: This first year will be a "learning as we go along adaptive management." We're also doing adaptive Management as a process and figuring out what process works best. There's a balance between wanting to make sure you get enough appropriate input as well as making sure there's an efficient process.*
- *Mr. Seaholm: The first thing you need is a set of targets that you want to try to achieve. That was the purpose behind trying to do goals initially and getting to the DFCs and so we have all these resource conditions that each one of us would like to see, but you've got to have some range of goals/DFCs that you're trying to achieve. Once you have that, then you start taking what I call a "judgement" model and say okay if I give you 50 pages, what's that going to cost me in terms of acres of vegetation. You start looking at some of the tradeoffs and discuss when an experiment can be done and then review the set of conditions that you have on the river. The hydrology for that year and the releases allow you to do those experiments successfully or not. Then you take all that into your knowledge assessment, get everybody working on the same plan and make adjustments for the coming year. Some of those experiments may fall out or you see that you can't do this one without coming up with confounding events with this experiment or I can move this one and say this isn't going to work or give you the desired result. You start forming things around the DFCs*



*and see if you can get some definition to those DFCs. Everybody is going to have a different idea of what is not acceptable, but at least you can come up with a range and you can say that I can design an experiment that will bring me some results within that range. But at some point you're going to have to start looking at what you can actually do because you can't have the beaches you want and still have enough acres of native vegetation. You need to get to a point where you have this conceptual model that allows you to see what some of those tradeoffs are.*

Mr. Dahl displayed a children's book, "[Phoebe and the Chub](#)" (2005) and suggested it be purchased for everyone to enjoy (though he didn't offer up who should pay for it).

**Public Comment:** None

**Adjourned:** 5 p.m.

## Glen Canyon Dam Technical Work Group Meeting

**October 19, 2016**

**Start Time:** 8:38 a.m.

**Conducting:** Seth Shanahan, TWG Chair  
Vineetha Kartha, TWG Vice-Chair

### **Committee Members/Alternates Present:**

Melinda Arviso-Ciocco, Navajo Nation  
Carlee Brown, State of Colorado  
Chris Budwig, Federation of Fly Fishers/TU  
Charley Bullets, Southern Paiute Consortium  
Shane Capron, WAPA  
Kerry Christensen, Hualapai Tribe  
Kevin Dahl, National Parks Conservation Assn. Bill Davis, CREDA  
Kurt Dongoske, Pueblo of Zuni  
Craig Ellsworth, WAPA  
Katrina Grantz, U.S. Bureau of Reclamation

Paul Harms, State of New Mexico  
Brian Healy, NPS/GRCA  
Ken Hyde, NPS/GLNRA  
Jeffrey Inwood, State of Arizona  
John Jordan, Int'l Federation of Fly Fishers/TU  
Robert King, State of Utah  
Jessica Neuwerth, State of California  
Ben Reeder, Grand Canyon River Guides  
Peggy Roefer, State of Nevada  
Michael Yeatts, Hopi Tribe  
Kirk Young, U.S. Fish and Wildlife Service

### **Committee Members Absent:**

Jan Balsom, NPS/GRCA  
Cliff Barrett, USAMPS (phone)  
Robert King, State of Utah  
Chip Lewis, Bureau of Indian Affairs

Larry Stevens, Grand Canyon Wildlands Council  
Steve Wolff, State of Wyoming

### **Grand Canyon Monitoring and Research Center:**

Helen Fairley, Program Manager  
Kyrie Fry, Communication

Scott VanderKooi, Center Director

### **Interested Persons**

Mark Anderson, NPS/GLNRA (phone)  
Cliff Barrett, UAMPS (phone)  
David Braun, Sound Science LLC  
Winkie Crook, Hualapai Tribe  
Jennifer Crandell, State of Nevada  
Marianne Crawford, Bureau of Reclamation (phone)  
Ed Gerak, CREDA  
Jessica Gwinn, U.S. Fish and Wildlife Service  
Craig Ellsworth, WAPA  
Chris Harris, State of California (phone)

Paul Hirt, Arizona State University  
Joseph Holway, member of the public  
Dawn Hubbs, Hualapai Tribe  
Leslie James, CREDA (phone)  
Ryan Mann, Arizona Game & Fish Department  
Theresa Pasqual, DOI Federal Tribal Liaison  
Randy Seaholm, State of Colorado  
Perry Shirley, Navajo Nation  
Rosemary Sucec, NPS/GLNRA (phone)  
Gloria Tom, Navajo Nation

**Meeting Recorder:** Linda Whetton

**Welcome and Administrative:** Mr. Shanahan welcomed the members and the public.

- AHAG Update - Ms. Grantz introduced Dr. Paul Hirt from Arizona State University who will be leading the Administrative History Project. Dr. Hirt is a historian specializing in the American West, global environmental history, environmental policy and sustainability studies at Arizona State University. His background is mostly in environmental policy and natural resources management. He specialized in water, energy and natural resources. He received a grant from the National Endowment for Humanities to develop a project a few years back called "Nature, Culture, and History of the Grand Canyon." He is under a CESU contract and is authorized for 5 years to do 30 oral histories since the beginning of the program and is hoping to talk with Bruce Babbitt (signed first AMWG Charter on 1/15/1997). He also intends to develop a website which will include the GCDAMP historical records which will be a supplement to the

“wiki” site.

- HFE Update - Ms. Grantz. This morning the HFE Technical Team met and discussed the final recommendation that we plan to go forward to the Leadership Team and supports moving forward with an HFE this fall on the condition that reports from the field through Friday confirmed that the GSF has been resolved and on the condition that DOI commits to prioritizing the development and implementation of non-native species monitoring and mitigation be in place within the next year. The report is being finalized and will be sent to the Leadership Team later today for their discussion tomorrow morning. A final decision will be forthcoming and she believes it will be verbal conditional approval with conditions and feedback from the field on Friday with a final decision on Monday at which time there will be a memo coming out from the Leadership Team that will go to AMWG members as well as members of the public. The Technical Team report will also be included. She heard that recreational anglers would like a formal response to their concerns and once the Leadership Team decision has been made, she'll respond to that request. She has also heard from Mr. Dongoske that if DOI moves forward with the HFE, he would make a formal request for follow-up with the Pueblo of Zuni to discuss the HFE. Overall, one of the obligations is to meet with MOA signatories after an HFE and she will reach out to the AMWG signatories it makes sense to do that later after there is enough information and data. In past years, they've met either in January or April.
  - Mr. Jordan said he heard the HFE is scheduled for around November 7 and one of the things he had asked be done is there are commitments for river use for that period of time when the HFE is going on. Many of those commitments have been made weeks or months in advance and involve travel and other costs. He asked that she look at different structuring of the decision mechanism, that the mechanism doesn't remain dormant until there is a determination that there's enough sediment. Everything is all decided ahead of time, assuming the GSF is under control, and then the only determinant becomes if there is enough sediment or not. The sediment determination came several weeks ago so that he asked that they administratively think about and it would be a go only on one issue and there can be some advanced notice on it. Ms. Grantz felt a better job could be done in honing down the dates ahead of time.

**Triennial Budget and Workplan Process ([Attachment 9a](#))** – Mr. Capron. He informed the group to work on the latest version of the document which includes Colorado's concerns and consensus from the BAHG on the previous version. The TWG reviewed each section and the changes were noted.

#### Section 1.0

- Need to identify the funding source. They're not opposed to funding but want this identification on the table and up for discussion.

#### Section 2.1

- Add language: “and dealing with long-term monitoring” ...
- In the interest of going through and reading all those documents, it would be helpful to say “dam operations” and not get bogged down with that continuing discussion.
- Reluctant paraphrasing legal documents in budget documents and just refer people to the actual law. Rod Smith joined by phone and concurred. Mr. Capron suggested that since Reclamation and Mr. Seaholm are pretty solid in their stances, he suggested moving the language. Mr. VanderKooi stated that GCMRC will follow SOL directions in all legal matters.
- It would be helpful to know what the sideboards are.
- LTEMP has activities that aren't dam operations and so having this wording “anything that isn't related to dam operations” wouldn't fall under the purview of this group. Another issue: Referencing that section of the GCPA seems to be able to stand alone but Section 1804 is specific to the old EIS and the GCPA and how is that going to apply moving forward? What portion is still relevant once LTEMP is in place?
- Rod Smith – My primary concern is that there are many sensitivities and gray areas. I don't think we're going to give you anything that isn't going to be high level and you'll be able to use.
- Add “as currently implemented through the 2007 Interim Guidelines.”
- Mr. Seaholm said that Colorado would like to put a period (.) after GCPA and delete the balance after that.
- Ms. Grantz said she was comfortable with the revision but she also heard that the issue of funding and where that funding is coming from is very important as well as it pertains to some GCPA sections. In discussions with Rod Smith, there will be further discussion of the funding at budget questions at the January TWG meeting and that decisions will come down to a project-by-project evaluation.

#### Section 2.3

Word change: add in the first sentence meeting “targeted” to

#### Section 2.4

No changes.

Section 2.4

No changes.

Section 2.5

No changes.

Section 2.6

Add "its" as an editorial change

Section 2.7

- New initiatives: New initiatives may be brought up for discussion by members during BAHG or TWG budget discussions (see Table 1) for consideration by Reclamation and GCMRC. These new initiatives may need to be considered by the GCDAMP Program Manager prior to requesting either GCMRC or Reclamation to develop a proposal for mid-work plan consideration. If DOI determines it is beyond the scope of a mid-work plan change, then the initiative could be considered during the development of the next work plan. Given that the budget will likely be fully accounted for, direction on funding source within the current budget will be required for discussion with the GCDAMP Program Manager. Revisions must comply with the Budget Principles (see Section 2.1).
- Under the February box – What's the intent of GCMRC meeting with the tribes?
  - Mr. VanderKooi said a criticism has been that projects aren't fully fleshed out when they meet with the tribes.

Mr. Capron advised that as projects are being considered, the members should decide which ones they're interested in and be prepared to provide input on those at the January 2017 TWG Meeting. That information will be provided to BOR and GCMRC with much of the work being done in support of the TWP budget process will be in the February-April time frame.

**Motion (proposed by Kevin Dahl, seconded by Vineetha Kartha): The TWG has reviewed the Triennial Budget and Work Plan Process as required by the Assistant Secretary for Water and Science (May 7, 2014), and recommends that the AMWG approve the document, as revised at the October 18, 2016, TWG meeting as the GCDAMP budget guidance. Passed by consensus.**

[Attachment 9b](#) - GCDAMP Triennial Budget and Work Plan Process Updated October 19, 2016.

**Socioeconomics Research and Monitoring Update ([Attachment 10](#))** – Mr. Bair. Project 13.1 was completed at the end of FY16 and this is a good time to present the results as the TWG prepares for the upcoming ARM and entering into budget and work plan discussions. He wanted to provide an update on the Project 13.1 (Recreation) because it was completed at the end of FY16 and he thinks it's a good time to talk about what would be a good time to start thinking about the subsequent work plans and what needs to be done. In 2005 Helen Fairley headed the [Recreation PEP](#) and suggested people revisit those findings.

- Creel data was used to look at angler preferences and demand at Lee's Ferry by season. They entered existing information into a statistical model to estimate demand for angling by season. The results from guided and non-guided trips above and below the River in spring revealed that trip costs increase for those living further away from the resource. There are also seasonal economic benefits.
- Scenario Analysis provided results on distribution of angler benefits by season indicating that spring and fall have higher values.
- Flows are a little complicated with whitewater trips (rapids, change in size, and difficulty) but flows also influence the amount of time that you can spend in side canyons and dictate how long you can spend on the river. They asked for their preferences on flows and how under average flows their trips would change (better, same, worse) indicating that in the current study with flows at 5,000 cfs their experiences were 95% worse; at 13,000 cfs about 75% the same; at 22,000 cfs about 66% the same; and at 40,000 cfs about 64% worse. Regional expenditures indicate they pay an average of \$1,634 to take a trip and about \$969 is spent locally with higher costs associated with boat rental, meals, and lodging.
- Angler results based on an average of flow of 10,800 cfs indicate that experiences at 3,000 cfs were 68% worse; at 10,000 cfs were better at 57%; at 25,000 cfs at about 71% worse; and at 40,000 cfs were 92% worse.

He thanked staff from Navajo Nation, the Park Service, and Arizona Game and Fish Department for assistance through the collection of all the information, permits, and sharing data.

**Introduction of Christine Lehnertz, Supt., GRCA** – Mr. Healy. Ms. Chris Lehnertz apologized that she couldn't be here today. She has an environmental background and has used the term "fish squeezer" in talking with staff which made them very happy. He will check with her on whether she can attend the Annual Reporting Meeting in January. ***Her bio is as follows:*** Texas born and Colorado raised, Ms. Lehnertz obtained her degree as an environmental biologist from the University of Colorado at Boulder. She started her conservation career in the Rocky Mountains where she worked as a seasonal wildlife and biological technician for the Colorado Division of Wildlife, the U.S. Forest Service and the U.S. Fish and Wildlife Service. She spent 16 years with the U.S. Environmental Protection Agency before she joined the National Park Service. In 2007, she entered the National Park Service as deputy superintendent at Yellowstone National Park, and then served from 2010 to 2015 as regional director for the NPS' Pacific West Region. She has been superintendent at Golden Gate National Recreation Area since May 2015. She assumed her new post as superintendent of Grand Canyon National Park in August 2016.

**Annual Reporting Meeting Preparation (Attachment 11)** Mr. Shanahan. The intent for discussion is to prepare for the ARM. Dr. Braun explained that knowledge assessments have been done over the years and by many organizations with standard processes. With a science driven program, it's important to figure out what the priorities are and reduce the uncertainties.

Q&A. Comments:

- *Scorecards can be used to track progress with lots of high and low level peer review.*
- *Tribal values can be applied to all areas, but the methods use in one area may not be the same in another area.*
- *How should the ARM be organized? Typically the ARM is scheduled around status and trend(s) of the resource, important findings from work plan activities, and recommendations for future monitoring and research.*
- *The whole system is a natural process and is regulated by dams. From Zuni perspective, if you interfere with nature's processes you get into trouble.*
- *The list is very characterized and doesn't sit well with Navajo Nation. Archaeological and cultural resources encompasses the whole list.*
- *Consider preparing a table/worksheet that answers the questions on the resource.*
- *Rather than looking at the system from a scientific approach and breaking into categories consider approaching it from a system model and what roles do each of them play in the system.*
- *Everything done in the canyon affects the Zuni people. Even though there is beneficial use from trout out of BAC, we believe it's still a negative affect at Zuni and the Zuni are dying earlier. The canyon is a fundamental part of their identity and federal agencies tend to segregate or ignore tribal relationships to the resources. If you treat water inappropriately, it will have negative consequences.*
- *Need a more holistic approach and a framework to work from. There might have to be some anthropological approach to getting some kind of assessment done through ethics and if there is an ethical framework we can work through.*
- *Need to make sure we don't have scientists talking for the tribes and not sure how to bridge this divide but want to discuss this more and make sure we don't speak for others and their viewpoints.*
- *Also struggling with the scope of this meeting. GCMRC is open to suggestions.*
- *We try to get a one-size that fits all and it's the area of the overlap that we need to find. We need to have a means to equally value each of the resources.*
- *In terms of methods, it would take work but having a parallel review would be good.*
- *Are people supportive of having a Knowledge Assessment Summary Sheet (refer to PPT slide)*
- *Suggest people look at the DFCs again to see the interrelationships.*

**ACTION ITEM:** TWG members need to submit any topics they want considered for the Annual Reporting Meeting (Jan 24-25, 2017) to Scott VanderKooi by Friday, November 4, 2016.

**Public Comment:** None

**Adjourned:** 3:05 p.m.

Respectfully submitted,

Linda Whetton  
Upper Colorado Region  
Bureau of Reclamation

**Upcoming Meetings:**

**AR Mtg Jan 24-25, 2017**

**TWG Mtg Jan 26, 2017**

DOIFF Feb 14, 2017

AMWG Feb 15-16, 2017

**TWG Mtg Apr 20-21, 2017**

AMWG Webinar May 24, 2017

**TWG Mtg Jun 13-14, 2017**

DOIFF Aug 22, 2017

AMWG Aug 23-24, 2017

## Key to Glen Canyon Dam Adaptive Management Program Acronyms

|                                                   |                                                                  |
|---------------------------------------------------|------------------------------------------------------------------|
| ADWR – Arizona Dept. of Water Resources           | HBC – Humpback Chub (endangered native fish)                     |
| AF – Acre Feet                                    | HFE – High Flow Experiment                                       |
| AZGFD – Arizona Game and Fish Department          | HMF – Habitat Maintenance Flow                                   |
| AIF – Agenda Information Form                     | HPP – Historic Preservation Plan                                 |
| AMP – Adaptive Management Program                 | IG – Interim Guidelines                                          |
| ARM – Annual Reporting Meeting                    | INs – Information Needs                                          |
| AMWG – Adaptive Management Work Group             | KA – Knowledge Assessment (workshop)                             |
| AOP – Annual Operating Plan                       | KAS – Kanab Ambersnail (endangered native snail)                 |
| ASMR – Age-Structure Mark Recapture               | LCR – Little Colorado River                                      |
| BA – Biological Assessment                        | LCRMCP – Lower Colorado River Multi-Species Conservation Program |
| BAHG – Budget Ad Hoc Group                        | LTEMP – Long-Term Experimental & Management Plan                 |
| BCOM – Biological Conservation Measure            | LTEP – Long Term Experimental Plan                               |
| BE – Biological Evaluation                        | MAF – Million Acre Feet                                          |
| BHBF – Beach/Habitat-Building Flow                | MA – Management Action                                           |
| BHMF – Beach/Habitat Maintenance Flow             | MATA – Multi-Attribute Trade-Off Analysis                        |
| BIA – Bureau of Indian Affairs                    | MLFF – Modified Low Fluctuating Flow                             |
| BO – Biological Opinion                           | MO – Management Objective                                        |
| BOR – Bureau of Reclamation                       | MRP – Monitoring and Research Plan                               |
| BWP – Budget and Work Plan                        | NAU – Northern Arizona University (Flagstaff, AZ)                |
| CAHG – Charter Ad Hoc Group                       | NEPA – National Environmental Policy Act                         |
| CAP – Central Arizona Project                     | NHPA – National Historic Preservation Act                        |
| GCT – Grand Canyon Trust                          | NNFC – Non-native Fish Control                                   |
| CESU – Cooperative Ecosystems Studies Unit        | NOI – Notice of Intent                                           |
| cfs – cubic feet per second                       | NPCA – National Parks Conservation Association                   |
| CFMP – Comprehensive Fisheries Management Plan    | NPS – National Park Service                                      |
| CMINS – Core Monitoring Information Needs         | NRC – National Research Council                                  |
| CMP – Core Monitoring Plan                        | O&M – Operations & Maintenance (USBR Funding)                    |
| CPI – Consumer Price Index                        | PA – Programmatic Agreement                                      |
| CRBC – Colorado River Board of California         | PBR – Paria to Badger Creek Reach                                |
| CRAHG – Cultural Resources Ad Hoc Group           | PEP – Protocol Evaluation Panel                                  |
| CRCN – Colorado River Commission of Nevada        | POAHG – Public Outreach Ad Hoc Group                             |
| CRE – Colorado River Ecosystem                    | Powerplant Capacity = 31,000 cfs                                 |
| CREDA – Colorado River Energy Distributors Assn.  | R&D – Research and Development                                   |
| CRSP – Colorado River Storage Project             | RBT – Rainbow Trout                                              |
| CWCB – Colorado Water Conservation Board          | RFP – Request for Proposal                                       |
| DAHG – Desired Future Conditions Ad Hoc Group     | RINs – Research Information Needs                                |
| DASA – Data Acquisition, Storage, and Analysis    | ROD Flows – Record of Decision Flows                             |
| DBMS – Data Base Management System                | RPA – Reasonable and Prudent Alternative                         |
| DOE – Department of Energy                        | SAP – Science Advisors Program                                   |
| DOI – Department of the Interior                  | Secretary – Secretary of the Interior                            |
| DOIFF – Department of the Interior Federal Family | SCORE – State of the Colorado River Ecosystem                    |
| EA – Environmental Assessment                     | SHPO – State Historic Preservation Office                        |
| EIS – Environmental Impact Statement              | SOW – Statement of Work                                          |
| ESA – Endangered Species Act                      | SPAHG – Strategic Plan Ad Hoc Group                              |
| FACA – Federal Advisory Committee Act             | SPG – Science Planning Group                                     |
| FEIS – Final Environmental Impact Statement       | SSQs – Strategic Science Questions                               |
| FRN – Federal Register Notice                     | TCD – Temperature Control Device                                 |
| FWS – United States Fish & Wildlife Service       | TCP – Traditional Cultural Property                              |
| FY – Fiscal Year (October 1 – September 30)       | TEK – Traditional Ecological Knowledge                           |
| GCD – Glen Canyon Dam                             | TES – Threatened and Endangered Species                          |
| GCES – Glen Canyon Environmental Studies          | TMC – Taxa of Management Concern                                 |
| GCT – Grand Canyon Trust                          | TMF – Trout Management Flows                                     |
| GCMRC – Grand Canyon Monitoring & Research Ctr    | TWG – Technical Work Group                                       |
| GCNP – Grand Canyon National Park                 | UCRC – Upper Colorado River Commission                           |
| GCNRA – Glen Canyon Nat'l Recreation Area         | UDWR – Utah Division of Water Resources                          |
| GCPA – Grand Canyon Protection Act                | USBR – United States Bureau of Reclamation                       |
| GIS – Geographic Information System               | USFWS – United States Fish & Wildlife Service                    |
| GLCA – Glen Canyon Nat'l Recreation Area          | USGS – United States Geological Survey                           |
| GRCA – Grand Canyon National Park                 | WAPA – Western Area Power Administration                         |
| GCRG – Grand Canyon River Guides                  |                                                                  |
| GCWC – Grand Canyon Wildlands Council             |                                                                  |