Glen Canyon Dam Adaptive Management Work Group
Agenda Item Information
August 24-25, 2010

Agenda Item

Temperature Control Device and Sediment Augmentation Report

Action Requested

✓ Motion requested. (The following motion is recommended by TWG. However, no motion is officially made unless and until an AMWG member makes the motion in accordance with the AMWG Operating Procedures.)

AMWG recommends that the Secretary of Interior develop an engineering feasibility study and risk assessment, with a synthesis of existing information, for the implementation of a Temperature Control Device whose goal would be to support recovery of native fish and that:

(a) incorporates a TCD design with both warm and cold-water release options and with a combination of 2, 4, 6, and 8 units,

(b) considers concerns that new warm-water non-natives and additional planktonic food sources might become delivered or established in the CRE, and

(c) considers the potential of using turbidity (silt and clay) as a mechanism to affect predation rates of nonnative fish on native fish.

AMWG further recommends that the consideration of a TCD be implemented within a long-term experimental process. No funding sources have been identified to complete this work.

Presenters

Dennis Kubly, Acting ERD Division Manager, Bureau of Reclamation
Shane Capron, Chair, Technical Work Group

Previous Action Taken

✓ By AMWG: At its August 2009 meeting, AMWG passed the following motion by consensus:
The AMWG recommends to the Secretary of the Interior that Reclamation report on the status of the TCD and Sediment Augmentation projects to the TWG. The TWG will make a recommendation to the AMWG for consideration at the spring 2010 AMWG meeting.

✓ By other: The Secretary of the Interior concurred with the above recommendation in a memorandum dated November 16, 2009.

✓ By TWG: At its March 2010 meeting, TWG passed the following motion by a vote of 11 yes, 3 no, and 3 abstentions:
The TWG recommends that the AMWG consider a recommendation to the Secretary of Interior to develop an engineering feasibility study and risk assessment, with a synthesis of existing information, for the implementation of a Temperature Control Device that considers the following:

(a) incorporates a TCD design with both warm and cold-water release options and with a combination of 2,4, 6, and 8 units,

(b) considers concerns that new warm-water non-natives and additional planktonic food sources might become delivered or established in the CRE, and
(c) considers the potential of using turbidity (silt and clay) as a mechanism to affect predation rates of nonnative fish on native fish. The goals of the action would be to support recovery of native fish.

TWG further recommends that the consideration of a TCD be implemented within a long-term experimental process. No funding sources have been identified to complete this work.

Relevant Science

Garrett, L.D., Baron, J., Dale, V., Gunderson, L.H., Howard, A., Hulse, D., Kitchell, J., Loomis, J., Palmer, M., Parker, R., Robertson, D., Schwartz, D., and Watkins, J., 2003, Evaluating a Glen Canyon Dam temperature control device to enhance native fish habitat in the Colorado River: A risk assessment by Adaptive Management Program Science Advisors: Prepared for the Glen Canyon Dam Adaptive Management Program and the Grand Canyon Monitoring and Research Center, Flagstaff, Ariz.

Gloss, S.P., Lovich, J.E., and Melis, T.S., eds., 2005, The state of the Colorado River ecosystem in Grand Canyon: U.S.Geological Survey Circular 1282, 220 p.

Melis, T.S., Topping, D.J., Rubin, D.M., and Wright, S.A., 2007, Sediment research supports sandbar restoration: U.S. Geological Survey Fact Sheet 2007-3020, 4 p.

Randle, T.J., Lyons, J.K., Christensen, R.J., and Stephen, R.D., 2007, Colorado River ecosystem sediment augmentation appraisal engineering report: U.S. Bureau of Reclamation, Technical Service Center, Sedimentation and River Hydraulics Group, Denver, Colorado

Rubin, D.M., Topping, D.J., Schmidt, J.C., Hazel, J., Kaplinski, M., and Melis, T.S., 2002, Recent sediment studies refute Glen Canyon Dam hypothesis: Eos, Transactions of the American Geophysical Union, v. 83, p. 273, 277–278.

Topping, D.J., Rubin, D.M., Schmidt, J.C., Hazel, J.E., Jr., Melis, T.S., Wright, S.A., Kaplinski, M., Draut, A.E., and Breedlove, M.J., 2006, Comparison of sediment-transport and bar-response results from the 1996 and 2004 controlled-flood experiments on the Colorado River in Grand Canyon, *in* Federal Inter- Agency Sedimentation Conference, 8th, Reno, Nevada, 2006, CD-ROM Proceedings (ISBN 0-9779007-1-1).

Wright, S.A., Schmidt, J.C., Melis, T.S., Topping, D.J., and Rubin, D.M., 2008, Is there enough sand? Evaluating the fate of Grand Canyon sandbars: Geological Society of America Today, v. 18, no. 8, p. 4–10.

Background Information

Dennis Kubly provided a presentation on TCD and sediment augmentation at TWG's September 2009 meeting. In August 2003, the Science Advisors completed a risk assessment on a temperature control device and the AMWG recommended that the Bureau of Reclamation initiate environmental compliance on the project. Reclamation initiated analysis of a 2-unit external frame selective withdrawal structure with a withdrawal range of 3700-3520' elevation, and incorporated the

assessment into the LTEP EIS when it began. The 2007 Reclamation biological assessment concluded that it was technically feasible to construct and operate a temperature control device to allow warmer dam releases and requested the Fish and Wildlife Service to determine in their biological opinion whether the benefits of warmer dam releases to endangered fish outweighed the risk of those releases to improve conditions for nonnative warmwater fish. The FWS expressed serious concerns in its 2008 biological opinion that the use of a TCD could result in a nonnative invasion that could impede the recovery of humpback chub and the option did not appear in the 2008-2012 environmental assessment. TWG recognized that mainstem temperatures may have positively affected humpback chub in the early 2000s and a TCD could benefit chub in the future.

Dennis answered questions and followed up with a relevant literature list for TWG to review in further detail. Many issues for a TCD were raised such as the need to consider the ability to release both warm and cold-water, the potential for nonnative invasions, cost, and potential for impaired operations if the reservoir becomes low.

Dennis Kubly continued with a report on sediment augmentation. Sediment augmentation is identified in the Humpback Chub Comprehensive Plan (Project 5) for turbidity control and habitat maintenance and restoration. A major consideration has been for building and maintenance of beaches for recreation purposes and for providing cover via turbidity. Randle et al. (2007) appraised the options and uses for sediment augmentation in Grand Canyon in order to facilitate decision-making. They identified two key needs:

> (a) Seasonally increase the turbidity of the Colorado River to provide cover for native and endangered fish during the months of May through December. This is the period when young young-of of-the year humpback chub emerge from the Little Colorado River and then rear in the Colorado River.
>
> (b) Annually increase the sand supply to the Colorado River during beach beach-building flows to build larger sandbars, especially in Marble Canyon, through fluvial processes.

They assumed that for turbidity, a concentration of 500 ppm silt/clay would require 3.8 million tons in 8 months. For a BHBF, 1 million tons of sand before the beach/habitat habitat-building flow would be needed, with a total annual sediment supply requirement of 4.8 million tons. Sediment source areas and delivery locations were described in the report, as well as collection methods, delivery methods, and storage areas. They concluded that it was technically feasible to construct and operate a sediment augmentation system. They evaluated five alternatives with cost estimates ranging from $140-430 million to construct and $3.6-17 million to operate annually.

TWG considered the information available and felt that additional planning was necessary, and that an LTEMP process should seriously consider how and for what purpose would a TCD and sediment augmentation system be used. TWG struggled with agreeing on a recommendation for AMWG. The major issue seemed to be that there was support for continued research on a TCD, but less support for continued work on sediment augmentation. Concern was raised about sediment affecting storage in Lake Mead. Thus, a combined motion was problematic with TWG. The resolution was to pass a motion that considered turbidity as a potential mechanism to reduce predation rates on humpback chub, but not to consider sediment augmentation for beach building.

After much deliberation, TWG passed a recommendation to AMWG in March that focused on a feasibility study that would weigh the pros and cons of implementing these expensive actions whose outcomes are uncertain. Assuming a TCD and sediment augmentation are considered in the proposed action, this risk assessment could be very useful if an LTEMP EIS process is undertaken.

RECLAMATION

Managing Water in the West

Selective Withdrawal and Sediment Augmentation Update

Dennis Kubly

Bureau of Reclamation

Adaptive Management Work Group Meeting

August 24-25, 2010

U.S. Department of the Interior

Bureau of Reclamation

AMWG Motion: August 2009

- **MOTION:** The AMWG recommends to the Secretary of the Interior that Reclamation report on the status of the TCD and Sediment Augmentation projects to the TWG. The TWG will make a recommendation to the AMWG for consideration at the spring 2010 AMWG meeting.
- Motion was passed by consensus.

Water Temperature: History of Concern

1978 Jeopardy Biological Opinion

"It is our opinion that the major reason for the decline of both listed fish species (Colorado squawfish and humpback chub) in this reach of the Colorado River has been the abnormal water conditions that result from the operation of Glen Canyon Dam. The foremost problem has been the cold, hypolimnic waters from Lake Powell."

Water Temperature: History of Concern

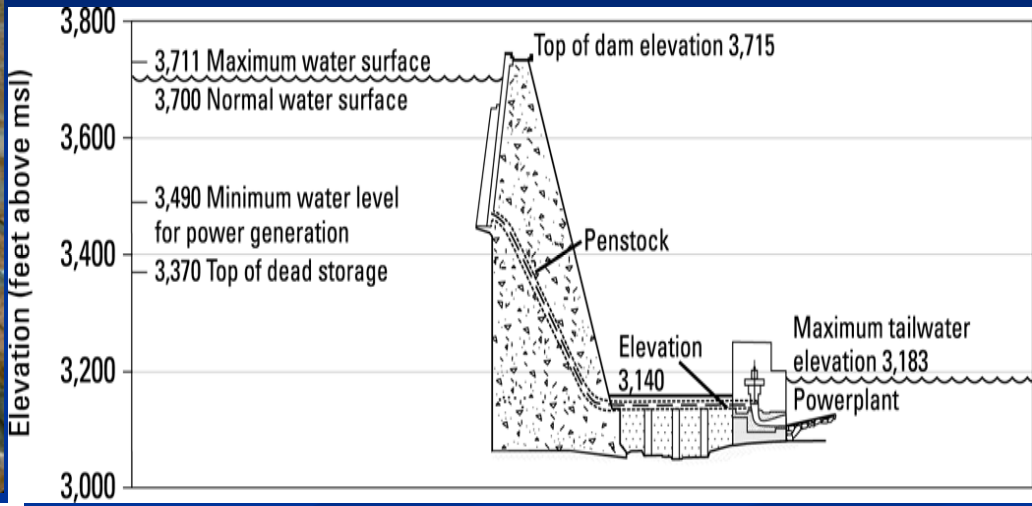
1995 Jeopardy Biological Opinion

"The preferred alternative (without a selective withdrawal structure) does not remove the issue of coldwater temperatures on reproductive success in the mainstem; thus, most eggs or developing larvae would not be expected to survive in the Colorado River below Glen Canyon Dam."

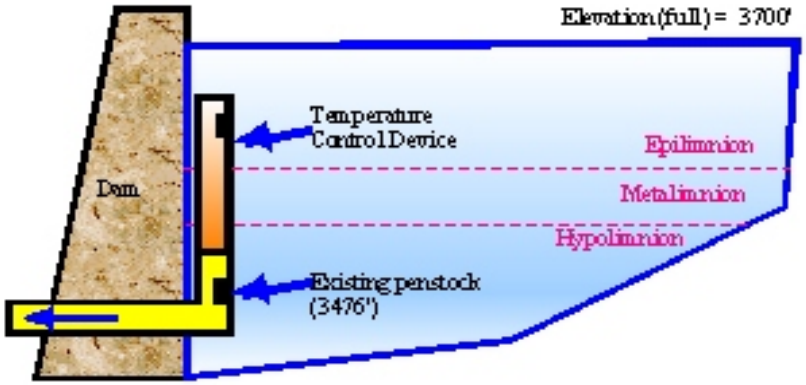
"Reclamation shall implement a selective withdrawal program for Lake Powell waters and determine feasibility using the following guidelines."

Glen Canyon Dam and Powerplant

Without Selective Withdrawal



With Selective Withdrawal



- Concrete Arch Dam
- 710 feet high
- 27 MAF Storage
- Eight Francis turbines
- 1,320 MW capacity

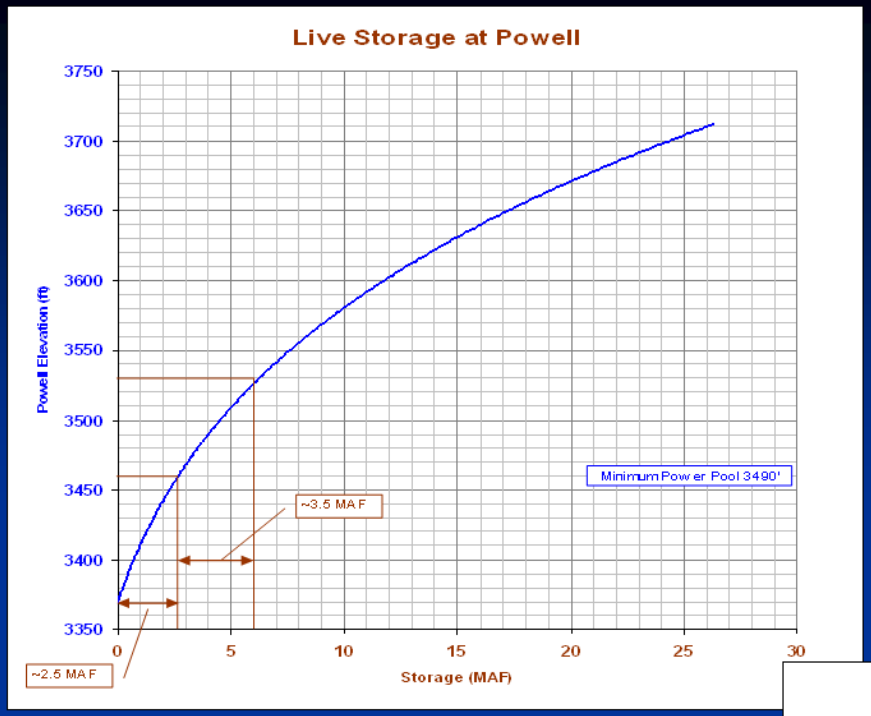
RECLAMATION

Selective Withdrawal History

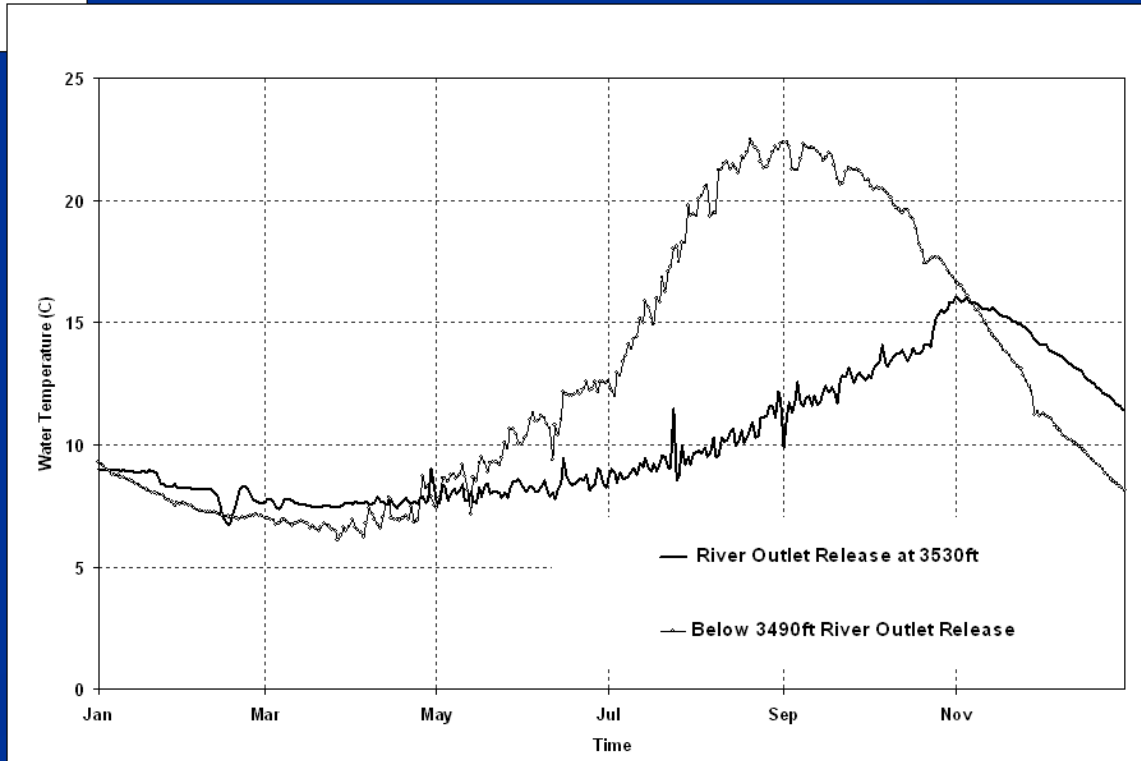
- 1999—Draft EA completed by Reclamation on single inlet, fixed elevation design; rescinded
- 1999 and 2001—Planning workshops; reports to AMWG
- 2003—Reclamation survey of selective withdrawals, SA risk assessment and AMWG recommendation to begin compliance
- 2005—2-unit external frame selective withdrawal evaluated; withdrawal range 3700-3520' elevation
- 2006—Draft EA for 2-unit external frame device; discontinued; begin LTEP
- 2007—LTEP draft alternatives all contain selective withdrawal; discontinued, reinitiate consultation; Reclamation biological assessment identifies it is feasible to construct and operate a selective withdrawal on Glen Canyon Dam; testing under adaptive management necessary to determine effects
- 2008—LTEP put on hold; 5-year experiment initiated; Fish and Wildlife Service in biological opinion views selective withdrawal risk as too high; advocates for more testing

Selective Withdrawal Findings

- 2-unit external frame cost ~$100 million
- Control available from full reservoir to 30’ above penstocks (180’ of reservoir elevation)
- Release temp increase begin late April; ~3°C average; up to 7°C late summer to early autumn
- Major advantage likely to native fish dispersing from tribs, but also to mainstem reproduction
- Concern exists for unintended consequences: ability to return to cold water; native vs nonnative fish--modeling unlikely to resolve, requires experiments under AM



Lake Powell, Hypsographic Curve



Glen Canyon Dam River Outlet Works water temperature releases from CE-QUAL-W2 model results

Fine Sediment: History of Concern

- 1978 biological opinion: No concern expressed for the role of fine sediment in endangered fish ecology.
- 1988 GCES Phase I: Concern for flood (>31,500 cfs) releases causing significant and irreversible degradation…of the sand deposits.
- 1995 biological opinion: Fine sediment must be available for development and maintenance of backwaters and other channel margin habitats.
- 2007-2009 biological opinions: Continued call for monitoring effect of sediment transport on humpback chub habitat.

Fine Sediment: Investigations

- 1995 GCD EIS: Modeling predicted sediment accumulation under MLFF.
- 1996 BHBF: Yes we can, but only for awhile.
- 2002: Rubin et al. EOS—The EIS hypothesis is false; sand inputs exported in weeks to months.
- 2004 HFE: We do better with sediment triggers, but effects are mixed downriver.
- 2005 SCORE: Research and monitoring conclusively demonstrate a net loss of fine sediment under MLFF.
- 2007 Melis et al.: Continued erosion under 1996 ROD
- 2008 Notable HFE success with exceptionally high sand input.
- 2008 Wright et al.: Flow only? Short-term yes with large constraints on load-following hydropower; long-term ??

Improving Sediment Conservation

- One possibility is augmenting the sand available from tributaries with sand trapped behind Glen Canyon Dam (Randle and others, 2007).
- Alternatively, the sand supply might be indirectly increased through the use of short-duration high flows following each average to large tributary input of sand (Topping et al. 2006)
- Another possibility is constraining dam releases following tributary sand inputs for a period of time until a high-flow release can be carried out (Melis et al. 2007), a movement toward the Wright et al. 2008 "best case scenario."

Sediment Augmentation

- Identified in the HBC Comprehensive Plan (Project 5) for turbidity control and habitat maintenance/restoration
- A major consideration is building and maintenance of beaches for recreation purposes
- Beaches also serve as substrate for riparian vegetation, which provides habitat and food for wildlife species

Randle and others 2007

- This appraisal-level study provides the necessary information to facilitate making decisions on whether or not to proceed with a detailed study and evaluation of any alternative. Purposes of augmentation:
  - 1. Seasonally increase the turbidity of the Colorado River to provide cover for native and endangered fish during the months of May through December. This is the period when young-of-the year humpback chub emerge from the Little Colorado River and then rear in the Colorado River (U.S. Department of the Interior, Bureau of Reclamation, 1995). These native fish evolved in a turbid environment and may use it for cover from potential predators.
  - 2. Annually increase the sand supply to the Colorado River during beach-building flows to build larger sandbars, especially in Marble Canyon, through fluvial processes.

Randle and others 2007

- Assumptions and Objectives:
  - Turbidity concentration 500 ppm silt/clay = 3.8 million tons in 8 months
  - 1 million tons (0.9 million Mg) of sand prior to the beach/habitat-building flow.
  - The total annual sediment supply requirement would be 4.8 million tons.
  - Augmentation required in most years, even with Paria River input

Randle and others 2007

- Sediment source areas (Navajo Canyon)
- Sediment delivery locations (below GCD or near Lee's Ferry)
- Sediment collection methods (clamshell dredge)
- Sediment delivery methods and alignments (slurry pipeline)
- Sand storage areas (CR in Glen Canyon or terrestrial site near Lee's Ferry)

Randle and others 2007

- Conclusions: Technically feasible to construct and operate sediment augmentation; 5 alternatives evaluated
- Cost Estimates: $140-430 million construct; $3.6-17 million annual to operate
- Should be considered in conjunction with selective withdrawal