

**Title:**                    **The Operation of Glen Canyon Dam during spring runoff periods, within the Constraints of the 1968 Colorado River Basin Project Act and the 1992 Grand Canyon Protection Act**

**Prepared by:**            **Bureau of Reclamation, Upper Colorado Region**

## **Introduction**

### **Purpose**

This document is a "working draft" discussion paper prepared by the Bureau of Reclamation. The purpose of this document is to encourage and facilitate discussion between and among the various stakeholders who have an interest in the operation of Glen Canyon Dam. The analysis and opinions expressed in this document are not intended to represent the formal position of the Bureau of Reclamation or the Department of the Interior. Reclamation welcomes comments on this document from all interested stakeholders. Comments should be directed to the Upper Colorado Regional Office of the Bureau of Reclamation.

### **Explain as background the 1968 and 1992 Acts**

The series of legal documents known as the "Law of the River" have evolved from 1922 to the present, gradually defining in greater detail the operational parameters of the Colorado River system reservoirs. The first specific constraints on Glen Canyon Dam operations came with the 1968 Colorado River Basin Project Act (1968 Act), specifically Section 602 of that Act. While the 1968 Act primarily dealt with the authorization of the Central Arizona Project (CAP) and five Colorado projects, the politics of authorizing CAP led to statutory language regarding Glen Canyon Dam operations, including (1) a storage volume designed to protect the Upper Basin States from shortages, (2) the transfer of water to Lake Mead if required for Lower Basin use, (3) annual storage equalization between Lakes Powell and Mead, and (4) the avoidance of anticipated spills from Glen Canyon Dam. Formal Operating Criteria were prepared in 1970 to guide Colorado River system reservoir operations and subsequent Annual Operating Plans (AOP) prepared under these Criteria.

As part of an inclusive omnibus bill, the 1992 Grand Canyon Protection Act (GCPA) directed the Secretary of the Interior to prepare an Environmental Impact Statement on the operation of Glen Canyon Dam (GCDEIS) and adopt criteria (separate and apart from the 1968 Act Criteria) for the operation of the dam with respect to the ecological health of the Grand Canyon. According to language in the GCPA, this Act does not modify the 1968 Act. Practicably, a distinction that has been made is that the 1968 Act more directly affects the allocation of water between basins and the annual and monthly release volumes from Glen Canyon Dam, while the GCPA more directly affects powerplant releases and any beach/habitat building and habitat maintenance flows.

**Describe the dispute over the 1996 Beach/Habitat Building Flow and the resulting "agreement". Where is the dividing line between the jurisdiction of these two Acts?**

Interpretation of the legal meaning of the term "spills" was the heart of differing positions on the release of water at rates greater than powerplant capacity. The States believe that the 1968 Act provision of avoiding anticipated spills means avoiding releases greater than powerplant capacity, while others believe that such releases, if used for the environmental benefit of the Grand Canyon, are not spills but are actually releases used for project purposes. These positions have not changed appreciably over the last few years and essentially blocked the testing of such releases with threat of litigation.

In 1995, a proposal was offered by Reclamation to change the preferred alternative of the GCDEIS. According to that proposal, beach/habitat building flows would not take place in years when the reservoir was low, but rather when Lake Powell storage was high. Powerplant bypasses occur naturally under these latter conditions as a result of high runoff or large forecast errors. Such releases would then be managed to the greatest extent possible to benefit the Grand Canyon. The acceptance of this idea by all parties involved in the GCDEIS cooperating agency discussions led to the March/April 1996 test of the beach/habitat building flow and modification of the preferred alternative in the ROD.

The extent of interaction between the jurisdiction of these Acts is still not clear to all parties. Most acknowledge that they must coexist. The purpose of this paper is to clarify this issue and identify the processes for consultation, coordination and information sharing during the annual forecast and spring runoff period of January through July.

#### **AOP Considerations**

**Is there a relationship between flood control operations at Hoover Dam and releases from Glen Canyon Dam? When are we in flood control operations? Is there a flood control diagram at Glen Canyon as at Hoover Dam?**

The Corps of Engineers flood control diagram for Hoover Dam is a legally binding set of release curves that dictate Hoover Dam releases based on basinwide storage and runoff forecasts. Flood control diagrams are prepared by the Corps when projects have quantified flood control benefits as part of the project cost allocation. The purpose of the diagram is to protect the downstream inhabitants from large, controlled or uncontrolled releases. There is little, if any, flexibility in determining releases using this diagram. In the case of Hoover Dam, either downstream consumptive use requirements or the flood control parameters specify releases.

The Colorado River Storage Project has flood control as an authorized project purpose, but only Blue Mesa and Navajo Dams have actual flood control allocations and Corps flood control diagrams. Glen Canyon Dam has no such flood control diagram, but through the years an acceptable method of determining monthly release volumes has been developed through the AOP process. Because Glen Canyon Dam has no flood control diagram currently, it is appropriate to consider a process that will provide support to this AOP process and also flexibility to respond to the AMWG mission and goals, especially as relates to environmental opportunities associated with managing spring flows. Filling the reservoir while avoiding spills is a prime objective during full reservoir conditions. The 1970 Operating Criteria prepared in response to the 1968 Act further provided a minimum objective annual release volume of 8.23 MAF. When combined with the requirement to equalize storage, these constraints effectively provide limits on monthly release volumes and patterns.

Despite the lack of a formal flood control diagram, flood control operations at Glen do exist when the forecasted runoff is expected to fill Lake Powell. When the monthly release volumes approach powerplant capacity, release options are significantly reduced from the perspective of avoiding spills (bypasses). The issue of planning for beach/habitat building flows complicates this process. Various interpretations exist regarding the timing and the threshold level of initiating these bypasses under the 1995 agreement with the Basin States.

**How do we use forecasts in our operation at Glen Canyon Dam? What is the frequency of forecasts? How are annual and monthly and daily release volumes determined?**

Inflow forecasts which have been coordinated between the National Weather Service and the Natural Resource Conservation Service are issued monthly, usually the fifth working day of the month. Specific predictions for the critical April through July snow runoff period are made as part of the January through July forecasts. Additionally, the National Weather Service issues mid-month updates which reflect changed snowpack and runoff conditions. These forecasts are input into a monthly planning computer model which then accounts for upstream dam operation and regulation. Annual and monthly release volumes then are determined by Reclamation to accomplish the objectives cited above.

Annual release volumes are determined by either the storage equalization or minimum objective flow provisions of the 1968 Act or the practical necessity of safely controlling runoff during high reservoir conditions. Monthly release patterns are sometimes more flexible and can take into account such things as desirable flow levels for downstream sediment transport, power production, and recreation. An example of this circumstance occurred in the spring of 1995, when flows were purposely kept below 20,000 cfs because the risk of an anticipated spill was small and we believed larger releases could be avoided. The prime focus for this decision was to limit sediment transport. However, when the risks associated with uncontrolled spills and dam

safety become significant, options for release patterns become fewer. In general, monthly release volumes are kept above 550,000 AF and below 1,200,000 AF when possible. Mid-winter and mid-summer releases are often greater than other months due to higher firm power demands. In years of high snowpack, monthly releases are increased beginning in January to make space for the expected spring runoff.

Under existing practice, daily releases can range significantly within power plant capacity (max 33,200 cfs; min 5,000 cfs) in accordance with the limits established by the recently signed Operating Criteria for Glen Canyon Dam. Daily releases greater than 33,200 cfs bypass the generators and require use of four jet tubes which have a combined capacity rating of 15,000 cfs. Full generator and jet tube capacity is about 48,000 cfs and is viewed as the normal maximum release capacity of the dam, due to considerations for spillway protection. Passing greater than 48,000 cfs through the dam requires use of the spillways, which can lead to degradation of the concrete spillway lining.

#### **What is the timeframe for development of each year's AOP?**

The AOP should be issued by October 1 of each year, and is signed by the Secretary of the Interior. It contains projected operational information for the coming water year (October through September) for all the mainstream reservoirs in the Colorado River Basin. Reclamation sponsors a "work group" which provides an opportunity for public discussion. Reclamation then uses comments received at these meetings to recommend decisions for the Secretary's issuance. The group usually meets 4 or 5 times, beginning between January and April of the previous water year. Often, the topics for discussion also include policy-related issues such as surplus and shortage determinations, risks of spills, and banking and leasing. This group typically has not addressed powerplant operations at Glen Canyon.

#### **What is the relationship between the 5-year review of the Operating Criteria and the AOP? How does the '68 Act apply to AOP-type issues?**

In addition to the preparation of an AOP, the 1968 Act required a periodic review of the Operating Criteria. The review of the Criteria is sponsored by the Secretary at least every 5 years to determine "if as the result of actual operating experience or unforeseen circumstances" the Criteria should be modified. The Criteria has thus far been kept purposely broad to allow the resolution of yearly operating issues within the context of the AOP. Reviews have occurred in 1975, 1980, 1985, and 1990 after the establishment of the original Criteria in 1970. The current 1995 review is scheduled to be completed in the fall of 1997.

The AOP is prepared using the general guidance contained in the Operating Criteria. With respect to Glen Canyon Dam operation, the Criteria basically contains a restatement of the 1968 Act provisions. The releases for the coming water year are based on a most probable forecast (in

October this is akin to average) and sensitivity analyses are made to bracket the likely operations scenarios. Updates to the AOP are made monthly throughout the operating year based on revised forecasts, thus release patterns respond to a moving target. Each month's decisions must be made by Reclamation with the most current information, but with regard for the risk of future forecast changes.

## **GCPA Considerations**

### **What objectives and purposes did GCPA place on Glen Canyon Dam operations?**

The GCPA directs the Secretary of the Interior to operate Glen Canyon Dam, "in accordance with the additional criteria and operating plans specified in [the GCPA] and exercise other authorities under existing law in such a manner as to project [sic], mitigate adverse impacts to and improve the values for which the Grand Canyon National Park and the Glen Canyon National Recreation Area were established," while preserving the compacts, treaty, decree and statutes that "govern allocation, appropriation, development, and exportation of the waters of the Colorado River Basin."

The new objectives placed on Glen Canyon Dam operations are to operate the dam in a manner that protects and enhances natural, and cultural resources and visitor use. The law, in essence, mandates the responsible public entity operating the dam, the Bureau of Reclamation, to place these values in equal stature with original purposes for dam operation, i.e., water storage, allocation, delivery and power production.

The GCPA did not:

1. Abrogate or in any way nullify the Secretary's responsibility to fulfill obligations of Colorado River water storage and allocation as prescribed in various laws, decrees, compacts, treaties, etc., which comprise the Law of the River.
2. Change Reclamation's role as the operating entity responsible for Glen Canyon Dam.

### **What processes were changed by the GCPA as regards determining Glen Canyon Dam Operations?**

Prior to passage of the GCPA, inputs to the Secretary on the operation of Glen Canyon Dam were derived via three processes.

1. The AOP process described earlier, which must accommodate the broad-based set of interests and constraints associated with the Law of the River and the annual dynamics of natural events and constituency demands.

2. The Review of the Operating Criteria Process which is conducted every five years and is currently underway.
3. Reclamation Operations Management Recommendations, formed by skilled specialists and managers who merge law, policy, constituency demands, and natural processes into formal decisions that provide annual, monthly, and even daily, management of releases.

Passage of the GCPA now requires incorporation of a fourth input to the Secretary as decisions are made on dam operations, as noted above. The new process is called for in the GCPA, and is given more definition in the GCDEIS.

This input is also directed to the Secretary and comes in the form of recommendations on dam operations from the Adaptive Management Work Group (AMWG), a Federal Advisory Committee Act (FACA) group appointed by the Secretary. Reclamation has full participation on the AMWG which also includes representatives from federal and state agencies, Native American tribes, environmental, power, water and recreation interests.

**What groups have the task of implementing the GCPA and what are their relative roles?**

Four groups have primary responsibility for implementing the GCPA, through what is referred to as the Adaptive Management Program (AMP). These are the Adaptive Management Work Group (AMWG), the Grand Canyon Monitoring and Research Center (GCMRC), the Bureau of Reclamation, and the National Park Service (NPS). Within the AMP, primary responsibility lies with the AMWG, which as noted above includes representatives of Reclamation, NPS, Native American Tribes, and environmental, power, water and recreation interests. The AMWG, using appropriate science and information from a Secretary-designated science center, evaluates the short and long-term impacts of dam operations on natural, cultural, power, water and recreation resources, and recommends to the Secretary potential changes in dam operations based on knowledge gained from resource monitoring. The Research Center (GCMRC) is charged to respond to the AMWG with state-of-art knowledge of resource impacts from differing dam operation criteria.

Once the Secretary has decided on final recommendations, Reclamation and NPS have the responsibility for implementation.

**How are AMWG recommendations considered, especially as regards other seemingly parallel processes, i.e., AOP and Operating Criteria? Is there linkage to the AOP?**

All recommendations are provided to and considered by the Secretary, i.e., those from the AMWG, AOP and Operations Criteria processes. The relative weight given each input source is not prescribed for any given issue, to give flexibility to the Secretary in the decision process. However, Congress stated in the GCPA that existing statutes and compacts would not be affected.

There is informal linkage from the AOP to the AMWG and vice versa. For example, many of the same organizations are involved in both processes. Further, each process is open, permitting formal and informal input to be received from any organization.

**What process should be used to evaluate emergency or time-constrained operational issues relating to the operation of Glen canyon Dam and its effects on Grand Canyon Riverine Corridor Resources?**

The Adaptive Management process established by the GCPA is specifically prescribed to address Glen Canyon Dam operations impacts on Glen and Grand Canyons riverine corridor resources. Protocols for issues relating to normal year operations are generally understood. Less clear are the protocols for emergency and time constrained flow events that could occur annually between January and July. Reclamation has the authority to operate the dam and decision point authorities must reside with Reclamation.

During the January through July period, a broader opportunity exists to interact with Colorado River stakeholders. The following paragraphs describe one possibility for this important interaction.

**Suggestion for Interaction**

Each year the GCMRC would present to the AMWG or the technical work group, a "State of the Canyon" report which would include the current condition of the critical resources below Glen Canyon Dam. This would include the condition of the following resources among others: sediment storage, elevated sand bars, backwater habitats, aquatic resources and habitats, mainstream geomorphology, endangered species, riparian vegetation and cultural resources.

Reclamation would update the AMWG on the current and expected reservoir levels of Lake Powell and Lake Mead for the following water year.

Reclamation would provide three scenarios for expected inflow to Lake Powell (probable maximum, most probable, probable minimum) to the AMWG. Similar information is currently used to inform the Colorado River Management Work Group within the Annual Operating Plan process.

The Technical Work Group, the GCMRC, and other participating scientists, would prepare and consider a set of potential spring release scenarios for Glen Canyon Dam based on: a) normal, high, and low inflow predictions, b) the risks of powerplant bypasses, and c) the information on the current reservoir and Grand Canyon ecosystem conditions. The objective of these scenarios is to simultaneously meet both dam safety and downstream ecosystem considerations.

The AMWG would then meet to discuss and prepare recommendations on release scenarios for a range of spring inflows. These recommendations would be included in the AMWG annual report to the Secretary and be available for use in the concurrent AOP process. Actual decisions on dam releases would remain with Reclamation based on the current hydrology and the recommendations for meeting statutory goals and objectives as provided to Reclamation.

## **Process for Mutual Implementation of the 1968 Act and GCPA**

### **Initial Questions**

- What is the process for deciding on releases?
- Who should have input in making these decisions?
- How is information transferred to interested parties?
- How do we receive comments on our proposed actions related to GCPA?

### **1. Decisionmaking entity**

The Secretary of the Interior has the responsibility for the operation of Glen Canyon Dam in accordance with existing statutes and compacts. He has delegated this responsibility to the Bureau of Reclamation. While basic operational parameters should be broadly discussed within both the AOP work group and potentials for changing parameters among the AMWG, a single decisionmaker is essential to the safe and timely real-time operation of the dam. Decisions by a committee would not be responsive for the day-to-day decisions that are required for reservoir operations.

This necessity does not imply that Reclamation need not consider the viewpoints of the various public interests; in fact, statutory requirements make this consideration part of the AOP process. Further discussion should occur about the possible scenarios that might occur in the future and how best to cope with these scenarios.



## **2. Gaining technical input from Adaptive Management representatives**

Two types of input are possible regarding reservoir operations: scenario planning and real-time operations. The AMWG should consider operations scenarios to understand the downstream implications of Glen Canyon releases. Members of either the AMWG as a whole or the technical work group should consider alternatives in a variety of situations. The GCMRC should take the lead in organizing these scenarios. It will be important for these groups to understand the constraints placed by other statutes such as the 1968 Act. Coordination with the AOP work group will facilitate this understanding.

During real-time operations, any comments on Glen Canyon Dam operations should be made directly to Reclamation under the AOP process of responding to changing forecasts. Randall Peterson (Upper Colorado Region, Reclamation) will be the point of contact for such comments.

## **3. Real-time information sharing**

Some of the problems encountered during February 1997 were that stakeholders were not adequately informed about (1) the potential releases that could occur with a high forecasted runoff, (2) proposed powerplant release changes for monitoring purposes prior to increasing powerplant releases, and (3) the impact of changing forecast conditions on prudent operations. A portion of each AMWG meeting should be devoted to information sharing of hydrologic conditions. This should include consideration of extremes as well as the most probable forecasted runoff. The group should be informed of expected release patterns, the reasoning behind the releases, and potential risks associated with scheduled and alternative releases.

During real-time reservoir operations, significant changes in releases or forecasted inflow should be immediately communicated to all interested stakeholders. While options for these circumstances would preferably have been discussed beforehand, during flood control operations decisions will continue to be made by Reclamation using its best judgment. To encourage the prior discussion of these issues, the GCMRC should be involved in analyzing potential operations scenarios which might affect the ecology of the canyon; recommendations could result from that AMWG process.

In order to facilitate information transfer, an email/fax list will be developed by Reclamation to broadcast updated operations data. The parties should determine their level of interest in receiving this type of information. Reclamation's website is currently updated frequently with the latest reservoir operations information and expectations (Website address: [www.uc.usbr.gov](http://www.uc.usbr.gov)).

#### 4. Linkage and coordination between GCPA and AOP issues

As was the case with the 1996 test of the Beach/Habitat Building Flow, there can be interaction between the AMWG and AOP work group with respect to legal or policy issues. This is especially true when proposed operations to benefit the Grand Canyon seem to conflict with interpretations of other statutes. Likewise, some broader AOP issues such as surplus determinations could have significant effects on reservoir or canyon resources.

We view the two groups as both operating on important topics. Broader allocation issues will likely originate in the AOP arena while canyon resource issues likely will likely originate in the AMWG. Major discussion items originating in either group should be coordinated with the other group. Since many individuals are involved in both groups this should not be difficult. In all cases, Reclamation will continue its role as the Secretary's operating entity at Glen Canyon Dam.

MONTH

AOP

BOR

AMWG

January  
February  
March  
April

Forecast, hydrological assessment

Grand Canyon Resource Assessment

Assess release scenarios in relation to Compact requirements:

Analysis of Scenarios (GCMRC)

- 1. Aggressive water flows
- 2. Target elevations
- 3. Risks of spill
- 4. Surplus designation
- 5. Monthly release schedules

- 1. Duration of high releases
- 2. Time since last spill
- 3. Enhancement opportunities
- 4. Sediment conditions
- 5. Other resource conditions

May  
June  
July

Develop AOP via P.L. 90-537 (annual, monthly volumes)

Proposed Operation Plan with Low, Med. & High Scenarios

Develop criteria, plans, monitoring via GCPA

August  
September

Secretary signs AOP with contingencies

Secretary issues GCPA Report

October  
November  
December

Further refinement of resource recommendations for hydrologic scenarios (contingency issues)

BOR decision making

January F  
 February O S  
 March R E  
 April E A  
 May C S  
 June A O  
 July S N  
 T

Input/information sharing

Input/information sharing

If forecasts change significantly are outside of AOP scenarios, or significant new data become available, reassess scenarios with both AOP and AMWG

Figure 1