

# Glen Canyon Dam

Long-Term Experimental and Management Plan EIS



Department of the Interior

Bureau of Reclamation—Upper Colorado Region

## Grand Canyon Protection, Hydropower Studied in Latest Glen Canyon Dam Planning

Management Alternatives Meeting Scheduled April 4-5 in Flagstaff, AZ



It's not easy managing the Colorado River, not even if you just focus on the 250-mile stretch that flows past Glen Canyon Dam through the Grand Canyon and into Lake Mead.

There are endangered fish and fragile ecosystems to be considered, as well as water storage and delivery and the production of hydroelectric power for millions of homes and businesses. Factor in other key issues—including sacred American Indian sites, recreational boating and fishing, camping, archeological sites, water supply for agriculture and cities and area employment—and you get a sense of the challenge the Department of the Interior faces.

But the Bureau of Reclamation (Reclamation) and National Park Service (NPS) are working on a plan that will use the latest science to help ensure releases of water from the dam and other potential actions meet the goals of protecting the environment in Glen and Grand Canyons while continuing to supply water and power for communities, agriculture, and industry.

Known as the Long Term Experimental and Management Plan (LTEMP), it requires the development of an Environmental Impact Statement (EIS) under the National Environmental Policy Act, one of the nation's oldest environmental laws.

It's not an easy process. There are dozens of federal and state agencies,

environmental groups, Indian Tribes, businesses, and people with interests in the Colorado River. But Reclamation and the NPS are making an extraordinary effort to ensure that the process is thorough, fair, and transparent.

Take public input, for example. Normally, an environmental impact statement requires public involvement at major milestones in the process. For this process, seven public meetings were held in November 2011, and public comment on the proposed management plan was collected through January 2012. A report of those public scoping comments was presented to the public in web-based meetings on March 27, 2012 and is currently posted on the project website.

Next, the public has a unique opportunity to have input to the process at a two-day meeting April 4-5 in Flagstaff, AZ. This will be a chance for the public and stakeholders to sit down with the project team to discuss their thoughts on alternatives.

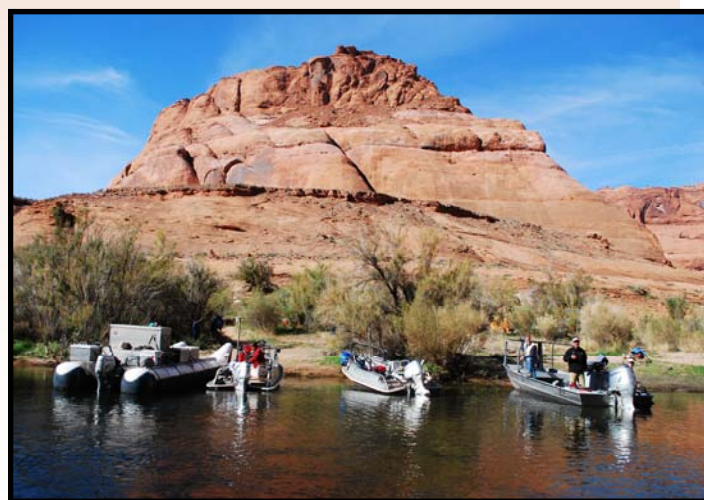
The NPS and Reclamation have started the process by developing draft preliminary concepts the public can react to. "But we recognize that managing the Colorado River is a complex process, and that there will be other ideas that deserve consideration," says Beverley Hefernan, Reclamation's LTEMP project manager.

"That's why we're making a concerted effort to go above and beyond minimum requirements to invite the public and the stakeholders to give us additional input on these preliminary alternatives or additional alternatives that we might have missed."

The meeting will be held on April 4 and 5 at the High Country Conference Center located at 201 West Butler Avenue Flagstaff, AZ 86001.

**"We're making a concerted effort to go above and beyond the minimum requirements to invite the public and the stakeholders to give us additional input"**

More information about the meeting and the preliminary draft alternative concepts can be found in this newsletter, and on the project website: <http://ltempeis.anl.gov>.



*Interactions between the Colorado River's native fish like the humpback chub, above, and non-native fish like rainbow and brown trout are studied by scientists like this team from the U.S. Geological Survey. (NPS Photo)*

# Setting the Stage for the Plan: Purpose, Need, Objectives



*A view down the Colorado River from Nankoweap in Marble Canyon at Grand Canyon National Park. (NPS Photo)*

The purpose and need are brief statements that agencies set at the beginning of a planning process. These statements are key to the formation of alternatives. Objectives further clarify the purpose.

## **Purpose**

To identify dam operations, management actions, and experimental options that will provide a framework for adaptively managing Glen Canyon Dam over the next 15 to 20 years consistent with the Grand Canyon Protection Act (GCPA) and other provisions of applicable Federal law.

The proposed action is to develop a plan that will determine specific options for dam operations, non-flow actions, and appropriate experimental and management actions that will meet the GCPA's requirements and minimize impacts to resources, including those of importance to Indian Tribes.

## **Need**

The proposed action is needed to incorporate scientific information developed since the 1996 Record of Decision to better inform Department of the Interior decisions on dam operations and other management and experimental actions so that the Secretary continues to meet statutory responsibilities for protecting and improving Glen Canyon National Recreation Area and Grand Canyon National Park resources and values for future generations, conserving Endangered Species Act (ESA) listed and other native species, respecting Indian Tribal interests, meeting water delivery obligations, and generating hydroelectric power.

## **Objectives**

- Develop an operating plan for Glen Canyon Dam in accordance with the Grand Canyon Protection Act to protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established, including, but not limited to natural and cultural resources and visitor use, and in such a manner as is fully consistent with and subject to the Colorado River Compact, the Upper Colorado River Basin Compact, the Water Treaty of 1944 with Mexico, the decree of the Supreme Court in *Arizona v. California*, and the provisions of the Colorado River Storage Project Act of 1956 and the Colorado River Basin Project Act of 1968 that govern allocation, appropriation, development, and exportation of the waters of the Colorado River Basin.
- Ensure water delivery to the communities and agriculture that depend on Colorado River water.
- Consider potential future modifications to Glen Canyon Dam operations and other flow and non-flow actions to protect and improve downstream resources, particularly fine sediment retention and endangered fish in Grand Canyon National Park, and the recreational experience, including the trout fishery in Glen Canyon National Recreation Area.
- Maintain and increase Glen Canyon Dam capacity and energy generation to produce the greatest practicable amount of power and energy, consistent with recovery and long-term sustainability of downstream resources.
- Respect the interests and perspectives of the Indian Tribes.
- Make use of the latest science considering all relevant studies, especially those conducted since 1996.
- Determine the appropriate experimental framework that allows for a range of programs and actions including ongoing and necessary research, studies, and management actions in keeping with the adaptive management process.
- Determine whether to establish a Recovery Implementation Program for endangered fish species below Glen Canyon Dam.
- Ensure Glen Canyon Dam operations are consistent with the GCPA, Endangered Species Act, National Historic Preservation Act, and other applicable federal laws.



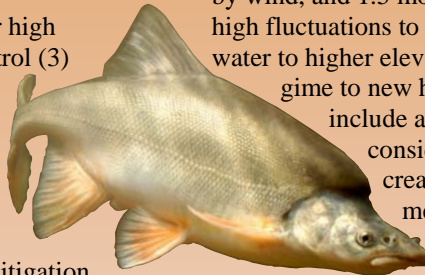
# Draft Preliminary Concepts For Glen Canyon Dam At A Glance

**Preliminary Concepts.** What follows is an initial list of the draft preliminary alternative concepts for the dam's management. These draft concepts are intended to cover a broad range of ideas that focus on various resources and that could be analyzed in the LTEMP EIS process. These are *preliminary drafts* and are likely to undergo revisions. Some concepts may be eliminated or merged with others and new ones may be developed as additional information is collected from the public. The concepts are not listed in any priority order.

**\* Common to All Alternatives.** (1) Consider high flow releases (2) consider non-native fish control (3) determine whether to establish a recovery implementation plan for humpback chub, (4) continue Adaptive Management (5) implement non-flow mitigation actions, which may include vegetation control, native plant restoration, Kanab ambersnail mitigation for high flows, and cultural resource monitoring and mitigation.

**\* No Action -** Continue operation of Glen Canyon Dam as guided by the 1996 Record of Decision (ROD), i.e., modified low-fluctuating flow alternative, continue Glen Canyon Dam Adaptive Management Program activities and implement the 2007 ROD for the Interim Guidelines EIS. The alternative also includes continued implementation of NPS activities including: the Colorado River Management Plan, vegetation management plan, tamarisk leaf beetle action plan, Grand Canyon National Park backcountry management plan, Glen Canyon National Recreation Area Colorado River riparian revegetation activities, and fish management plan (under development).

**\* Native Ecosystem Focus.** Restore, to the extent practical, ecological patterns and processes, including a diverse biotic community dominated by native species, and that include rare, endemic, and sensitive species. Low, relatively steady flows would be provided from July through October to benefit the aquatic foodbase and native fishes including humpback chub. Fluctuations would occur during the winter-early spring period (December-April), when adverse impacts to ecological resources from higher fluctuating flows would be lower. In April or May, at the beginning of the growing season, a series of relatively high flows would be provided to increase soil moisture at higher elevations occupied by native vegetation and reduce the size of the annual cohort of trout. This alternative would include consideration of a temperature control device (TCD) and sediment augmentation.



**\* Native Ecosystem With a Focus on Cultural Resource Preservation and Tribal Values.** Provide flows that promote seasonal disturbance regimes tied to natural ecological processes. The flow regime would include low summer flows with minor fluctuations in July through October to benefit native fish, higher flows with moderate fluctuations in November through February to accommodate winter power generation needs, a high flow in March if sediment conditions warrant followed by 1.5-2 months of low flows with minor fluctuations to enhance sandbar exposure for sediment redistribution by wind, and 1.5 months of higher volume with moderate to high fluctuations to provide for power generation, provide water to higher elevation vegetation, restore a disturbance regime to new high water zone. Non-flow actions would include actions in the NPS fish management plan, consideration of sediment augmentation to increase turbidity, and consideration of implementing a TCD.

**\* Experimental Design to Resolve Biological Uncertainties.** Design an experimental program (potentially multi-year experimental manipulations) to resolve biological uncertainties in keeping with the adaptive management process. This alternative would provide for continuation of research and experimentation necessary to inform management on how to better operate Glen Canyon Dam and protect, mitigate adverse impacts to, and improve resources. Key uncertainties that would be addressed include: (1) trout-humpback chub interactions; (2) effects of flows on trout; (3) impact of flow and non-flow actions on the quality of the trout fishery and protection of native fish from increased trout recruitment; (4) important drivers of the aquatic foodbase; (5) conditions that allow humpback chub to complete their life cycle in the mainstem; and (6) the efficacy of suppression flows for trout population control. Further details of this alternative cannot be determined until the experimental design has been identified.

**\* Increased Hydropower Without New Infrastructure.** Maintain and increase Glen Canyon Dam capacity and energy generation, relative to current operations, to produce the greatest practicable amount of power and energy, by considering options such as relaxed ramping rate restrictions and allowing for a wider range of daily flows depending on hydrologic conditions, while using existing infrastructure and proposed management actions to mitigate adverse effects.

**\* Hydropower Focus with New Infrastructure.** Maintain and increase Glen Canyon Dam hydropower capacity and energy generation, relative to current operations, and produce the greatest practicable amount of power and energy, consistent with recovery and long-term sustainability of downstream resources. Adverse effects of hydropower generation on other resources would be mitigated through infrastructure additions and modifications and a variety of non-flow actions while allowing for continued or increased load following. Mitigation of adverse effects would occur through (1) implementing high flow releases using rapid response to tributary sediment inputs, (2) providing higher flows (greater than bypass tube capacity) if possible for the purpose of conserving sediment in critical reaches; (3) developing sediment augmentation infrastructure; and (4) developing a TCD. The alternative would also include consideration of the possibility of adding hydropower capacity to bypass tubes; relaxing ramping rate restrictions; allowing for higher fluctuations at certain times of the year; and allowing for a wider daily range of flows depending on hydrologic conditions.

**\* Naturally Patterned Flow Regime.** Provide flows that mimic a naturally patterned flow regime based on historic monthly averages. Flows would be scaled to ensure annual water delivery requirements, but would vary month to month in conformance with the historic flow pattern, and would not include daily fluctuations. Minimum flows could be lower than the current minimum, and maximum flows as high as full bypass, scaled for the annual hydrologic condition. Transitions between months would be relatively smooth with established limitations on the rate of change between days. The highest flows would be sediment triggered, but timing would be adjusted to historic flood timing and could be higher than full bypass capacity. Sediment augmentation and a TCD would be used to provide for more natural sediment supplies and water temperatures.

**\* Recreational Resources Focus.** Protect, mitigate adverse impacts to, and improve the recreational experience of park visitors. The flow regime would include a range of flows consistent with current operations but a higher minimum flow would be targeted and flow stage changes would be greatly restricted. Monthly volume adjustments would be made to mimic more natural patterns (i.e., lower in the summer and higher in the spring). Non-flow options would include active vegetation management and stabilization to optimize campsites, active management of rainbow trout based on the NPS fishery management plan, minimize non-recreational river trips, consider a TCD to manage for warmer water temperatures in summer, and consider sediment augmentation.

**\* Sediment Focus.** Dynamically and sustainably increase and maintain sandbars and beaches in the Glen, Marble, and Grand Canyon reaches above the elevation of the average base flow for ecological, cultural, and recreational purposes. An annual operating scenario that preserves sediment and sand between high flow releases would be determined. Additionally, releases above full bypass capacity when conditions allow (i.e., abundant sediment inputs and a full reservoir) would

be made. For three months after each high flow release, fluctuating flows would be moderated to reduce sediment transport and preserve sandbars and beaches that have been created by higher flows. An additional component of this alternative would be to manage vegetation to increase campable areas and increase wind-blown transport of sediment.

**\* Maximum Sediment Conservation.** Maximize the amount of sediment conserved in Marble Canyon and Eastern Grand Canyon reaches of the Colorado River. This is based on year-round steady flows, and is expected to result in an accumulation of sand below the normal water level. High flow releases every 1-3 years would redistribute sediment above this level. This alternative has the potential to result in an accumulation of sediment in the canyon.

**\* Structured Adaptive Management with Condition-Dependent Decision-Tree.** Implement a structured adaptive management framework that uses a condition-dependent decision tree to maximize benefits to a wide range of resources. Biological and physical resources would be monitored annually, and management actions appropriate for existing conditions would be implemented. Responses could include changes to monthly and daily flows, water release temperatures, and turbidity. Conditions that would be monitored and used to determine annual operations include: (1) annual operating volume (inflows and reservoir levels), (2) sediment conditions (sandbar condition and tributary inputs of sediment), and (3) biological conditions (e.g., status of native fish populations, exotic fish populations, and vegetation conditions). The alternative would provide a high degree of flexibility in response to annual conditions rather than a static prescription for all years. High flows in excess of full bypass capacity, a TCD, and sediment augmentation are potential options for this alternative.



*Maintaining hydroelectric power production while sustaining resources is an objective in the planning process. (NPS Photo)*

**Table 1. Preliminary Draft Alternative Concepts**

Below is the No Action Alternative which is required by National Environmental Policy Act and the first five preliminary draft alternative concepts (not in any priority order). See the additional concepts on Table 2.

Actions	Characteristics and Elements of Preliminary Draft Alternative Concepts					
Flow Actions	No Action	Ecosystem Focus	Ecosystem with Cultural and Tribal Focus	Experiment Design to Address Biology	Hydropower Focus with Infrastructure	Hydropower Focus without Infrastructure
<b>High Flows</b>	Follow 1996 Record of Decision for high flows	Sediment triggered high flows	Sediment triggered high flows	TBD	Consider releases greater than bypass capacity; rapid response	Consider releases greater than bypass capacity; rapid response
<b>Intervening Flows</b>						
Steady flows	No	July-Oct	low steady flows during late marmid may, July-Sep,	TBD	No	No
Fluctuating flows	Same as current operations	Dec-Apr only	Nov-Feb; May-Jul 4	TBD	Increased range depending on hydrology	Increased range depending on hydrology
<b>Intervening Flow Values</b>						
Minimum flow	Same as current minimum	Same as current minimum	Same as current minimum	TBD	Same as current minimum	Same as current minimum
Maximum flows	Same as current maximum	Same as current maximum Dec-June; lower otherwise	Same as current maximum Nov-Feb and May- Jul 4; lower otherwise	TBD	Increased depending on hydrology	Increased depending on hydrology
Daily range	Same as current daily range	Same as current daily range during periods of fluctuations	Same as current daily range during periods of fluctuations	TBD	Increased depending on hydrology	Increased depending on hydrology
Ramping Rates (cfs/hr)	Same as current ramp rates	Same as current ramp rates	Same as current ramp rates	TBD	Relaxed ramping restrictions	Relaxed ramping restrictions
<b>Special Issue Flows</b>						
Ponding flows	No	Yes	TBD	TBD	Yes	Yes
Spring native vegetation watering flows and trout recruitment inhibition flows	No	Yes	No	TBD	No	No
Summer stranding flows	No	No	No	TBD	Yes	Yes
Redd exposure flows	No	No	No	TBD	Yes	Yes
<b>Non Flow Options</b>						
Sediment augmentation	No	TBD	TBD	TBD	Yes	No
Temperature control device	No	Yes	TBD	TBD	Yes	No
Trout and other fish management	Yes	Yes	Yes	Yes	Yes	Yes

**Table 2. Preliminary Draft Alternative Concepts Continued**

Below is a second set of preliminary alternative concepts (not in any priority order). See the additional concepts on Table 1.

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Actions	Characteristics and Elements of Preliminary Draft Alternative Concepts				
Flow Actions	Naturally Patterned Flow Regime	Recreational Resource Focus	Sediment Focus	Sediment Focus with Maximum Retention	Structured Adaptive Management
<b>High Flows</b>	Consider releases greater than bypass capacity; peak release to approximate natural spring peak	Sediment triggered high flows	Consider releases greater than bypass capacity	Consider releases greater than bypass capacity; rapid response	Adjust criteria based on beach condition and other resources and time since the last flood
<b>Intervening Flows</b>					
Steady flows	Approximate natural seasonal pattern	No	No	Year-round steady	June-Sep if native fish conditions call for it
Fluctuating flows	None within day, between day only	Reduced year-round to limit stage change	Reduced for 3 months after high flow releases; same as current otherwise	None	Current operations adjusted per conditions
<b>Intervening Flow Values</b>					
Minimum flow	Approximate natural seasonal pattern	Higher than current based on recreational experience	Same as current minimum	Higher than current based on annual volume	Same as current minimum
Maximum flows	Up to full bypass capacity to approximate natural seasonal pattern	Same as current maximum	Same as current maximum, most of year; reduced for 3 months after high flow releases	Lower than current based on annual volume	Same as current maximum, most of year; reduced for 3 months after high flow releases
Daily range	None	Decreased to limit stage change	Could increase if had sand augmentation	None	Could increase if had sand augmentation
Ramping Rates (cfs/hr)	None within day	Same as current ramp rates	Same as current ramp rates	None	Same as current ramp rates
<b>Special Issue Flows</b>					
Ponding flows	Would occur with natural seasonal pattern	TBD	No	No	No
Spring native vegetation watering flows and trout recruitment inhibition flows	No	No	No	No	Yes, depending on conditions
Summer stranding flows	No	No	No	No	Yes, depending on conditions
Redd exposure flows	No	No	No	No	Yes, depending on conditions
<b>Non Flow Options</b>					
Sediment augmentation	Yes	TBD	TBD	No	TBD
Temperature control device	Yes	TBD	No	No	TBD
Trout and other fish management	Yes	Yes	Yes	Yes	Yes