Draft

FISCAL YEAR 1997 - 1998

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

From

Secretary of the Interior

January 1998

TABLE OF CONTENTS

FIGURE

APPENDIX

ORGANIZATIONAL CHART

FISCAL YEAR 1997 - 1998

REPORT TO CONGRESS: OPERATIONS OF GLEN

GLEN CANYON DAM PURSUANT TO THE

1992 GRAND CANYON PROTECTION ACT

REPORT TO CONGRESS

The Grand Canyon Protection Act (GCPA) requires the Secretary of the Interior (Secretary)to submit to congress an annual report as follows:

> Section 1804 (c) (2) "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."

This report responds to the above noted reporting requirements. The report focuses on activities pursuant to FY 1997, adoption of criteria, environmental impact statement (EIS), operating criteria and the Adaptive Management Program (AMP) in FY 1997 and projected activities planned for FY 1998.

Extensive administrative, technical, and science reports are the basis for information presented in this report. In the final section we provide source contacts for any additional reports needed for clarification of information presented. Reviewers of this report may access any additional information through these contacts.

HISTORY

The Colorado River Storage Project (CRSP) Act of 1956 authorized the construction, operation, and maintenance of Glen Canyon Dam (GCD) to regulate the flow of the Colorado River for flood control, consumptive use, and the generation of hydroelectric power. Seven years later, in 1963 the GCD was completed and made Lake Powell the key storage unit for CRSP. In addition to water storage for flood control and consumptive uses, the dam was built as a hydroelectric power peaking facility, permitting it to move from low electrical output during low power demand to high output in peak demand periods. Thus, flow releases from the dam were adjusted daily to respond to these variances in electrical demand.

At optimum operations, GCD's generators are capable of producing 1.38 million kilowatts of power. Water releases from the GCD occur at 200-230 feet below the surface of

Lake Powell, which results in clear cold water with year round temperatures of 41 to 45° F. The recreation, irrigation and hydropower benefits introduced to the Southwest by GCD are extensive and continue to expand.

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, combined with available storage space in Lake Powell, resulted in emergency spillway releases from GCD which reached 97,000 cfs. Except for the 1983 event, releases over the last 32 years have ranged generally between 1,000 and 25,000 cfs, with flows averaging between 5,000 and 16,000 cfs since 1991.

At the same time, and as a result of the construction of GCD, the Colorado River ecosystem below the dam differs significantly from its pre-dam natural character. In addition, GCD's highly variable flow releases from 1980 to 1991 caused additional concern over resource degradation resulting from dam operations. In 1991 flow criteria from GCD were changed. The Secretary adopted interim operations criteria in October 1991, which narrowed the range of flow operations to historical seasonal flows . Normally these flows do not exceed 25,000 cubic feet per second (cfs), and range most often between 5,000 and 16,000 cfs.

A NEED FOR SCIENCE

Responding to concerns that changes to the Colorado River ecosystem were resulting from dam operations, the US Bureau of Reclamation (Reclamation) launched the Glen Canyon Environmental Studies (GCES) program in 1982. The research program's first phase, 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 nonnative fishes, hydrology and aquatic habitats, terrestrial flora and fauna, cultural and ethnic resources, and social and economic impacts. Developing spatial and temporal data using GIS has also been a critical part of the second phase.

By the late 1980s, sufficient knowledge had been developed to raise 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 the Secretary of the Interior (Secretary) to direct Reclamation to prepare an EIS on operation of GCD. The intent was to evaluate alternative operation strategies.

In October of 1992 the President signed into law the Reclamation Projects Act, Public Law 102-575. Responding to continued concerns over potential impacts of GCD operations on downstream resources, Congress included in the Reclamation Projects Act Title 18, the Grand Canyon Protection Act (GCPA). The GCPA directs the Secretary to operate GCD:

"In such a manner so 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."

GCPA also tells the Secretary to implement this Title in a manner consistent with existing laws that govern allocation, appropriation, development, and exportation of the waters of the Colorado River.

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

Section 1804 required preparation of an EIS, adoption of operating criteria and plans, reports to Congress and allocation of costs. The EIS requirement merely validated the Secretary's previous direction to Reclamation earlier and provided time frames. The final EIS was filed in March of 1995 and a Record of Decision (ROD) signed October 1996. The ROD changed only two flow parameters from the those shown in the EIS preferred alternative, they were: increasing the maximum flow from 20,000 cfs to 25,000 cfs and increasing the upramp rate from 2500 cfs/hr to 4000 cfs/hr. Following signing of the ROD the Secretary adopted a set of operating criteria and a 1997 plan of operation, copies of which are attached in the appendix. This terminated the interim flow criteria.

The Secretary's 1998 plan of operations is included as the final section of the report. Glen Canyon Dam was operated in 1997 and will be operated in 1998 in compliance with the ROD, operating criteria and the plans of operation.

Reclamation has begun the process of reallocating the costs of construction, operations, maintenance, replacement and emergency expenditures among the purposes directed in section 1802 and the purposes established in the Colorado River Storage Project Act of April 11, 1956. Work began in FY 1997 and will continue in FY 1998. All work will be performed in consultation with the Secretary of Energy.

AN ADAPTIVE MANAGEMENT PROGRAM (AMP)

Section 1805 of GCPA directs the Secretary to:

> "...establish and implement long-term monitoring programs and activities that will insure the Glen Canyon Dam is operated in a manner consistent with the above actions . . . On the natural, recreation, and cultural resources of Grand Canyon."

And, that this

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

The final Glen Canyon Dam Environmental Impact Statement (GCDEIS) (USBR 1995) and the ROD specifies an "Adaptive Management Program" (AMP) as the required process for incorporating science and diverse stakeholders in the evaluation and management of future dam operations. The AMP calls for continued interaction of managers and scientists to both monitor the effects of current dam operations on the Colorado River ecosystem and conduct research on alternative dam operating criteria that may be necessary to insure protection of resources and improve natural processes.

The AMP, schematically characterized in Figure 1 identifies the following entities that contribute to the adaptive management process.

- Adaptive Management Work Group (AMWG)
- Technical Work Group (TWG)
- Grand Canyon Monitoring and Research Center (GCMRC)
- Independent Science Review Groups (ISRG)

INITIATING THE ADAPTIVE MANAGEMENT PROGRAM

The Adaptive Management Work Group (AMWG) is a Federal Advisory Committee chartered by the Secretary, copy attached, consisting of a group of stakeholders that are federal and state resource managers, Native American Tribes, power marketers, environmental groups, recreationists and other interest groups. The Technical Work Group (TWG) is composed of AMWG technical representatives. The roles and responsibilities of these groups are outlined in the GCDEIS.

The AMWG is established to develop, evaluate and recommend alternative operations strategies for GCD and make recommendations to the Secretary. This is accomplished by the AMWG specifying management objectives and information needs. The TWG then translates

the AMWG management objectives into research needs for the GCMRC, which in turn conducts appropriate science activities. The results of these scientific activities are provided to the AMWG. AMWG uses the results of GCMRC scientific activities to evaluate differing operating criteria and recommend continuance or changes in criteria.

The AMWG does not displace Federal agency legal authority and responsibility to manage resources in the best interests of both the environment and society. The GCDEIS does specify a different process for developing dam operation strategies into the future. That process specifies that the Secretary will receive recommendations from the AMP and will utilize ecosystem science to help evaluate and select future operation strategies for GCD.

The Independent Science Review Group provides a scientific review of overall program areas to assure credible science is being accomplished.

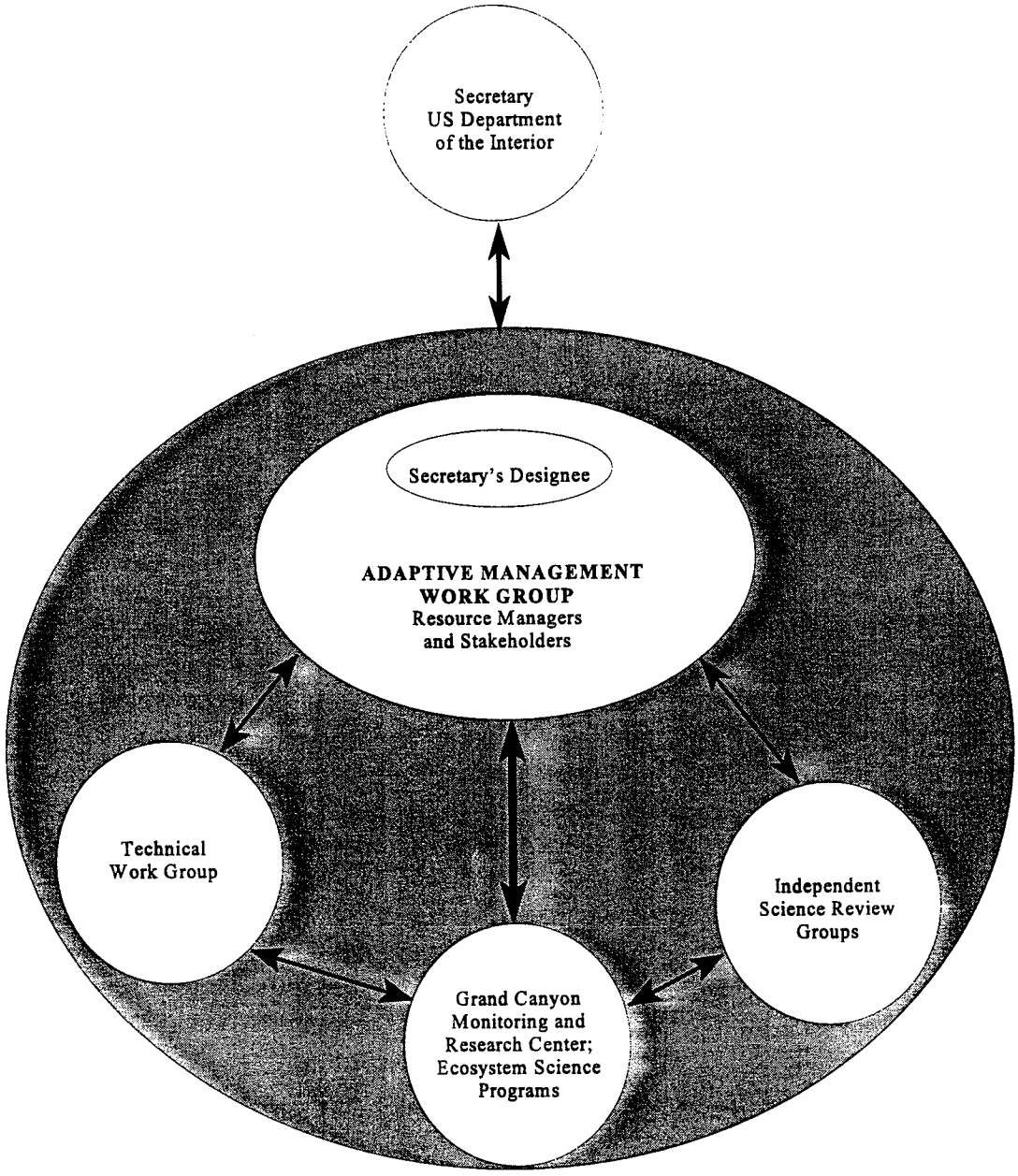

Figure 1. Critical entities of the Adaptive Management Program.

ADAPTIVE MANAGEMENT PROGRAM ACTIVITIES:

FY 1997

In FY 1997, significant progress was made on activities relating to the AMP, including:

1. Establishment of the AMP. The AMP was established by the Secretary through the development and approval of the Charter for the AMWG pursuant to the Federal Advisory Committee Act.
2. Formation of the AMWG and TWG and associated programs. The first meeting of the AMWG was in September and the TWG has been meeting monthly since October
3. Complete formation of the GCMRC, completion of a "Transition Plan" for moving all activities from the GCES program to GCMRC, and development of long-term and annual monitoring and research plans.
4. In addition to ongoing monitoring and research a high flow, within powerplant capacity was conducted in early November to redistribute sediment.

Actions taken for FY 1997 in the first meeting of the AMWG were as follows:

1. Approval of operating procedures for the AMWG.
2. Recommendations to the Secretary to approve the GCMRC FY 1998 research and monitoring plan (referenced in following section).
3. Recommendation to the Secretary for the GCMRC to develop and initiate FY 1998 monitoring and research programs for Lake Powell.
4. Objectives, and information needs for all programs are to be reviewed in FY 1998, for implementation in FY 2000.
5. Recommendations to the Secretary to initiate a $\simeq$ 31,000 cfs test flow in October/November of FY 1998 to conserve sediment resources.
6. Recommendation to the Secretary to evaluate the effects of a $\simeq$ 45,000 cfs beach/habitat-building flow (BHBF) between January to June, 1998 to mitigate the potentially negative effects of sustained high steady releases on the biological, physical and cultural resources and riverine processes.
7. Selection of a TWG to work closely with the GCMRC in developing objectives, information needs and monitoring and research programs.

The TWG, established as a subgroup of the AMWG implemented the following activities in FY 1997.

1. Initiated development of protocols and processes to evaluate and implement

Adaptive Management flow regimes as recommended by the AMWG.

2. Review and evaluation of GCMRC FY 1999 Annual Monitoring and Research Plan.
3. Review and evaluation of GCMRC, FY 1997, State of Natural & Cultural Resources in the Colorado River Ecosystem Report.
4. Review and evaluation of GCMRC information on the effects of a $\simeq$ 45,000 cfs BHBF between January to June, 1998.

FY 1998

AMWG/TWG activities include a broad cross section of programs as follows:

- Continued Development of protocols/procedures for operation of AMWG/TWG.
- Review of AMP budget process and budget allocations for short and long-term programs.
- Review and revision of objectives and information needs for the Colorado River Ecosystem and Lake Powell Monitoring and Research programs.
- Participation in Conceptual Modeling Workshops for the Colorado River Ecosystem and Lake Powell programs.
- Review and recommendation of the following GCMRC documents.
  - FY 1998 Adaptive Management Flow Regime Information.
  - FY 1998 Contingency Monitoring and Research Plans for scheduled and unscheduled high flows.
  - FY 1999 Monitoring and Research Plan.
  - FY 1998 State of Natural and Cultural Resources in the Colorado River Ecosystem Report.
- Development of improved processes for implementing Adaptive Management flows/activities.
- Development of objectives and information needs for long-term planning for Selective Withdrawal (temperature control) programming.
-

The Grand Canyon Monitoring and Research Center (GCMRC)

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

FY 1997 GCMRC Activities

The GCMRC has developed extensive planning and documentation regarding its operation and monitoring and research plans. Operation Protocols, Stakeholder Information Needs, a Long-Term Plan, the FY 1998 Annual Plan, and the State of Natural and Cultural Resources in the Colorado River Ecosystem Reports were developed in FY 1997. In addition, the GCMRC managed 33 separate research projects to completion.

Operations protocols were specified for GCMRC cooperatively with stakeholders and addresses planning, implementation instruments (Interagency and Cooperative Agreements) and program and product reviews.

Stakeholder information needs were developed by all stakeholders in cooperation with the GCMRC. Needs were specified for a five year period.

A 5-Year strategic and FY 1998 annual plan were developed, reviewed by the stakeholders and recommended for approval by the Secretary.

A 1997 State of the Natural and Cultural Resources in the Colorado River Ecosystem Resources report was developed to assist the AMWG in evaluating any new or modified dam operations criteria they might recommend. The resources report will be drafted annually.

A Total of 33 independent monitoring and research projects were managed by the GCMRC. These and other science activities contributed to 42 differing technical reports and publications from the GCMRC in 1997.

A science symposium on the 1996 BHBF was convened by the GCMRC. Three major science proceedings are expected to result from the symposium.

FY 1998 GCMRC Activities

The GCMRC will implement diverse activities in FY 1998 to accommodate long and short-term objectives and information needs of the AMWG/TWG. These activities are:

- Develop Final FY 1999 Annual Monitoring and Research Plan, RFPs, and cooperative agreements for implementation.
- Draft Final FY 1998 State of the Natural and Cultural Resources of the Colorado River Ecosystem Report.
- Draft Summary of Program Accomplishments for FY 1998.
- Evaluate AMWG specified adaptive management flows of 31,000 and 45,000 cfs on Colorado River ecosystem and Lake Powell resources.
- Evaluate long-term sustained flows of 22,000-27,000 cfs, during much of

1997, on Colorado River ecosystem and Lake Powell resources.

- Initiate program to develop conceptual ecosystem models for Colorado River Ecosystem Resources and Lake Powell Resources.
- Review and revise where appropriate all measurement and assessment protocols for GCMRC monitoring and research programs.

Glen Canyon Dam 1998 Annual Plan of Operations
prepared in accordance with the Operating Criteria
developed for the Grand Canyon Protection Act (GCPA)

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 3695 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 probably 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 Glen Canyon Dam Environmental Impact Statement.

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 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 (BHBF) 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 BHBF:

1. if the January forecast for the January-July unregulated spring runoff into Lake Powell exceeds 13 MAF 9about 140 percent of normal), or

2. anytime a Lake Powell inflow forecast would require a powerplant monthly release greater than 1.5 MAF,

then a BHBF could be released from Glen Canyon Dam if then deemed appropriate from an environmental perspective. The AOP prepared under the 1968 Act allows a BHBF to occur in 1998 if hydrologic conditions are appropriate.

Appendix

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 of the Interior 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 5 years in consultation with the appropriate Federal agencies, Governors of the Colorado River Basin States, Indian 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 Operation of Glen Canyon Dam Final Environmental Impact Statement and its Record of Decision. The specific criteria are as follows:

Minimum Releases – 8,000 cfs between 7 a.m. and 7 p.m. 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 floodflow 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 8,000 acre feet.

Maximum Ramp Rates – 4,000 cfs/hour when increasing, and 1,500 cfs/hour 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:

4. Insufficient generating capacity
5. Transmission system: overload, voltage control, and frequency
6. System restoration
7. 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 Adaptive Management Program. 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/hour, and down-ramp rates not to exceed 1,500 cfs/hour) 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 (Feb 24 1997)
Secretary of the Interior Date

Glen Canyon Dam 1997 Annual Plan of Operations
prepared in accordance with the Operating Criteria
developed for the Grand Canyon Protection Act (GCPA)

Under the most probable inflow conditions in water year 1997, Glen Canyon Dam is expected to release about 14.1 million acre-feet through the Grand Canyon to Lake Mead. This is about 5.9 million acre-feet greater than the minimum objective release and is the result of high snowpack conditions throughout the Colorado River basin. Lake Powell is expected to fill in July.

Monthly release volumes from Glen Canyon Dam during 1997 are expected to range from 600,000 acre-feet to 1,500,000 acre-feet. Projected allowable fluctuations therefore will be 6,000 cfs or 8,000 cfs (see criteria). With projected monthly release volumes, it is likely that peak daily releases will exceed 20,000 cfs during the months of February through July, when monthly release volumes are at their highest for the year. Minimum releases of 5,000 cfs/hr decreasing will be followed. All of the above is outlined in the Record of Decision implementing the preferred alternative of the Glen Canyon Dam Environmental Impact Statement.

With projected monthly release volumes, it is likely that peak daily releases will exceed 20,000 cfs during the months of February through July, when monthly release volumes are at their highest for the year. Releases above 25,000 cfs will be made as steady flows. Since there are concerns for possible modifications of the environmental restoration in the Grand Canyon accomplished last year with the beach/habitat building flow, monitoring of the impacts of this spring's releases will be an important objective of the Grand Canyon Monitoring and Research Center and may result in fluctuating flows to aid in this effort.

Every measure will be taken to prevent a powerplant bypass this spring in order to preserve the environmental enhancement accomplished by the beach/habitat building flow test in April 1996. Water year 1997 had a January 1, 1997, Lake Powell storage content greater than 19 million acre-feet; therefore a beach/habit maintenance flow of powerplant capacity is not planned.

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.

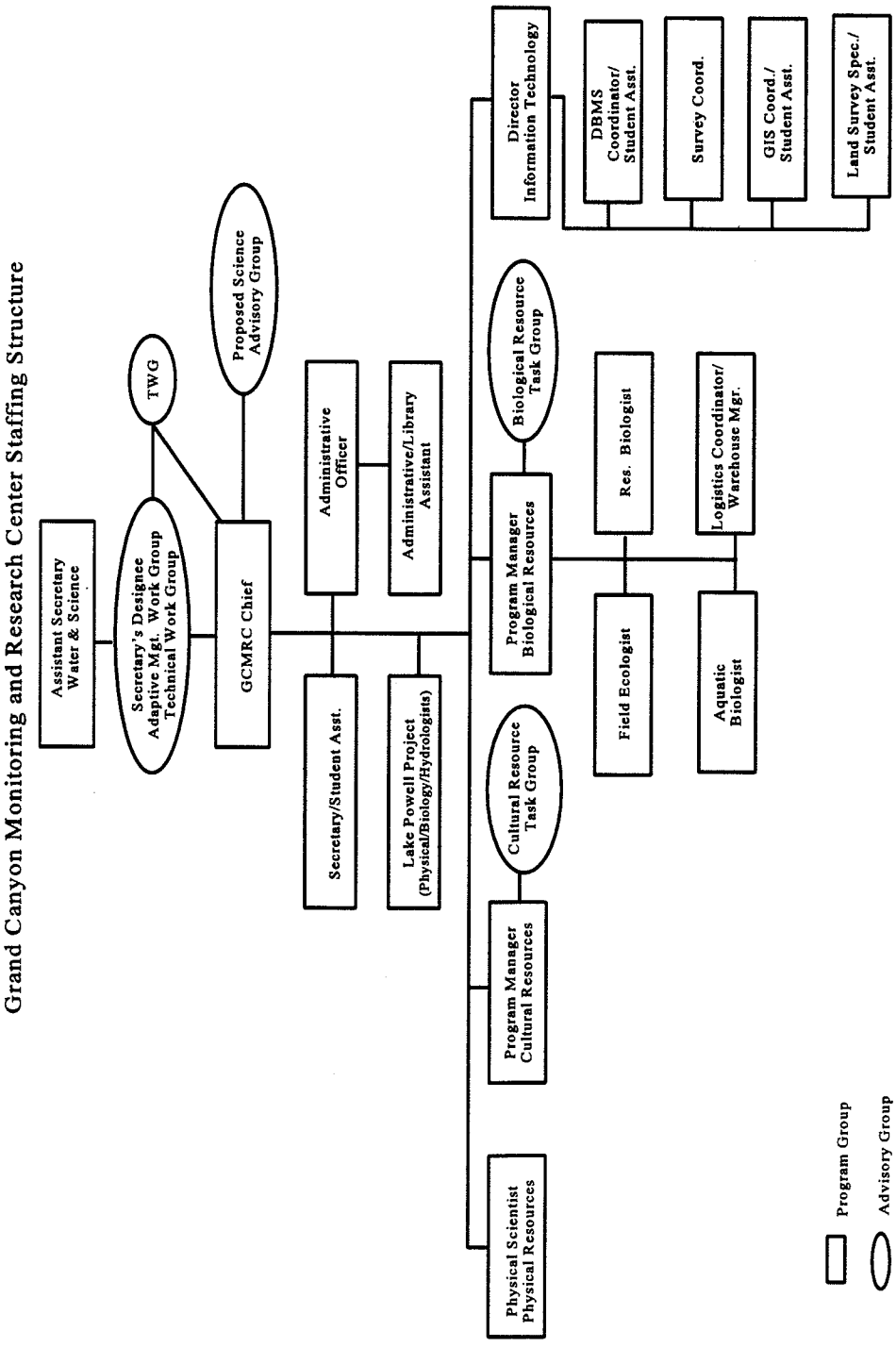

Figure 2. Staffing requirements of the Grand Canyon Monitoring and Research Center.