



United States Department of the Interior

BUREAU OF RECLAMATION

Upper Colorado Regional Office
125 South State Street, Room 6107
Salt Lake City, Utah 84138-1102



IN REPLY REFER TO:

UC-288
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APR 5 1999

MEMORANDUM

To: Commissioner
Attention: W-1000

From: Regional Director, Salt Lake City UT
Chief, Grand Canyon Monitoring and Research Center, Flagstaff AZ

Subject: Report to Congress: Operations of Glen Canyon Dam Pursuant to the Grand Canyon Protection Act of 1992 (Water Years 1998 and 1999)

In October 1992, the President signed into law, the Reclamation Projects Authorization and Adjustments Act, Public Law 102-575, containing the Grand Canyon Protection Act (GCPA), Title 18. Section 1804 (c)(2) of the GCPA reads as follows:

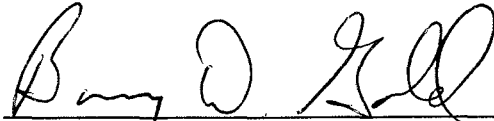
Each year after the date of the adoption of criteria and operating plans pursuant to paragraph (1), the Secretary shall transmit to the Congress and to the Governors of the Colorado River Basin States a report, separate from and in addition to the report specified in section 602(b) of the Colorado River Basin Project Act of 1968 on the preceding year and the projected year operations undertaken pursuant to this Act.

Attached is the Report to Congress: Operations of Glen Canyon Dam Pursuant to the Grand Canyon Protection Act of 1992 (Water Years 1998 and 1999). The report was collaboratively prepared by the Bureau of Reclamation and the Grand Canyon Monitoring and Research Center with comments and recommendations provided by the Adaptive Management Work Group and the Technical Work Group. Also attached are the following draft documents: a letter transmitting the subject report to the Secretary of the Interior for signature, letters to the Congress, letters to the Governors of the Colorado River Basin States, and a *Federal Register* notice announcing the transmittal of the report from the Secretary of the Interior to the Congress and the Governors of the Seven Basin States.

If you or your staff have any questions concerning the materials submitted, please contact Mr. Randall Peterson at (801) 524-3715.



Charles A. Calhoun
Regional Director
Upper Colorado Region



Dr. Barry Gold
Chief, Grand Canyon Monitoring and
Research Center

cc: Regional Director, Boulder City NV
Attention: LC-100
Regional Director, Salt Lake City UT
Attention: UC-100, -115, -600, -320, -140, -288 ⁴³² ✓
Chief, Grand Canyon Monitoring and Research Center, Flagstaff AZ
(w/attchs)

**REPORT TO CONGRESS: OPERATIONS OF
GLEN CANYON DAM PURSUANT TO THE
GRAND CANYON PROTECTION ACT
OF 1992**

WATER YEARS 1998 AND 1999

**From
Secretary of the Interior**

June 1999

TABLE OF CONTENTS

REPORT TO CONGRESS	1
HISTORY	1
A NEED FOR SCIENTIFIC EVALUATION	2
GLEN CANYON DAM OPERATIONS – WATER YEAR 1998	4
GLEN CANYON DAM OPERATIONS – WATER YEAR 1999	5
ADAPTIVE MANAGEMENT PROGRAM	5
Adaptive Management Program Activities – Water Year 1998	8
Adaptive Management Program Activities – Water Year 1999	8
GRAND CANYON MONITORING AND RESEARCH CENTER	9
Grand Canyon Monitoring and Research Center Activities – Water Year 1998	9
Grand Canyon Monitoring and Research Center Activities – Water Year 1999	10

FIGURE

Figure 1— Critical Entities of the Adaptive Management Program	7
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APPENDICES

Appendix A	Operating Criteria for Glen Canyon Dam in Accordance with the Grand Canyon Protection Act of 1992
Appendix B	Glen Canyon Dam 1998 Annual Plan of Operations Prepared in Accordance with the Operating Criteria Developed for the Grand Canyon Protection Act
Appendix C	Glen Canyon Dam 1999 Annual Plan of Operations Prepared in Accordance with the Operating Criteria Developed for the Grand Canyon Protection Act
Appendix D	Staffing Requirements of the Grand Canyon Monitoring and Research Center

Appendix E Glen Canyon Dam Monthly Powerplant Releases and
Generation (Water Year 1998)

Appendix F Preliminary Results of the November 4-5, 1997, Peak Powerplant Test
Release from Glen Canyon Dam

Appendix G Charter of the Adaptive Management Work Group

**REPORT TO CONGRESS: OPERATIONS OF
GLEN CANYON DAM PURSUANT TO THE
GRAND CANYON PROTECTION ACT
OF 1992**

WATER YEARS 1998 AND 1999

REPORT TO CONGRESS

Section 1804(c)(2) of the Grand Canyon Protection Act (GCPA) of 1992 requires the Secretary of the Interior (Secretary) to:

... transmit to the Congress and to the Governors of the Colorado River Basin States a report, separate from and in addition to the report specified in section 602(b) of the Colorado River Basin Project Act of 1968 on the preceding year and the projected year operations undertaken pursuant to this Act.

This report responds to the above-cited reporting requirements. In this report, the time frame for water and fiscal years is identical, October 1 through September 30. The report focuses on Glen Canyon Dam operations and activities for water years 1998 and 1999, Adaptive Management Program (AMP) activities for water years 1998 and 1999, and activities of the Grand Canyon Monitoring and Research Center (GCMRC) for water years 1998 and 1999.

HISTORY

The Colorado River Storage Project (CRSP) Act of 1956 authorized the construction, operation, and maintenance of Glen Canyon Dam to regulate the flow of the Colorado River for flood control, consumptive use, and the generation of hydroelectric power. In 1963, Glen Canyon Dam was completed, making Lake Powell the key storage unit for the CRSP and providing water supply, recreation, and hydropower benefits for the Southwest.

At optimum operations, the generators at Glen Canyon Dam are capable of producing about 1,300 megawatts of power. Since the powerplant was constructed to meet a portion of the electrical needs of the Southwest, flow releases from the dam were adjusted daily to respond to variances in electrical demand. Water releases from the dam occur at 200-230 feet below the surface of Lake Powell, which results in clear, cold water with year-round temperatures of 47°F to 52°F.

Since the damming of the river in 1963, there has been only one flow release which approached average pre-dam spring floods. In 1983, a combination of unanticipated hydrologic events in the upper Colorado River Basin and available storage space in Lake Powell resulted in emergency spillway releases from Glen Canyon Dam which reached 93,000 cubic feet per second (cfs). Powerplant releases generally ranged between 1,000 cfs and 30,000 cfs from 1964 to 1991, and between 5,000 and 20,000 cfs since 1991.

As a result of the construction of Glen Canyon Dam, the Colorado River ecosystem below the dam has changed significantly from its pre-dam natural character. In addition, Glen Canyon Dam's highly variable flow releases from 1964 to 1991 caused additional concern over resource degradation resulting from dam operations. In November 1991, the Secretary adopted interim operations criteria which narrowed the range of daily powerplant fluctuations. Since the signing of the operating criteria in February 1997 (see Appendix A), these releases do not exceed 25,000 cfs except during high inflow years, and have most often ranged between 10,000 cfs and 20,000 cfs.

A NEED FOR SCIENTIFIC EVALUATION

Responding to concerns that changes to the Colorado River ecosystem were resulting from dam operations, the Bureau of Reclamation (Reclamation) launched the Glen Canyon Environmental Studies (GCES) program in 1982. The first phase of the program (1982-1988) focused on developing baseline resource assessments of physical and biotic resources. The second program phase (1989-1996) expanded research programs in native and non-native fishes, hydrology and aquatic habitats, terrestrial flora and fauna, cultural and ethnic resources, and social and economic impacts. Developing spatial and temporal data using a Geographic Information System began during the second phase.

By the late 1980s, sufficient knowledge had been developed to support concerns that downstream impacts were occurring, and that additional information needed to be developed to quantify the effects and to develop management actions that could avoid and/or mitigate the impacts. This collective information and other factors led to a July 1989 decision by the Secretary to direct Reclamation to prepare an environmental impact statement (EIS) on the operation of Glen Canyon Dam. The intent was to evaluate alternative operation strategies that could lessen the impacts of operations on downstream resources.

In October 1992, the President signed into law the Reclamation Projects Authorization and Adjustments Act, Public Law 102-575. Responding to continued concerns over potential impacts of Glen Canyon Dam operations on downstream resources, Congress included the GCPA as Title 18 of the Reclamation Projects Authorization and Adjustments Act. Section 1802(a) of the GCPA requires the Secretary to operate Glen Canyon Dam:

... in accordance with the additional criteria and operating plans specified in section 1804 and exercise other authorities under existing law in such a manner as 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.

In addition, the GCPA directs the Secretary to implement section 1802 in a manner fully consistent with all existing laws and compacts that govern allocation, appropriation, development, and exportation of the waters of the Colorado River Basin.

Section 1803 of the GCPA validated the interim operating criteria adopted by the Secretary in 1991 and provided for consultation, a deviation process, and a method for termination upon adoption of final operating criteria.

Section 1804 of the GCPA required preparation of an EIS on operations, adoption of operating criteria and plans, reports to Congress, and reallocation of costs. The EIS requirement merely validated the Secretary's earlier direction to Reclamation and provided specific time frames for preparation and submittal. The final Environmental Impact Statement for the Operation of Glen Canyon Dam (GCDEIS) was filed with the Environmental Protection Agency in March 1995 and a Record of Decision (ROD) was signed in October 1996.

The ROD changed two flow parameters from those shown in the preferred alternative of the GCDEIS. They were (1) increasing the normal maximum flow from 20,000 cfs to 25,000 cfs and (2) increasing the upramp rate from 2,500 cfs/hour to 4,000 cfs/hour. The ROD also changed the triggering mechanism for conducting beach/habitat-building flows (BHBFs). Instead of conducting them in years in which Lake Powell storage is low on January 1, they will be conducted in years in which Lake Powell storage is high and reservoir releases in excess of powerplant capacity are required for dam safety purposes. Following the signing of the ROD, the Secretary adopted a set of operating criteria and the 1997 Annual Plan of Operations. This terminated the 1991 interim flow criteria.

Reclamation has begun the process of reallocating the costs of construction, operations, maintenance, replacement, and emergency expenditures among the purposes directed in section 1802 of the GCPA and the purposes established in the CRSP Act of April 11, 1956. Work began in water year 1997 and will continue in water year 1999. All work will be performed in consultation with the Secretary of Energy.

Section 1805 of the GCPA requires the Secretary to establish and implement a long-term monitoring and research program (see the section entitled "Adaptive Management Program" for details).

Section 1807 makes the costs of preparing the EIS, supporting studies, and long-term monitoring programs described in section 1805 nonreimbursable, except in fiscal years 1993-1997. In fiscal years 1993-1997, the costs shall be nonreimbursable only to the extent that the effect of all provisions of the GCPA increases offsetting receipts. The Commissioner of Reclamation has submitted to Congress reports on the results of the net operating receipts computations for fiscal years 1993 through 1996. The fiscal year 1997 report will be submitted in the near future.

Section 1808 of the GCPA authorizes appropriated funds as necessary to carry out the provisions of the Act. Section 1809 requires the Secretary of Energy, in consultation with the Secretary of the Interior and stakeholder representatives, to identify economically and

technically feasible methods of replacing any power generation that is lost through adoption of long-term operating criteria for the operation of Glen Canyon Dam. The Western Area Power Administration completed a final report in March 1998.

GLEN CANYON DAM OPERATIONS – WATER YEAR 1998

Glen Canyon Dam was operated in 1998 in compliance with the ROD, operating criteria, and the 1998 Annual Plan of Operations. Total unregulated inflow to Lake Powell during 1998 was about 116 percent of normal, which resulted in an annual release of 13.5 million acre-feet (maf). Monthly releases ranged from 799,000 acre-feet (af) in April to 1,290,000 af in August. A table of monthly release volumes and the associated power generation is shown in Appendix E.

On November 4-5, 1997, a 48-hour release at powerplant capacity (30,600 cfs at the time) was made. This test release was conducted to move Paria River tributary sediment inputs from the main channel of the Colorado River into eddies and channel margins where less sediment would be transported downstream. The average daily releases before and after the release were about 21,000 cfs; thus, the test flow increased the river discharge by about 10,000 cfs, a 45 percent increase. The river stage increased between about 1.5 feet to 3 feet depending on the location in the Grand Canyon. The preliminary results of the test release are described in a report from the GCMRC (see Appendix F).

As in many years, the 1998 spring runoff forecast changed during the winter and spring as a result of varying month-to-month precipitation. Expectations were high that spring precipitation would be much greater than normal as a result of the strong El Nino temperature anomaly in the Pacific Ocean.

Fall and early winter releases were kept near 20,000 cfs in order to draw down the reservoir to guard against higher than forecasted runoff. Late winter releases were then dropped to an average of about 15,000 cfs. While the forecast did increase by about 1.5 maf between April and July due to above-average precipitation, the additional volume was easily accommodated by increasing powerplant releases in July and August to about 20,000 cfs.

The maximum reservoir elevation during the year was 3,697.1 feet during July, approximately 3 feet from full. Since the end-of-water-year elevation in Lake Mead was higher than the elevation in Lake Powell, equalization provisions of the 1968 Colorado River Basin Project Act were not applicable in water year 1998.

GLEN CANYON DAM OPERATIONS – WATER YEAR 1999

The Secretary intends to operate Glen Canyon Dam in accordance with the 1999 Annual Plan of Operations (see Appendix C). Releases during the fall of 1998 averaged about 15,000 cfs, about the average release when the reservoir is near full. Snowpack during the winter of 1999 was slightly below normal and a near normal spring runoff is expected.

ADAPTIVE MANAGEMENT PROGRAM

Section 1805 of GCPA directs the Secretary to:

... establish and implement long-term monitoring programs and activities that will ensure that Glen Canyon Dam is operated in a manner consistent with that of section 1802.

The Act also states that:

Long-term monitoring of Glen Canyon Dam shall include any necessary research and studies to determine the effect of the Secretary's actions under section 1804(c) on the natural, recreational, and cultural resources of Grand Canyon National Park and Glen Canyon National Recreational Area.

One of the key elements specified in the GCDEIS and the ROD is an “Adaptive Management Program.” The AMP provides a process for incorporating science and recommendations from a diverse group of stakeholders in the evaluation and management of future dam operations. The AMP calls for continued interaction of managers and scientists to monitor the effects of current dam operations under the GCDEIS and the ROD on the Colorado River ecosystem, and to conduct research on proposed alternative dam operating criteria that may be necessary to achieve the goals of the GCDEIS, ROD, and GCPA.

The AMP, schematically characterized in Figure 1 on page 7, identifies the following entities that contribute to the adaptive management process:

- Secretary’s Designee
- Adaptive Management Work Group (AMWG)
- Technical Work Group (TWG)
- Grand Canyon Monitoring and Research Center
- Independent Review Panels (IRPs)

The EIS calls for the Secretary's designee to be a senior departmental official who will serve as the Secretary's principal contact for the AMP, and as the focal point for issues and decisions associated with the program. The designee's responsibilities include ensuring that the department complies with its obligations under the GCPA, EIS, and ROD. The designee is to review, modify, accept, or remand recommendations from the AMWG in making any decisions about changes in dam operations and other management actions.

The AMWG is a Federal Advisory Committee chartered by the Secretary consisting of a group of stakeholders that are federal and state resource managers, Native American tribes, power marketers, environmental groups, recreationists, and other interested stakeholders (see Appendix G). The AMWG is chaired by the Secretary's designee and was established to develop, evaluate, and recommend alternative operation strategies for Glen Canyon Dam, and make recommendations to the Secretary. The AMWG does not displace federal agency legal authority and responsibility to manage resources in the best interests of both the environment and society.

In addition to creation of the AMWG, the TWG, GCMRC, and IRPs (which have yet to be formed) were created to play vital roles as part of the adaptive management process. The unique organizational structure outlined in the GCDEIS can be viewed as a "triangle with parity," with the IRPs playing a critical balancing role to ensure the overall scientific credibility of the AMP. The TWG is composed of technical representatives appointed by the AMWG. The EIS calls on the TWG to translate AMWG policy and goals into resource management objectives, criteria, and standards for long-term monitoring and research in response to the GCPA; develop resource management questions for the design of GCMRC monitoring and research; and provide information for preparing annual resource reports and other reports as required for the AMWG.

The EIS calls on the GCMRC to support the AMWG and the Secretary's designee. The GCMRC is specifically responsible for developing and implementing the annual monitoring and research plan, managing all adaptive management monitoring and research programs, managing and maintaining all data collected as part of these programs, administering research proposals through a competitive contract process, coordinating the review of the monitoring and research programs as well as the technical reports and documents resulting from these programs, and preparing and forwarding technical management recommendations and annual reports as specified in section 1804 of the GCPA to the AMWG.

As described in the EIS, the IRPs will be responsible for periodically reviewing resource-specific monitoring and research programs, and for making recommendations to the AMWG and GCMRC regarding monitoring, priorities, integration, and management. The IRPs will be specifically called on to provide an annual review of the monitoring and research program, technical advice as requested by the GCMRC or AMWG, and a five-year review of monitoring and research protocols.

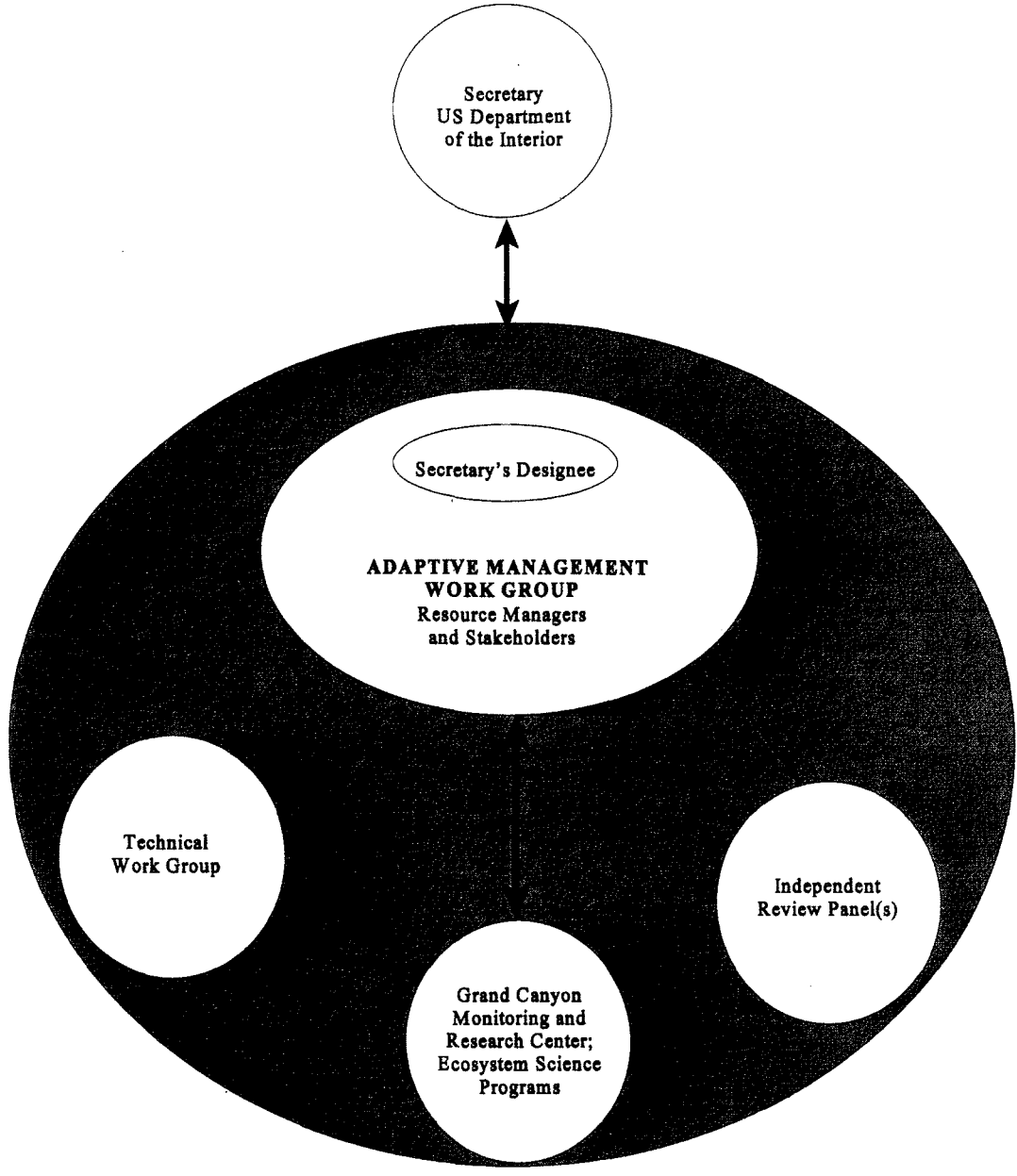


Figure 1.—Critical Entities of the Adaptive Management Program.

Adaptive Management Program Activities – Water Year 1998

In fiscal year 1998, the AMWG/TWG accomplished a broad cross-section of program activities as follows:

1. Continued development of protocols/procedures for operation of the AMWG/TWG.
2. Reviewed and commented on Reclamation's draft environmental assessment for the temperature control device modification to Glen Canyon Dam.
3. Reviewed the AMP budget process and budget allocations for short- and long-term programs.
4. Recommended management objectives and information needs for the AMP and Lake Powell.
5. Participated in workshops to develop a conceptual ecological model for the Colorado River downstream from Glen Canyon Dam.
6. Reviewed and recommended the following:
 - Resource criteria to be used in conjunction with BHBF hydrologic triggering criteria
 - Establishment of a scientific advisory panel
 - 5-Year Strategic Plan
 - Fiscal Year 1999 Monitoring and Research Plan
 - Final water year 1998 report entitled, *State of Natural and Cultural Resources in the Colorado River Ecosystem*
7. Recommended postponing the installation of Glen Canyon Dam spillway gate extensions.
8. Recommended adoption of hydrologic triggering criteria for BHBFs.

Adaptive Management Program Activities – Water Year 1999

In fiscal year 1999, progress will be made on the following activities related to the AMP:

1. Review of the scope of the AMP.
2. Develop an AMP guiding document and strategic plan.
3. Develop a programmatic compliance approach for various flow experiments, including long-term BHBFs.
4. Develop a plan for conducting a low, steady summer flow in the future.

5. Perform protocol reviews on several program areas.
6. Prepare for a possible spring BHBF.
7. Conduct several scientific workshops.
8. Provide final recommendations on the temperature control device for Glen Canyon Dam.

GRAND CANYON MONITORING AND RESEARCH CENTER

The GCMRC was established November 11, 1995, by the Assistant Secretary for Water and Science. Responsibility for the program was established in the Assistant Secretary's office, at the request of stakeholders, to represent and respond to the broad spectrum of resources, research, and monitoring needs that would have to be addressed in the AMP. The GCMRC was established early so that it could accomplish a critical transition from the GCES program which had been in place since 1982.

Grand Canyon Monitoring and Research Center Activities – Water Year 1998

The GCMRC implemented diverse activities in water year 1998 to accommodate the long- and short-term objectives and information needs of the AMWG/TWG. These activities included the following:

1. Developed a final water year 1999 Annual Monitoring and Research Plan, requests for proposals, and cooperative agreements for implementation.
2. Prepared a final water year 1998 report entitled, *State of Natural and Cultural Resources in the Colorado River Ecosystem*.
3. Prepared a summary of program accomplishments for water year 1998.
4. Evaluated the AMWG's specified adaptive management flows of 31,000 cfs and 45,000 cfs on the Colorado River ecosystem and Lake Powell resources.
5. Evaluated long-term sustained flows of 22,000 cfs to 27,000 cfs (conducted during much of 1997) on the Colorado River ecosystem and Lake Powell resources.
6. Initiated a program to develop conceptual ecosystem models for the Colorado River ecosystem.
7. Reviewed and revised all measurement and assessment protocols for GCMRC monitoring and research programs.

8. At the request of the AMWG, initiated the development of appropriate monitoring and research plans for experimental flows greater than 45,000 cfs, with and without fluctuating flows above 25,000 cfs, for water year 1999 and beyond.
9. Initiated the revision of the GCMRC Five-Year Strategic Plan.
10. Drafted a plan for the development of long-term monitoring programs using protocol evaluation panels.
11. In conjunction with the TWG, developed "resource triggering criteria" for BHBFs and habitat maintenance flows.

Grand Canyon Monitoring and Research Center Activities – Water Year 1999

1. Continue to review and revise all measurement and assessment protocols for GCMRC monitoring and research programs using protocol evaluation panels.
2. Complete the development of appropriate monitoring and research plans for experimental flows greater than 45,000 cfs, with and without fluctuating flows above 25,000 cfs, for water year 1999 and beyond.
3. Complete the revision of the GCMRC Five-Year Strategic Plan.
4. Relocate the GCMRC warehouse to the Flagstaff Field Center of the United States Geological Survey (USGS).
5. Complete the consolidation of GCMRC staff and facilities at the Flagstaff Field Center.
6. Complete development of Phase I of the conceptual model for the Colorado River ecosystem.
7. Review and comment on the environmental assessment for the temperature control device.
8. Implement the water year 1999 annual plan. Achieve a recommendation in support of the water year 2000 annual plan, and begin development of the water year 2001 annual plan and budget.
9. Provide technical support to the TWG in their development of AMP guidance documents.
10. Develop a long-term plan for the integrated water quality program.
11. Provide technical support for the development of a programmatic compliance document.

12. Conduct a scientific symposium to review the “state of the science” on the Colorado River ecosystem.
13. Award contracts for the development of plans to implement endangered fish research flows and develop a plan for establishing a second population of humpback chub.
14. Facilitate, as appropriate, the revision of the existing management objectives and information needs.

APPENDIX A

OPERATING CRITERIA FOR GLEN CANYON DAM IN ACCORDANCE WITH THE GRAND CANYON PROTECTION ACT OF 1992

These Operating Criteria are promulgated in compliance with section 1804 of Public Law 102-575, the Grand Canyon Protection Act of 1992. They are to control the operation of Glen Canyon Dam, constructed under the authority of the Colorado River Storage Project Act. These Operating Criteria are separate and apart from the Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs prepared in compliance with the Colorado River Basin Project Act of 1968.

1. Annual Report

As required in the Grand Canyon Protection Act, a report shall be prepared and submitted to Congress annually that describes the operation of Glen Canyon Dam for the preceding water year and the expected operation for the upcoming water year. The annual plan of operations shall include such detailed rules and quantities as are required by the Operating Criteria contained herein. It shall provide a detailed explanation of the expected hydrologic conditions for the Colorado River immediately below Glen Canyon Dam.

2. Review of Criteria

The Secretary shall review these Operating Criteria as the result of actual operating experiences to determine if the Operating Criteria should be modified to better accomplish the purposes of the Grand Canyon Protection Act. Such a review shall be made at least every five years in consultation with the appropriate federal agencies, Governors of the Colorado River Basin States, Native American tribes, representatives of academic and scientific communities, environmental organizations, the recreation industry, and contractors for the purchase of federal power produced at Glen Canyon Dam.

3. Specific Operational Constraints

The plan of operations will follow the description of the preferred alternative (Modified Low Fluctuating Flow) in the GCDEIS and the ROD. The specific criteria are as follows:

Minimum Releases – 8,000 cfs between 7:00 a.m. and 7:00 p.m. and 5,000 cfs at night.

Maximum Releases – 25,000 cfs. Several circumstances warrant exception to this restriction. These are the beach/habitat-building flows and the habitat maintenance flows (both described below) and the release of large volumes of water to avoid spills or flood flow releases from Glen Canyon Dam. These latter releases would most likely result from high snowmelt runoff into Lake Powell; if such high releases above 25,000 cfs are required, they shall be made at constant daily flow rates.

Allowable Daily Flow Fluctuations – 5,000 cfs/24 hours for monthly release volumes less than 600,000 acre-feet, 6,000 cfs/24 hours for monthly release volumes of 600,000 to 800,000 acre-feet, and 8,000 cfs/24 hours for monthly release volumes over 800,000 acre-feet.

Maximum Ramp Rates – 4,000 cfs/hr when increasing, and 1,500 cfs/hr when decreasing.

Emergency Exception Criteria – Normal powerplant operations will be altered temporarily to respond to emergencies. These changes in operations typically would be of short duration (usually less than 4 hours) and would be the result of emergencies at the dam or within the interconnected electrical system. Examples of system emergencies include:

1. Insufficient generating capacity
2. Transmission system: overload, voltage control, and frequency
3. System restoration
4. Humanitarian situations (search and rescue)

Flood Frequency Reduction Measures – The frequency of unanticipated flood flows in excess of 45,000 cfs will be reduced to no more than 1 year in 100 years as a long-term average. This will be accomplished initially through the Annual Operating Plan process and eventually by raising the height of the spillway gates at Glen Canyon Dam 4.5 feet.

Habitat Maintenance Flows – Habitat maintenance flows are high steady releases within powerplant capacity (33,200 cfs) not to exceed 14 days in March, although other months will be considered under the AMP. Actual powerplant release capacity may be less than 33,200 cfs under low reservoir conditions. These flows will not be scheduled when projected storage in Lake Powell on January 1 is greater than 19,000,000 acre-feet, and typically would occur when annual releases are at or near the minimum objective release of 8,230,000 acre-feet. Habitat maintenance flows differ from beach/habitat-building flows because they will be within powerplant capacity, and will occur nearly every year when the reservoir is low.

Beach/Habitat-Building Flows – These controlled floods will occur as described in the EIS (steady flow not to exceed 45,000 cfs, duration not to exceed 14 days, up-ramp rates not to exceed 4,000 cfs/hr, and down-ramp rates not to exceed 1,500 cfs/hr) except instead of conducting them in years in which Lake Powell storage is low on January 1, they will be accomplished by utilizing reservoir releases in excess of powerplant capacity required for dam safety purposes. Such releases are consistent with the 1956 Colorado River Storage Project Act, the 1968 Colorado River Basin Project Act, and the 1992 Grand Canyon Protection Act.

/s/ Bruce Babbitt
Secretary of the Interior

February 24, 1997
Date

APPENDIX B

GLEN CANYON DAM 1998 ANNUAL PLAN OF OPERATIONS PREPARED IN ACCORDANCE WITH THE OPERATING CRITERIA DEVELOPED FOR THE GRAND CANYON PROTECTION ACT

This plan is prepared in conformance with section 1804(c)(1)(A) of the GCPA. Any changes to the plan would require reconsultation in accordance with this Act.

In water year 1997, Glen Canyon Dam was operated in accordance with the criteria established in response to the 1992 Grand Canyon Protection Act, including the constraints on daily fluctuations and ramping rates. Since the annual release volume was 13.8 maf, powerplant releases were above normal for much of the year. In portions of February, March, June, and July, average daily releases were 27,000 cfs, and thus were released at a steady flow rate. Lake Powell's peak elevation for the year was 3,695 feet and no water bypassed the powerplant.

As a result of the preparation of the Annual Operating Plan under the 1968 Colorado River Basin Project Act, monthly release volumes from Glen Canyon Dam during 1998 are expected to range from 600,000 af to 1,200,000 af. Under the most probable inflow conditions in water year 1998, Glen Canyon Dam is expected to release about 10.75 maf through the Grand Canyon to Lake Mead. This is about 2.5 maf greater than the minimum objective release and is the result of high reservoir storage in both Lakes Powell and Mead. Lake Powell is expected to fill in July. Monthly updates to these release projections will be made throughout the year.

With current projected monthly release volumes, hourly powerplant releases will exceed 20,000 cfs from October through the month of January and again during the summer peak months of July and August, when monthly release volumes are at their highest for the year. Average daily releases of 20,000 cfs are expected during these months. If average daily releases above 25,000 cfs are made, they will be made as steady flows. Projected daily allowable fluctuations therefore will be between 6,000 cfs and 8,000 cfs (see criteria). Minimum releases of 5,000 cfs at night and 8,000 cfs during the day and ramping rates of 4,000 cfs/hr increasing and 1,500 cfs/hr decreasing will be followed. All of the above is outlined in the Record of Decision implementing the preferred alternative of the GCDEIS.

With the strong current El Niño Southern Oscillation anomaly, there is some indication that winter precipitation could be higher than normal in the southern portion of the upper Colorado River Basin, and that spring precipitation could also be higher than normal in the northern portion of the Basin. Since there are concerns for resulting unplanned spills from Glen Canyon Dam, releases from Glen Canyon Dam are expected to be higher than normal during the fall months in order to achieve a prudent January 1, 1998, reservoir storage level. Releases throughout the year will be made in such a way as to reduce the risk of uncontrolled spring releases that could result from large forecast errors similar to that which occurred in 1983.

Every measure will be taken to prevent such an uncontrolled powerplant bypass this spring in order to protect the Grand Canyon ecosystem downstream of Lake Powell. In this regard, technical discussions have recently occurred regarding the hydrologic triggering mechanisms under which beach/habitat-building flows could be released from Glen Canyon Dam. The Technical Work Group has evaluated and the Adaptive Management Work Group has recommended the following triggering criteria for the release of a beach/habitat-building flow:

1. If the January forecast for the January-July unregulated spring runoff into Lake Powell exceeds 13 maf (about 140 percent of normal) when the January 1 storage is 21.5 maf (i.e., when the sum of January 1 storage and forecast is greater than 34.5 maf), or
2. Anytime a Lake Powell inflow forecast would require a powerplant monthly release greater than 1.5 maf or use of the 0.5 maf storage buffer, then a beach/habitat-building flow could be released from Glen Canyon Dam if then deemed appropriate from an environmental perspective. The Annual Operating Plan prepared under the 1968 Act allows a beach/habitat-building flow to occur in 1998 if hydrologic conditions are appropriate.

APPENDIX C

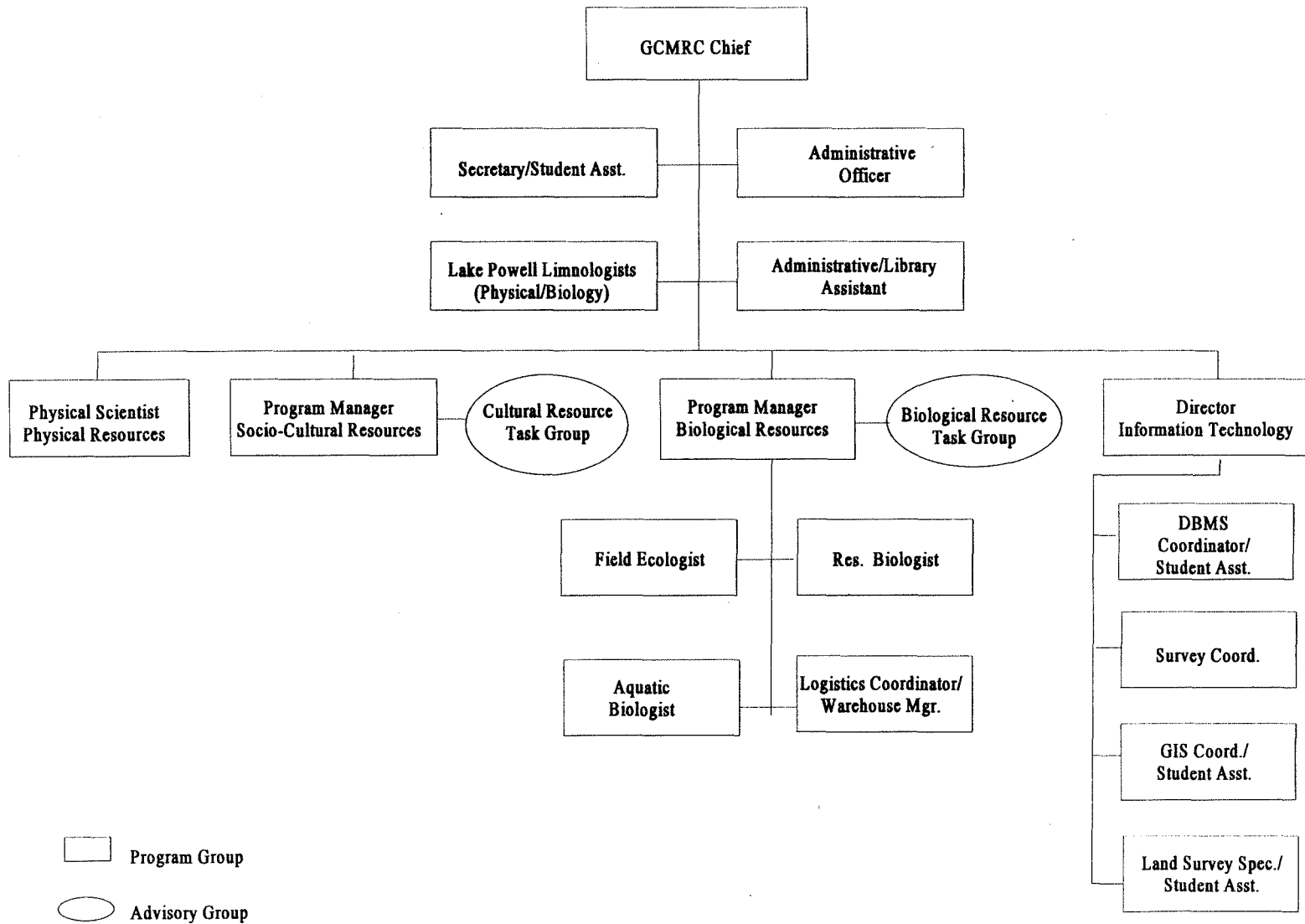
GLEN CANYON DAM 1999 ANNUAL PLAN OF OPERATIONS PREPARED IN ACCORDANCE WITH THE OPERATING CRITERIA DEVELOPED FOR THE GRAND CANYON PROTECTION ACT

This plan is prepared in conformance with section 1804(c)(1)(A) of the GCPA. Any changes to the plan would require reconsultation in accordance with this Act.

In water year 1998, Glen Canyon Dam was operated in accordance with the criteria established in response to the 1992 Grand Canyon Protection Act, including the constraints on daily fluctuations and ramping rates. The annual release volume was 13.5 maf and powerplant releases were above normal for part of the year. Several months in both the fall of 1997 and the summer of 1998 experienced releases of about 20,000 cfs. Lake Powell's peak elevation for the year was 3,697.1 feet and no water bypassed the powerplant.

As a result of the preparation of the Annual Operating Plan under the 1968 Colorado River Basin Project Act, monthly release volumes from Glen Canyon Dam during 1999 are expected to range from 600,000 af to 1,000,000 af. Under the most probably inflow conditions in water year 1998, Glen Canyon Dam is expected to release about 9.8 maf through the Grand Canyon to Lake Mead. This is about 1.6 maf greater than the minimum objective release and is the result of high reservoir storage in both Lakes Powell and Mead. Lake Powell is expected to be near full in July. Since Lake Mead storage at the end of water year 1999 is expected to be greater than Lake Powell storage, equalization releases are not likely in 1999. Monthly updates to these release projections will be made throughout the year.

The BHBF triggering criteria recommended by the AMWG will be employed in 1999 to determine if a BHBF could hydrologically occur. With current projected monthly release volumes, hourly powerplant releases will not exceed 25,000 cfs and thus a beach/habitat-building flow will not be triggered. However, since the reservoir is near full in the spring, there is the potential for a BHBF if the runoff is much greater than currently expected. Section 7 consultation with the U.S. Fish and Wildlife Service is underway to permit a BHBF slightly less than 45,000 cfs if hydrologic triggers are exceeded. Subsequently, if average daily releases above 25,000 cfs are made, they will be made as steady flows. Projected daily allowable fluctuations will be between 6,000 cfs and 8,000 cfs (see criteria). Minimum releases of 5,000 cfs at night and 8,000 cfs during the day and ramping rates of 4,000 cfs/hr increasing and 1,500 cfs/hr decreasing will be followed. All of the above is outlined in the Record of Decision implementing the preferred alternative of the GCDEIS.



Staffing Requirements of the Grand Canyon Monitoring and Research Center

APPENDIX E

GLEN CANYON DAM MONTHLY POWERPLANT RELEASES AND GENERATION
WATER YEAR 1998

Month	Powerplant Release (acre-feet)	Powerplant Generation (kilowatt-hours)
October	1,206,582	594,808,000
November	1,212,942	595,131,000
December	1,254,100	613,806,000
January	1,201,580	583,726,000
February	1,091,166	530,310,000
March	1,197,415	576,168,000
April	798,836	383,038,000
May	902,867	440,037,000
June	1,096,487	541,856,000
July	1,249,750	624,564,000
August	1,290,443	646,487,000
September	1,016,354	505,652,000
Total	13,518,522	6,635,583,000

APPENDIX F

PRELIMINARY RESULTS OF THE NOVEMBER 4-5, 1997, PEAK POWERPLANT TEST RELEASE FROM GLEN CANYON DAM

Background: The GCDEIS proposes benefits to downstream ecosystem resources from periodic implementation of a BHBF. The Secretary of the Interior's 1996 ROD allows for this type of controlled, high flow release under current dam operations. The BHBF is a short duration release at least 10,000 cfs above powerplant capacity, but not more than 45,000 cfs, intended to rebuild high elevation sandbars, deposit nutrients, restore backwater channels, and provide some of the dynamics of a natural system. Because the BHBF, by definition, requires a portion of releases from Glen Canyon Dam to bypass the powerplant, it is technically considered a "flood flow" or spill. Under the ROD, a BHBF will likely only be released during years when forecasted inflow to Lake Powell is above average and the January 1 target storage is relatively high (21.5 maf).

The GCDEIS states that additional testing of the BHBF might occur to study benefits of implementing the BHBF in summer or fall so as to closely follow tributary inputs of fine sediment (meaning sand, silt, and clay). The intended goal of altering seasonal timing of the BHBF is to reduce sediment export to upper Lake Mead while also restoring riverine habitat. For a number of reasons, implementation of the BHBF is currently limited to January through July on the basis of hydrologic and other resource criteria adopted by the AMWG. For this reason, it has not been possible to study responses of the BHBF in summer or fall following tributary inputs. An alternative fall test release at powerplant capacity (about 31,000 cfs) was proposed by USGS sediment researchers in September 1997, following significant summer tributary flooding.

Four large floods on the Paria River (river mile 1) in August and September 1997 added about 2 million tons of sand to the Colorado River about 15 miles downstream from Glen Canyon Dam. The total load of fine sediment input was estimated by the USGS to be 4.2 million tons, and was approximately equal to three times the historical average annual input. On the basis of technical advice presented to the AMWG by the GCMRC, the AMWG recommended to the Secretary that a powerplant capacity test be conducted in November 1997, the purpose of which was to determine whether such non-spill releases following tributary inputs would promote fine sediment conservation through beach building. Because backwater channels were not restored by the larger BHBF in 1996, studies of the 1997 test release focused specifically on fine sediment transport and impacts to beaches. On November 4-5, 1997, a constant powerplant discharge of approximately 31,000 cfs was released from Glen Canyon Dam for a duration of 48 hours. Scientists from Northern Arizona University and the USGS were deployed by the GCMRC to measure physical resource responses of the Colorado River ecosystem.

Results: Survey measurements and sediment analyses of terrestrial beaches after the test flow revealed that many study sites had accumulated thin deposits of fine sand and silt, deposits much finer than those found on beaches after the 1996 BHBF test. Backwater channel habitats were not restored by the November 1997 test, as anticipated on the basis of

observations following the larger magnitude BHBF test. Scientists concluded that beach deposits from the 1997 test were more similar to pre-dam beaches in texture than those created by either the 1996 BHBF test or the unplanned 1983-1984 flood flows (40,000 to 93,000 cfs). The 1997 deposits were unique in that they contained higher amounts of silt, thought to be recently input to the ecosystem by Paria River flooding. In addition, suspended sediment sampling in critical upper reaches of the Colorado River ecosystem made during the 1997 test indicated that suspended sediment concentrations and grain size distributions were equal upstream and downstream of the confluence of the Little Colorado River (river mile 61).

The confluence of the Little Colorado River, the largest contributing drainage for fine sediment inputs, divides critical, sediment limited upstream reaches from the relatively more sediment rich downstream reaches of the Colorado River. The 1997 sediment load equalization contrasted dramatically with measurements made during the 1996 BHBF test, which revealed a much reduced supply in the first 76 miles downstream of Glen Canyon Dam, relative to those measured downstream of the Little Colorado River confluence. The contrast between sediment supply conditions in Marble Canyon (above the Little Colorado River confluence) at the time of the 1996 BHBF test, versus conditions during the 1997 test, indicate that the 1997 Paria River floods (all 5- to 10-year recurrence events) were sufficient to resupply upstream critical reaches with new supplies of fine sediment. The Paria River inputs were the largest since 1980, but USGS scientists estimated that these supplies would be exported from the critical upstream reaches in less than one year if they were not put into long-term storage sites as shoreline beaches. Beach storage responses to the 1997 test were relatively minimal compared with deposit thickness measured after the 1996 BHBF test. The relatively thinner 1997 beach deposits were more likely a result of the limited stage elevation of the peak powerplant discharge than a result of limited fine sediment supply.

Owing to annual motor use restrictions imposed by the National Park Service between September 15 and December 15, sediment scientists were unable to use hydrographic vessels to map the channel bottom. This limitation prevented them from determining whether the 1997 test was effective in moving significant volumes of fine sediment from the main channel to hundreds of eddies that dominate the geomorphic framework of the river ecosystem. Eddies are thought to be relatively long-term storage sites for fine sediment that can later be elevated to higher elevation shoreline beaches by floods. The 1997 test results suggested that benefit to downstream beaches occurred through some aggradation of beaches by fine sand and silt, with textures being similar to beaches of the pre-dam era. However, scientists still need to be able to measure eddy and main channel bottom responses under similar test conditions to compare changes in eddy storage with net sediment export to Lake Mead. Such studies must be conducted before a complete evaluation can be made of whether or not flows of this magnitude, timing, and duration will be of long-term benefit to sediment conservation.

On the basis of current knowledge and research findings, the finest portions of tributary sediment inputs are stored in the main channel for only several weeks to less than one year. Results of the 1997 test and ongoing sediment research suggest that if the finest tributary

sediment is to be retained within beaches at elevations above the 25,000 cfs stage, BHBF releases from Glen Canyon Dam of 45,000 cfs or higher need to be made as soon as possible following tributary floods.

APPENDIX G

CHARTER

ADAPTIVE MANAGEMENT WORK GROUP

Establishment of a Federal Advisory Committee
to Advise the Secretary of the Interior
on the Impacts of
Glen Canyon Dam Operations

- 1. Official Designation:** Glen Canyon Dam Adaptive Management Work Group.
- 2. Background and Purpose:** The Grand Canyon Protection Act (Act) of October 30, 1992, embodied in Public Law 102-575, directs the Secretary of the Interior (Secretary), among others to operate Glen Canyon Dam in accordance with the additional criteria and operating plans specified in section 1804 of the Act and to exercise other authorities under existing law in such a manner as to protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and the Glen Canyon National Recreation Area were established, including but not limited to the natural and cultural resources and visitor use. The Secretary shall implement this section in a manner fully consistent with and subject to section 1802 of the Act. Section 1805 of the Act calls for implementation of long-term monitoring programs and activities that will ensure that Glen Canyon Dam is operated in a manner consistent with that of section 1802. As part of long-term monitoring, the Secretary's Record of Decision (ROD) mandates development and initiation of an Adaptive Management Program (AMP). The AMP provides for monitoring the results of the operating criteria and plans adopted by the Secretary and changes to those operating criteria and plans. The AMP includes an Adaptive Management Work Group (AMWG). The AMWG will facilitate the AMP, recommend suitable monitoring and research programs, and make recommendations to the Secretary as required to meet the requirements of the Act. The AMWG may recommend research and monitoring proposals outside the Act which complement the AMP process, but such proposals will be funded separately, and do not deter from the focus of the Act.
- 3. Duration:** It is the intent that the AMWG shall continue indefinitely, unless otherwise terminated by the Secretary. In accordance with the Federal Advisory Committee Act (FACA), 5 U.S.C. App., this charter will terminate 2 years from the date of filing unless renewed by the Secretary prior to that time.
- 4. Agency To Whom The AMWG Reports:** The AMWG reports to the Secretary through the Secretary's designee who shall serve as the chairperson of the AMWG.
- 5. Administrative Support:** The logistical and support services for the meetings of the AMWG shall be provided by the Bureau of Reclamation (Reclamation).

6. **Duties:** The duties or roles and functions of the AMWG are to:

- a. Establish AMWG operating procedures.
- b. Advise the Secretary in meeting environmental and cultural commitments of the EIS, as requested.
- c. Recommend the framework for the AMP policy, goals, and direction.
- d. Develop recommendations for modifying operating criteria and other resource management actions pursuant to the Act.
- e. Define and recommend resource management objectives for development and implementation of a long-term monitoring plan, and any necessary research and studies required to determine the effect of the operation of Glen Canyon Dam on the natural, recreational, and cultural resources of the Grand Canyon National Park and Glen Canyon National Recreation Area.
- f. Review and provide input to the Secretary on the reports required in Sections 1804 (c)(2) and 1804 (d).
- g. Facilitate input and coordination of information from stakeholders to the Secretary to assist in meeting consultation requirements under Sections 1804 (c)(3) and 1805 (c) of the Act.
- h. Monitor and report on compliance of all program activities with applicable laws, permitting requirements, and the Act. The duties and functions of the AMWG are in an advisory capacity only.

7. **Meetings:** The AMWG is expected to meet biannually. The Secretary's designee, who will serve as the designated Federal Official, may call additional meetings as deemed appropriate. Fifteen members must be present at any meeting of the AMWG to constitute a quorum.

The Secretary's designee shall be responsible for preparation of meeting agendas and scheduling meetings of the AMWG. The Secretary's designee shall attend and chair all meetings of the AMWG. In accordance with FACA, a notice of each meeting of the AMWG shall be published in the Federal Register at least 15 days prior to the meeting advising the date, time, place, and purpose of the meeting. If it becomes necessary to postpone or cancel an announced meeting, a subsequent notice shall be published in the Federal Register as early as possible and shall explain the reasons for the postponement or cancellation. A similar notice of each meeting, postponement, or cancellation shall also be published in selected major newspapers in Phoenix and Flagstaff, Arizona, Denver, Colorado, and Salt Lake City, Utah.

In accordance with FACA, all meetings of the AMWG shall be open to the general public. Any organization, association, or individual may file a written statement or, at the discretion of the AMWG, provide verbal input regarding topics on a meeting agenda in accordance with FACA.

8. **Minutes:** The minutes of each AMWG meeting; reports; related documents; and copies of all documents received, issued, or approved by the AMWG shall be available for public inspection and duplication during regular business hours within 30 working days after the meeting at the:

Upper Colorado Regional Office
Bureau of Reclamation
125 South State Street, Room 6107
Salt Lake City, Utah 84138-1102
(801) 524-6096, Extension 1

The Secretary's Designee shall approve AMWG meeting agendas and minutes.

9. **Estimated Operating Costs:** The operating costs are estimated at \$154,000 annually for the establishment and support of the AMWG. This includes costs for required staff support of about 0.3 of a person year. Expenses would also include the travel and per diem of some members and employees of the Department of the Interior while attending meetings of the AMWG, and for expenses incurred in the recording and reproduction of the minutes, reports, notices, etc.

10. **Allowances:** While engaged in the performance of approved business away from home or their regular places of business, members of the AMWG (tribal, environmental, recreation, and Contractors who purchase Federal power) shall be reimbursed for travel expenses, including per diem in lieu of subsistence.

11. **Membership:** Members of the AMWG to be appointed by the Secretary shall be comprised of:

- a. **Secretary's Designee**, who shall serve as chairperson for the AMWG.
- b. **One representative each from the 12 cooperating agencies associated with the EIS:**
 - (1) Bureau of Reclamation
 - (2) Bureau of Indian Affairs
 - (3) U.S. Fish and Wildlife Service
 - (4) National Park Service
 - (5) Western Area Power Administration
 - (6) Arizona Game and Fish Department

- (7) Hopi Tribe
- (8) Hualapai Tribe
- (9) Navajo Nation
- (10) San Juan Southern Paiute Tribe
- (11) Southern Paiute Consortium
- (12) Pueblo of Zuni

c. One representative each from the seven basin states:

- (1) Arizona
- (2) California
- (3) Colorado
- (4) Nevada
- (5) New Mexico
- (6) Wyoming
- (7) Utah

d. Two representatives each from:

- (1) Environmental groups
- (2) Recreation interests
- (3) Contractors who purchase Federal power from Glen Canyon Powerplant

Members will be appointed to the AMWG by the Secretary, with input and recommendations from the cooperating agencies, States, tribes, contractors for Federal power from Glen Canyon Dam, environmental representatives, and other stakeholders. To be eligible for appointment to the AMWG, a person must (a) be qualified through education, knowledge, or experience to give informed advice on water supply, diversion and delivery facilities, and their operation and management, or the environmental aspects of such operation; and (b) have the capability to constructively work in a group setting toward a common objective of structuring a mechanism for program implementation.

Members of the AMWG will be appointed for a 4-year term. At the discretion of the Secretary, members may be reappointed to additional terms. Vacancies occurring by reason of resignation, death, or failure to regularly attend meetings will be filled by the Secretary for the balance of the vacating member's term using the same method by which the original appointment was made. Failure to attend two consecutive meetings will substantiate grounds for dismissal.

To avoid conflict of interest issues arising from entities having representatives on the AMWG and also submitting responses to request for proposals to perform work, the Federal procurement process shall be strictly adhered to. While members of the AMWG may give

advice to the Secretarial Designee, all decisions in the procurement process shall be made by Federal procurement officials free of influence from AMWG members.



Secretary of the Interior

JAN 15 1997

Date

FEB 04 1997

Date charter filed: _____