Balanced Resource Alternative[1]

Narrative Description

The Proposed Balanced Resource Alternative focuses on non-flow actions and experiments to address the sediment resource, non-native fish control and temperature impacts to native and non-native fish communities. The Proposed Balanced Resource Alternative assumes continuation of existing operating criteria related to downstream water deliveries as well as generally continuing the modified low fluctuating flow operation, with some adjustments, consisting of modest increases to daily flow fluctuations (varying by month of the year) and increases to the downramp rates in all months of the year. The Proposed Balanced Resource Alternative also includes non-flow actions, including implementation of the Non-Native Fish Control Environmental Assessment actions, as well as:

- increased humpback chub relocation to tributaries when and where advisable
- vegetation removal where advisable
- updated investigation and potential implementation of sediment augmentation options
- analysis of recreational use of beaches by testing impacts to users by prohibiting use of select beaches and monitoring sand losses
- utilization of areas with shelving as campsites in lieu of sand beaches in these areas
- Paria River sediment check dams (to enhance turbidity conditions downstream for reduction of trout predation)
- investigation/implementation of bubblers in the forebay to break down reservoir thermocline (to test theories on benefits and detriments of temperature increases)

Specific Flows

Flow aspects of the Proposed Balanced Resource Alternative include increasing daily flow fluctuations compared to current ROD operations for 10 of 12 months. These increases would be greatest in February with a 66% increase over current ROD operations (10,000 vs. 6,000 cfs range), while December and January would increase 50% compared with current ROD operations (12,000 vs.8,000 cfs). In September through November and in March through June, the Proposed Balanced Resource Alternative would increase daily flow fluctuations by 25% compared with current ROD operations (8,000 vs. 6,000 cfs). A 25% increase would also occur in July and August (10,000 vs. 8,000 cfs). The release flows would remain unchanged relative to current ROD operations only in April through May (6,000 cfs). Compared to current ROD operations, the hourly upramp rate would remain unchanged at 4,000 cfs/hr under the Proposed Balanced Resource Alternative, but the hourly downramp rate would be increased by 100% in all months of the year to 3,000 cfs/hr instead of 1,500 cfs/hr and by 167% in November through March (4,000 cfs/hr compared to 1,500 cfs/hr).

In addition, the Proposed Balanced Resource Alternative includes a number of other experiments that could be used to analyze specific hypotheses. Examples are nonnative fish management flows (e.g., summer stranding flows) to reduce the Glen Canyon Dam rainbow trout population, and tests of the effects of ramp rates on sediment transport. The specifics of the flows that would be tested in these experiments would be subject to reservoir levels, hydrologic conditions, powerplant maintenance, and economic considerations, and *could* include:

[1] Submitted for consideration in the Long-Term Experimental and Management Plan (LTEMP) Environmental Impact Statement (EIS) process by the Colorado River Energy Distributors Association (CREDA), July 2, 2012

- **Summer Stranding Flows**: A stranding flow would maintain elevated flows (e.g., 15,000 cfs) for 2 or 3 days, followed by a very sharp drop in flows to a minimum level (i.e., 7,000 cfs). A stranding flow would be considered in the period of June, July, or August.
- **Ponding Flows**: Ponding flows are those relatively high flows that produce slackwater areas in tributary mouths for the benefit of humpback chub.
- **Fluctuating Flow Experiments**: Power production experiments are short-term flow experiments intended to investigate alternative fluctuating flow parameters that might be compatible with downstream resource objectives.
- **Maximum Power Production:** Full use of the Glen Canyon Dam generators should be analyzed, with mitigation of downstream impacts.

Based on the most recent "best available science" provided by USGS to AMP stakeholders during the summer and fall of 2011 and early 2012, additional elements which could be considered in the Proposed Balanced Resource Alternative could include (but are not limited to):

- evaluation of faster downramps
- monthly volumes of water delivery
- evaluation of specific beach conditions in all reaches, not just Glen, Marble and Grand Canyons
- consideration given to the current state of knowledge regarding Humpback Chub habitat preferences
- greater relocation of humpback chub to tributaries, including Bright Angel Creek
- greater fluctuations to dry trout redds in the spring
- mechanical removal of brown trout up and downstream of Bright Angel Creek
- modification of recreational use of beaches by testing impacts to users by prohibiting use of select beaches and monitoring sand losses; utilization of areas with shelving as campsites in lieu of sand beaches in these areas
- Paria River sediment check dams (to enhance turbidity condition downstream for reduction of trout predation)
- consideration of infrastructure - bubblers in the forebay to break down reservoir thermocline (an inexpensive, temporary method to increase water temperatures downstream that could test theories on benefits and detriments to temperature increases)
- consideration of infrastructure – adding generators to the bypass valves to increase operational flexibility and increase control of water release temperatures

Science Basis

The Proposed Balanced Resource Alternative recognizes the significant positive improvement in the Humpback Chub population and takes a conservative approach to experimentation intended to maintain and increase that endangered species population. It takes a conservative approach to high flow events given the documented impacts to Humpback Chub. It incorporates additional experimentation that would be designed to tease out cause and effect of experimental flow and non-flow actions, building on the learning that has been shared with AMP stakeholders. Some of the recent science findings from AMP workshops that support the Proposed Balanced Resource Alternative (with attribution) follow, and support ongoing experimentation to further establish cause and effect:

- "There was a large rainbow trout population response to reduced flow fluctuations in the early 1990's (and in 2000)." (AGF data). In other words, steady flows increase trout response.
- "Juvenile HBC survival in the mainstem is very high; no obvious changes in survival occurring during flow experiment (referring to the fall nearshore ecology steady flow test)." (Pine). Fall steady flows don't increase humpback chub survival.
- Fish growth rate actually *declined* during fall (steady flows) from summer (fluctuating flows)." (Pine). Steady flows slow fish growth rate.

- Habitat is a necessary element for HBC success. HBC occupy eddy habitats and talus shorelines, but are apparently selective for backwater habitats, and there are similar daily movements and habitat use between flow events" (Pine). Efforts specifically directed at creating backwater habitat for humpback chub may be unnecessary.
- Sufficient foodbase is necessary for HBC success. "Sediment effects on foodbase causes decreased autotrophic production" (Yard). "Further constraining hydropeaking may not lead to measurable benefits to fish." (Kennedy). Steady flows may not benefit fish by virtue of their impacts to foodbase.
- Appropriate water temperature is necessary for HBC success. "No significant difference in release water temperature has been recorded whether the releases are steady or fluctuating." (Anderson and Wright). Volume, not fluctuations, is the strongest factor in downstream temperatures.

- "Ramp rates do not significantly contribute to mass bar failure. The biggest effect is the steepness of the slope". (Grams). "By doing floods, you can't maximize sand through the entire canyon. So you can't have both – mass balance AND bars." (Wright). Policy objectives of mass balance versus sandbars and beaches may not be mutually achievable.

- "We need to figure out timing and magnitude of high flows and not just 'shoot from the hip' and do one every time there is an inflow event." (Jackson). "Floods combined with tributary inputs can build bars. Not certain if that is sustainable for Marble Canyon. The long-term trend – sandbars in central and western Grand Canyon are being partially maintained by sand eroded from upstream sandbars and HFEs. The changes at lower elevations are variable and it is difficult to determine long-term trends." (Hazel). Choices regarding *which* beaches and *which* reaches are targeted for improvement must be made, as the entire system does not benefit equally.

- "The amount of sand above the 8,000 cfs level is a very small proportion of the total mass balance in the system, and of that small amount, the majority of it is covered by vegetation." (Fairley/Schmidt). Given the potential implications of high flow events for trout/humpback chub interactions, strong consideration should be given to vegetation management to improve camping beaches, as is being done by the NPS in other regions.

The Proposed Balanced Resource Alternative is similar to "Alternative A Variation" which was analyzed by the GCMRC and recommended for consideration in the previous Long-Term Experimental Plan (LTEP) EIS process.

Experimental Design

The Proposed Balanced Resource Alternative seeks to implement as many treatments as possible as soon as feasible. In terms of design, the Proposed Balanced Resource Alternative incorporates reverse titration, meaning that all treatments are implemented to achieve resource benefit until such time that a

positive response in targeted resources is detected. That is, treatments may be systematically removed one at a time under continued monitoring until benefits are observed to diminish (learning by undoing). Although learning through this process may be more complicated, beneficial resource response is posited as a priority above establishing cause-effect science results.

TABULAR DESCRIPTION OF THE PROPOSED BALANCED RESOURCE ALTERNATIVE

	Flow/Nonflow Treatment	Current ROD Operations	Proposed Balanced Resource Alternative	Resource Linkage
Flow	Increased daily flow fluctuations	No	Yes (increased by 25% to 66% in all months except April and May)	Hydropower Non-native fish
Flow	Steady flows	No	No	
Flow	High flow experiments	Possibly	Yes, not to exceed 1 HFE biannually	Camping Beaches Cultural Resources
Flow	Alternative ramping rates	No	Yes (hourly downramping rate increased 100% in April-Oct and 167% in Nov-March)	Hydropower Trout
Flow	Maximum power generation	No	Yes, depending on hydrologic conditions	Hydropower
Nonflow	Nonnative fish control	No	Yes	Trout Humpback Chub
Nonflow	Humpback Chub translocation	Yes	Yes, increased	Humpback Chub
Nonflow	Humpback Chub refuge	Yes	Yes, increased	Humpback Chub
Flow and Nonflow	Mini Experiments	Possibly	Yes, planning and implementation	Various
Experimental Design		Not applicable	Reverse Titration	
Nonflow	Bubblers in forebay	No	Yes	Temperature/Non-native and Native Fish
Nonflow	Vegetation removal	No	Yes	Camping Beaches
Nonflow	Selective beach testing	No	Yes	Camping Beaches
Nonflow	Sediment augmentation	No	Yes, potentially	Camping Beaches Cultural Resources
Nonflow	Use of shelving areas as campsites	No	Yes	Camping Beaches
Nonflow	Paria River	No	Yes	Camping Beaches

	sediment check dams			
Nonflow	Generators on bypass valves	No	Yes, potentially	Hydropower Downstream resources

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