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ATTACHMENT 1

Environmental Commitments

The following is a list of environmental commitments that would be honored under any of the restricted fluctuating or steady flow alternatives described in this document. These commitments are described in detail in chapter II.

1. *Adaptive Management:* This commitment includes long-term monitoring, research, and experimentation possibly leading to operational changes. However, operational changes would not be implemented without further NEPA compliance.

2. *Monitoring and Protection of Cultural Resources:* Cultural sites in Glen and Grand Canyons include prehistoric and historic sites, and Native American traditional use and sacred sites. Some of these sites may erode in the future under any EIS alternative. Reclamation and NPS, in consultation with Native American groups, would develop and implement a long-term monitoring program for these sites. Any necessary mitigation would be carried out according to a programmatic agreement written in compliance with the National Historic Preservation Act (see attachment 5).

3. *Flood Frequency Reduction Measures*: Under this commitment, the frequency of unanticipated floods in excess of 45,000 cfs would be reduced to an average of once in 100 years. This would 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.

4. *Beach/Habitat-Building Flows:* Under certain conditions, flows in excess of a given alternatives' maximum would be scheduled in April for periods ranging from 1 to 2 weeks. Scheduling, duration, and flow magnitude would be recommended by the Adaptive Management Work Group. The objectives of these flows would be to:

   - Deposit sediment at high elevations
   - Re-form backwater channels
   - Deposit nutrients
   - Provide for system dynamics
   - Help NPS to manage riparian habitats

5. *New Population of Humpback Chub:* In consultation with the FWS, NPS, and AGFD, Reclamation would make every effort—through funding, facilitating, and technical support—to ensure that a new population of humpback chub is established in the mainstem or one or more of the tributaries within Grand Canyon.

6. *Further Study of Selective Withdrawal:* Reclamation would aggressively pursue and support research on the effects of multilevel intake structures at Glen Canyon Dam and use the results of this research to make a firm decision on construction. FWS, in consultation with AGFD, would be responsible for recommending to Reclamation whether or not selective withdrawal should be implemented at Glen Canyon Dam. Reclamation would be responsible for design, NEPA compliance, permits, construction, operation, and maintenance.

7. *Emergency Exception Criteria:* Operating criteria would be established to allow Western to respond to various emergency situations in accordance with their obligations to the North American Electric Reliability Council. This commitment also provides for exceptions to a given alternative's operating criteria during search and rescue situations, special studies and monitoring, dam and powerplant maintenance, and spinning reserves.

ATTACHMENT 2

Grand Canyon Protection Act

SEC. 1801. SHORT TITLE.

This Act may be cited as the "Grand Canyon Protection Act of 1992".

SEC. 1802. PROTECTION OF GRAND CANYON NATIONAL PARK

(a) IN GENERAL.—The Secretary shall 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.

(b) COMPLIANCE WITH EXISTING LAW.—The Secretary shall implement this section in a manner fully consistent with and subject to the Colorado River Compact, the Upper Colorado River Basin Compact, the Water Treaty of 1944 with Mexico, the decree of the Supreme Court in Arizona vs. California, and the provisions of the Colorado River Storage Project Act of 1956 and the Colorado River Basin Project Act of 1968 that govern allocation, appropriation, development, and exportation of the waters of the Colorado River Basin.

(c) RULE OF CONSTRUCTION.—Nothing in this title alters the purposes for which the Grand Canyon National Park or the Glen Canyon National Recreation Area were established or affects the authority and responsibility of the Secretary with respect to the management and administration of the Grand Canyon National Park and Glen Canyon National Recreation Area, including natural and cultural resources and visitor use, under laws applicable to those areas, including, but not limited to, the Act of August 25, 1916 (39 Stat. 535) as amended and supplemented.

SEC. 1803. INTERIM PROTECTION OF GRAND CANYON NATIONAL PARK

(a) INTERIM OPERATIONS.—Pending compliance by the Secretary with section 1804, the Secretary shall, on an interim basis, continue to operate Glen Canyon Dam under the Secretary's announced interim operating criteria and the Interagency Agreement between the Bureau of Reclamation and the Western Area Power Administration executed October 2, 1991 and exercise other authorities under existing law, in accordance with the standards set forth in section 1802, utilizing the best and most recent scientific data available.

(b) CONSULTATION.—The Secretary shall continue to implement Interim Operations in consultation with—

(1) Appropriate agencies of the Department of the Interior, including the Bureau of Reclamation, United States Fish and Wildlife Service, and the National Park Service;

(2) The Secretary of Energy;

(3) The Governors of the States of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming;

(4) Indian Tribes; and

(5) The general public, including representatives of the academic and scientific communities, environmental organizations, the recreation industry, and contractors for the purchase of Federal power produced at Glen Canyon Dam.

(c) DEVIATION FROM INTERIM OPERATIONS.—The Secretary may deviate from Interim Operations upon a finding that deviation is necessary and in the public interest to—

(1) comply with the requirements of Section 1804(a);

(2) respond to hydrologic extremes or power system operation emergencies;

(3) comply with the standards set forth in Section 1802;
(4) respond to advances in scientific data; or
(5) comply with the terms of the Interagency Agreement.

(d) TERMINATION OF INTERIM OPERATIONS.—Interim operations described in this section shall terminate upon compliance by the Secretary with section 1804.

SEC. 1804. GLEN CANYON DAM ENVIRONMENTAL IMPACT STATEMENT; LONG-TERM OPERATION OF GLEN CANYON DAM.

(a) FINAL ENVIRONMENTAL IMPACT STATEMENT.—Not later than 2 years after the date of enactment of this Act, the Secretary shall complete a final Glen Canyon Dam environmental impact statement, in accordance with the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.).

(b) AUDIT.—The Comptroller General shall—
(1) audit the cost and benefits to water and power users and to natural, recreational, and cultural resources resulting from management policies and dam operations identified pursuant to the environmental impact statement described in subsection (a); and
(2) report the results of the audit to the Secretary and the Congress.

(c) ADOPTION OF CRITERIA AND PLANS.—(1) Based on the findings, conclusions, and recommendations made in the environmental impact statement prepared pursuant to subsection (a) and the audit performed pursuant to subsection (b), the Secretary shall—
(A) adopt criteria and operating plans separate from and in addition to those specified in section 602(b) of the Colorado River Basin Project Act of 1968; and
(B) exercise other authorities under existing law, so as to ensure that Glen Canyon Dam is operated in a manner consistent with section 1802.

(2) 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.

(3) In preparing the criteria and operating plans described in section 602(b) of the Colorado River Basin Project Act of 1968 and in this subsection, the Secretary shall consult with the Governors of the Colorado River Basin States and with the general public, including—
(A) representatives of academic and scientific communities;
(B) environmental organizations;
(C) the recreation industry; and
(D) contractors for the purpose of Federal power produced at Glen Canyon Dam.

(d) REPORT TO CONGRESS.—Upon implementation of long-term operations under subsection (c), the Secretary shall submit to the Congress the environmental impact statement described in subsection (a) and a report describing the long-term operations and other reasonable mitigation measures taken to protect, mitigate adverse impacts to, and improve the condition of the natural, recreational, and cultural resources of the Colorado River downstream of Glen Canyon Dam.

(e) ALLOCATION OF COSTS.—The Secretary of the Interior, in consultation with the Secretary of Energy, is directed to reallocate the costs of construction, operation, maintenance, replacement and emergency expenditures for Glen Canyon Dam among the purposes directed in section 1802 of this Act and the purposes established in the Colorado River Storage Project Act of April 11, 1956 (70 Stat. 170). Costs allocated to section 1802 purposes shall be nonreimbursable. Except that in fiscal year 1993 through 1997 such costs shall be nonreimbursable only to the extent to which the Secretary

finds the effect of all provisions of this Act is to increase net offsetting receipts; Provided, That if the Secretary finds in any such year that the enactment of this Act does cause a reduction in net offsetting receipts generated by all provisions of this Act, the costs allocated to section 1802 purposes shall remain reimbursable. The Secretary shall determine the effect of all the provisions of this Act and submit a report to the appropriate House and Senate committees by January 31 of each fiscal year, and such report shall contain for that fiscal year a detailed accounting of expenditures incurred pursuant to this Act, offsetting receipts generated by this Act, and any increase or reduction in net offsetting receipts generated by this Act.

SEC. 1805. LONG-TERM MONITORING.

(a) IN GENERAL.—The Secretary shall 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.

(b) RESEARCH.—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 Recreation Area.

(c) CONSULTATION.—The monitoring programs and activities conducted under subsection (a) shall be established and implemented in consultation with—

(1) the Secretary of Energy;

(2) the Governors of the States of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming;

(3) Indian tribes; and

(4) the general public, including representatives of academic and scientific communities, environmental organizations, the recreation industry, and contractors for the purchase of Federal power produced at Glen Canyon Dam.

SEC. 1806. RULES OF CONSTRUCTION.

Nothing in this title is intended to affect in any way—

(1) the allocations of water secured to the Colorado Basin States by any compact, law, or decree; or

(2) any Federal environmental law, including the Endangered Species Act (16 U.S.C. 1531 et seq.).

SEC. 1807. STUDIES NONREIMBURSABLE.

All costs of preparing the environmental impact statement described in section 1804, including supporting studies, and the long-term monitoring programs and activities described in section 1805 shall be nonreimbursable. The Secretary is authorized to use funds received from the sale of electric power and energy from the Colorado River Storage Project to prepare the environmental impact statement described in section 1804, including supporting studies, and the long-term monitoring programs and activities described in section 1805, except that such funds will be treated as having been repaid and returned to the general fund of the Treasury as costs assigned to power for repayment under section 5 of the Act of April 11, 1956 (70 Stat. 170). Except that in fiscal year 1993 through 1997 such provisions shall take effect only to the extent to which the Secretary finds the effect of all the provisions of this Act is to increase net offsetting receipts; Provided, That if the Secretary finds in any such year that the enactment of this Act does cause a reduction in net offsetting receipts generated by all provisions of this Act, all costs described in this section shall remain reimbursable. The Secretary shall determine the effect of all the provisions of this Act and submit a report to the appropriate House and Senate committees by January 31 of each fiscal year, and such report shall

contain for that fiscal year a detailed accounting of expenditures incurred pursuant to this Act, offsetting receipts generated by this Act, and any increase or reduction in net offsetting receipts generated by this Act.

SEC. 1808. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated such sums as are necessary to carry out this title.

SEC. 1809. REPLACEMENT POWER.

The Secretary of Energy in consultation with the Secretary of the Interior and with representatives of the Colorado River Storage Project power customers, environmental organizations and the States of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming shall identify economically and technically feasible methods of replacing any power generation that is lost through adoption of long-term operational criteria for Glen Canyon Dam as required by section 1804 of this title. The Secretary shall present a report of the findings, and implementing draft legislation, if necessary, not later than two years after adoption of long-term operating criteria. The Secretary shall include an investigation of the feasibility of adjusting operations at Hoover Dam to replace all or part of such lost generation. The Secretary shall include an investigation of the modifications or additions to the transmission system that may be required to acquire and deliver replacement power.

ATTACHMENT 3

Long-Range Operating Criteria

CRITERIA FOR COORDINATED LONG-RANGE OPERATION OF COLORADO RIVER RESERVOIRS PURSUANT TO THE COLORADO RIVER BASIN PROJECT ACT OF SEPTEMBER 30, 1968 (P.L. 90-537)

These Operating Criteria are promulgated in compliance with Section 602 of Public Law 90-537. They are to control the coordinated long-range operation of the storage reservoirs in the Colorado River Basin constructed under the authority of the Colorado River Storage Project Act (hereinafter "Upper Basin Storage Reservoirs") and the Boulder Canyon Project Act (Lake Mead). The Operating Criteria will be administered consistent with applicable Federal laws, the Mexican Water Treaty, interstate compacts, and decrees relating to the use of the waters of the Colorado River.

The Secretary of the Interior (hereinafter the "Secretary") may modify the Operating Criteria from time to time in accordance with Section 602(b) of P. L. 90-537. The Secretary will sponsor a formal review of the Operating Criteria at least every 5 years, with participation by State representatives as each Governor may designate and such other parties and agencies as the Secretary may deem appropriate.

I. ANNUAL REPORT

(1) On January 1, 1972, and on January 1 of each year thereafter, the Secretary shall transmit to the Congress and to the Governors of the Colorado River Basin States a report describing the actual operation under the adopted criteria for the preceding compact water year and the projected plan of operation for the current year.

(2) The plan of operation shall include such detailed rules and quantities as may be necessary and consistent with the criteria contained herein, and shall reflect appropriate consideration of the uses of the reservoirs for all purposes, including flood control, river regulation, beneficial consumptive uses, power production, water quality control, recreation, enhancement of fish and wildlife, and other environmental factors. The projected plan of operation may be revised to reflect the current hydrologic conditions, and the Congress and the Governors of the Colorado River Basin States shall be advised of any changes by June of each year.

II. OPERATION OF UPPER BASIN RESERVOIRS

(1) The annual plan of operation shall include a determination by the Secretary of the quantity of water considered necessary as of September 30 of each year to be in storage as required by Section 602(a) of P.L. 90-537 (hereinafter "602(a) Storage"). The quantity of 602(a) Storage shall be determined by the Secretary after consideration of all applicable laws and relevant factors, including, but not limited to, the following:

(a) Historic streamflows;
(b) The most critical period of record;
(c) Probabilities of water supply;
(d) Estimated future depletions in the upper basin, including the effects of recurrence of critical periods of water supply;
(e) The "Report of the Committee on Probabilities and Test Studies to the Task Force on Operating Criteria for the Colorado River," dated October 30, 1969, and such additional studies as the Secretary deems necessary;
(f) The necessity to assure that upper basin consumptive uses not be impaired because of failure to store sufficient water to assure deliveries under Section 602(a)(1) and (2) of P.L. 90-537.

(2) If in the plan of operation, either:

(a) the Upper Basin Storage Reservoirs active storage forecast for September 30 of the current year is less than the quantity of 602(a) Storage determined by the Secretary under Article II(1) hereof, for that date; or
(b) the Lake Powell active storage forecast for that date is less than the Lake Mead active storage forecast for that date:

the objective shall be to maintain a minimum release of water from Lake Powell of 8.23 million acre-feet for that year. However, for the years ending September 30, 1971 and 1972, the release may be greater than 8.23 million acre-feet if necessary to deliver 75,000,000 acre-feet at Lee Ferry for the 10-year period ending September 30, 1972.

(3) If, in the plan of operation, the Upper Basin Storage Reservoirs active storage forecast for September 30 of the current water year is greater than the quantity of 602(a) Storage determination for that date, water shall be released annually from Lake Powell at a rate greater than 8.23 million acre-feet per year to the extent necessary to accomplish any or all of the following objectives:

(a) to the extent it can be reasonably applied in the States of the Lower Division to the uses specified in Article III(e) of the Colorado River Compact, but no such releases shall be made when the active storage in Lake Powell is less than the active storage in Lake Mead,
(b) to maintain, as nearly as practicable, active storage in Lake Mead equal to the active storage in Lake Powell, and
(c) to avoid anticipated spills from Lake Powell.

(4) In the application of Article II(3)(b) herein, the annual release will be made to the extent that it can be passed through Glen Canyon Powerplant when operated at the available capability of the powerplant. Any water thus retained in Lake Powell to avoid bypass of water at the Glen Canyon Powerplant will be released through the Glen Canyon Powerplant as soon as practicable to equalize the active storage in Lake Powell and Lake Mead.

(5) Releases from Lake Powell pursuant to these criteria shall not prejudice the position of either the upper or lower basin interests with respect to required deliveries at Lee Ferry pursuant to the Colorado River Compact.

III. OPERATION OF LAKE MEAD

(1) Water released from Lake Powell, plus the tributary inflows between Lake Powell and Lake Mead, shall be regulated in Lake Mead and either pumped from Lake Mead or released to the Colorado River to meet requirements as follows:

(a) Mexican Treaty obligations;
(b) Reasonable consumptive use requirements of mainstream users in the Lower Basin;
(c) Net river losses;
(d) Net reservoir losses;
(e) Regulatory wastes.

(2) Until such time as mainstream water is delivered by means of the Central Arizona Project, the consumptive use requirements of Article III(1)(b) of these Operating Criteria will be met.

(3) After commencement of delivery of mainstream water by means of the Central Arizona Project, the consumptive use requirements of Article III(1)(b) of these Operating Criteria will be met to the following extent:

(a) *Normal*: The annual pumping and release from Lake Mead will be sufficient to satisfy 7,500,000 acre-feet of annual consumptive use in accordance with the decree in *Arizona v. California*, 376 U.S. 340 (1964).
(b) *Surplus*: The Secretary shall determine from time to time when water in quantities greater than "Normal" is available for either pumping or release from Lake Mead pursuant to Article II(b)(2) of the decree in *Arizona v. California* after consideration of all relevant factors, including, but not limited to, the following:

(i) the requirements stated in Article III(1) of these Operating Criteria;
(ii) requests for water by holders of water delivery contracts with the United States, and of other rights recognized in the decree in *Arizona v. California;*
(iii) actual and forecast quantities of active storage in Lake Mead and the Upper Basin Storage Reservoirs; and
(iv) estimated net inflow to Lake Mead.

(c) *Storage*: The Secretary shall determine from time to time when insufficient mainstream water is available to satisfy annual consumptive use requirements of 7,500,000 acre-feet after consideration of all relevant factors, including, but not limited to, the following:

(i) the requirements stated in Article III(1) of these Operating Criteria;
(ii) actual and forecast quantities of active storage in Lake Mead;
(iii) estimate of net inflow to Lake Mead for the current year;
(iv) historic streamflows, including the most critical period of record;
(v) priorities set forth in Article II(A) of the decree in *Arizona v. California;* and
(vi) the purposes stated in Article I(2) of these Operating Criteria.

The storage provisions of Article II(B)(3) of the decree in *Arizona v. California* shall thereupon become effective and consumptive uses from the mainstream shall be restricted to the extent determined by the Secretary to be required by Section 301(b) of Public Law 90-537.

IV. DEFINITIONS

(1) In addition to the definitions in Section 606 of P. L. 90-537, the following shall also apply:

(a) "Spills," as used in Article II(3)(c) herein, means water released form Lake Powell which cannot be utilized for project purposes, including, but not limited to, the generation of power and energy.
(b) "Surplus," as used in Article III(3)(b) herein, is water which can be used to meet consumptive use demands in the three Lower Division States in excess of 7,500,000 acre-feet annually. The term"surplus" as used in these Operating Criteria is not to be construed as applied to, being interpretive of, or in any manner having reference to the term "surplus" in the Colorado River Compact.
(c) "Net inflow to Lake Mead," as used in Article III(3) (b)(iv) and (c)(iii) herein, represents the annual inflow to Lake Mead in excess of losses from Lake Mead.
(d) "Available capability," as used in Article II(4) herein, means that portion of the total capacity of the powerplant that is physically available for generation.

ATTACHMENT 4

Fish and Wildlife Consultation

RECOMMENDATIONS AND RESPONSES

In accordance with the Fish and Wildlife Coordination Act (FWCA), the U.S. Fish and Wildlife Service (FWS) submitted recommendations to the Bureau of Reclamation (Reclamation) in connection with Glen Canyon Dam operations. These recommendations were included in FWS's FWCA report dated June 28, 1994. Copies of this report can be obtained by writing to the Field Supervisor, U.S. Fish and Wildlife Service, Arizona Ecological Services State Office, 3616 West Royal Palm Road, Suite 103, Phoenix, Arizona 85021-4951.

The FWCA does not require Reclamation to accept the recommendations; however, reasonable and practicable recommendations will be implemented. The recommendations and Reclamation's responses to them are listed below.

Recommendation 1. The historical operations of Glen Canyon Dam have eliminated the features of a natural hydrograph from river operations. To provide conditions more suitable for endangered and other native fish species, a hydrological pattern comparable to the pre-dam hydrologic pattern should be evaluated.

a. Flows should be as described in the October 1993 Draft Biological Opinion. The preferred alternative would be used as a platform from which to conduct studies of an experimental flow regime that more closely resembles the pattern of the pre-dam hydrograph. Experimental flows should occur from April through October and include high steady flows in the spring and low steady flows in the summer and fall carried out during low water years. High flows should occur during the spring run-off, peaking sometime between April and June. Low flows should follow and continue through October. Flows should include beach/habitat building and habitat maintenance flows to be released during the spring in low water years. Experimental flows should be conducted for sufficient period of time to allow biological processes to function and for variability inherent in riverine ecosystems to be expressed.

Response

This recommendation would be evaluated under the Adaptive Management Program, as described in chapter II.

Recommendation 2. In order to maintain the integrity of the Grand Canyon ecosystem, the sediment resource should be maintained or enhanced. Associated resources that provide habitat such as backwaters, substrate, and vegetation depend upon the availability and placement of sediment.

a. During steady flow periods, daily flows should be steady with the exception of system regulation and adjustment that would allow fluctuations limited to 2,000 cubic feet per second (cfs) per day. Ramp rates for greater flow adjustments should be limited to 2,000 cfs per hour. These restrictions would minimize the rate of sediment erosion.

b. Annual controlled high flows within powerplant capacity and periodic (approximately once in ten years) controlled high flows that exceed powerplant capacity should be conducted to reform the channel and translocate sediment and nutrients. These high flows should coincide with the pre-dam, spring run-off peak. Implementation of these flows should take into consideration sediment storage

and availability, channel configuration, and vulnerable species' life cycles. The frequency and magnitude of these flows should be determined after an assessment is made of resource response to trial flows.

c. Juvenile native fish may be susceptible to displacement by high volume flows. Therefore, these fish need to be considered when determining the magnitude and timing of controlled floods.

Response

All of the steady flow alternatives and the Moderate, Modified Low, and Interim Low Fluctuating Flow Alternatives would be expected to maintain a long-term sediment balance.

a. Steady flows are not necessary to maintain the integrity of the postdam ecosystem in Grand Canyon. The postdam ecosystem has developed under a regime of strong daily flow fluctuations. Data collected during the Glen Canyon Environmental Studies indicated that moderation of the strong daily fluctuations is necessary to maintain and provide some enhancement for this dynamic system. Experience with interim flow criteria since August, 1991, has confirmed this analysis. The steady flow alternatives all have ramp rates of 2,000 cfs per day for adjustments between months.

b. Reclamation agrees. The habitat maintenance flows, which are a part of the Moderate and Modified Low Fluctuating and Seasonally Adjusted Steady Flow Alternatives, and beach/habitat-building flows, which are a part of all of the restricted fluctuating and steady flow alternatives, accomplish this.

c. Reclamation agrees. The EIS addresses this potential problem.

Recommendation 3. Construction of Glen Canyon Dam has greatly modified the aquatic environment and resulted in degraded conditions for native species. Every attempt should be made to ensure native fish life stage requirements are met. These requirements include a reliable food resource and availability of and access to suitable spawning and rearing habitat.

a. Extended periods of flows less than 5,000 cfs should be avoided, and releases below 8,000 cfs for fluctuating flows should be minimized to protect aquatic food resources. Studies indicate that extended periods of exposure to desiccation or freezing limit occupation of the wetted perimeter of the channel by Cladophora and its associated invertebrate community (Angradi et al. 1992, Blinn et al. 1992, AGFD 1993). Cladophora production should continue to be monitored.

b. Flows should be steady on a seasonal basis, particularly during the summer months (some variations may exist from tributary input or forecast changes), to provide warmer, stable backwaters and other low velocity sites suitable as native fish rearing habitat.

c. Information on the life stage requirements, distribution, and abundance of non-native warm water fishes should be collated and analyzed. Native and non-native fish interactions and responses to changes in dam operations should be evaluated in both the lab and the field. If operations are found to be detrimental or offer no improvement in conditions for native fishes, operations should be reevaluated and modified if necessary.

d. Baseline information on possible tributary use or suitability for use by spawning humpback chub is being collected. Using that information, information from other Grand Canyon endangered fish research, and information from the Gila taxonomy study (Reclamation contract 1-CS-40-0970), Reclamation, in consultation with the Service, National Park Service, AGFD, and land management

agencies such as the Havasupai Tribe, should make every reasonable effort through funding, facilitating, and provide technical assistance to establish a program for additional spawning aggregations (or populations depending on genetic status) in the mainstem or tributaries.

Response

a. The criteria for the Existing Monthly Volume, Seasonally Adjusted, and Year-Round Steady Flow Alternatives provide minimum flows of 8,000 cfs 24 hours a day. The Modified Low and Interim Low Fluctuating Flow Alternatives provide minimum flows of 8,000 cfs for at least 12 hours each day and an absolute minimum flow of 5,000 cfs (table II-2). Monitoring of *Cladophora* production would continue as part of the Adaptive Management Program.

b. Most backwaters currently exist at flows less than 11,000 cfs (Weiss, 1992). Therefore, while steady flows during the summer months may provide warmer, stable backwaters, such flows also would need to be high enough to make sufficient numbers of backwaters available to benefit young native fish. None of the steady flow alternatives would provide flows of less than 11,000 cfs in May, June, or July. In August and September, the Seasonally Adjusted Steady Flow Alternative would provide 9,000-cfs flows, but this may be too late for young native fish that exit the tributaries in May through July.

Selective withdrawal structures have much greater potential to provide suitable rearing and spawning habitat for native fish in the Colorado River mainstem than any possible incremental benefit of seasonally adjusted steady flows over modified low fluctuating flows (the preferred alternative).

c. Review and analysis of these data would be a part of the studies on selective withdrawal and also would be part of the Adaptive Management Program.

d. Establishing additional spawning populations (or aggregations depending on genetic status) in the mainstem or tributaries of the Colorado River in Grand Canyon is one of the elements common to all restricted fluctuating flow and steady flow alternatives in the EIS.

Recommendation 4. Trout health problems in the Lees Ferry reach are significant. Infestation by nematode parasites (Bulbodacnitis ampullastoma), possibly transmitted by a copepod or amphipod intermediate host, continues to be the prime factor.

a. The life cycle of this parasite should be verified.

b. Environmental stressors such as flow regime, food reduction, water temperature, angling pressure, and stocking rate that may exacerbate parasitic infestations should be quantified.

Response

Through consultation with the Adaptive Management Work Group, these recommendations would be considered during implementation of long-term monitoring and research under the Adaptive Management Program.

Recommendation 5. A high incidence of the Asian tapeworm (Bothriocephalus acheilognathi) occurred in humpback chub in 1990 to 1992 and in speckled dace in 1991 and 1992 (AGFD 1993). This parasite was not detected before 1990 (Angradi et al. 1992, AGFD 1993). The intermediate hosts for this parasite are cyclopoid copepods.

a. Effects of this exotic parasite on humpback chub and other native fishes should be assessed.

b. Effects related to flow regime, food availability, water temperature, and density-dependent factors should be quantified.

Response

The effects of dam operations on the endangered humpback chub are more fully addressed in the Reasonable and Prudent Alternative contained in FWS's Biological Opinion on the operation of Glen Canyon Dam and will be addressed through the Endangered Species Act consultation process. Specific research would be determined through the long-term monitoring and research process under the Adaptive Management Program.

Recommendation 6. Special status species and their habitats should continue to be monitored, taking measures to protect species and promote their recovery as information is developed.

a. The minimum patch-size and vegetation-structure requirements of nesting Southwestern willow flycatchers should be determined. The rates of cowbird parasitism on Southwestern willow flycatchers as a function of patch-size should also be determined. Population numbers and associated habitats should continue to be monitored.

b. Wintering and migrating bald eagle habitat utilization and foraging patterns should continue to be monitored.

c. The northern leopard frog should be considered during the experimental high flows or floods which have the potential to negatively impact the frogs and/or their habitat.

Response

Through consultation with the Adaptive Management Work Group, these recommendations would be considered during implementation of long-term monitoring and research under the Adaptive Management Program.

Recommendation 7. Neotropical and other avifauna that may be potentially affected by operations of Glen Canyon Dam should continue to be monitored in association with shoreline emergent marsh and other riparian vegetation they utilize.

Response

Through consultation with the Adaptive Management Work Group, these recommendations would be considered during implementation of long-term monitoring and research under the Adaptive Management Program.

Recommendation 8. Reclamation should continue to evaluate alternatives characteristic of the BIO/WEST proposal which include high spring flows, stable summer flows, temperature modification, and sediment augmentation.

Response

The Adaptive Management Program would be used to evaluate the preferred alternative as it is implemented, and any changes in the criteria deemed necessary would be carried out in accordance with that program.

Recommendation 9. The Service recommends that Reclamation pursue a risk assessment and other necessary studies to determine the feasibility of a MLIS. We believe Reclamation should seek authorization to complete a feasibility study. The completion of these studies would be necessary in order for the Service and AGFD to make a recommendation for Reclamation to pursue congressional authorization. We offer the following guidelines for inclusion in the risk assessment and feasibility studies.

a. Review historic information and employ existing modeling with possible updates using alternative reservoir and operating conditions to prepare a set of possible scenarios of temperature change of the mainstem.

b. Determine from the literature, experimentation, and or consultation with the scientific community the effects on native fish populations which may result from implementation of temperature changes from selective withdrawal structure. Determine the range of temperatures for successful larval fish development and recruitment and the relationship between larval, young-of-year and juvenile growth and temperature.

c. Assess the temperature induced interactions between native and non-native fish competitors and predators.

d. Assess the effects of elevated temperature on water quality, Cladophora and associated diatoms, Gammarus, aquatic insects, and fish parasites and diseases.

e. Investigate the effects of withdrawing water on the head budget of Lake Powell, the effects of potentially warmer inflow into Lake Mead, and the concomitant effects on the biota within both reservoirs.

f. Investigate the effects of reservoir withdrawal level on fine particulate organic matter to understand the relationship between withdrawal level and reservoir and downstream resources, including aquatic invertebrates and fish species.

Response

Further study of selective withdrawal is an element common to all restricted fluctuating and steady flow alternatives. The guidelines offered would be used in formulating a plan of study.

REASONABLE AND PRUDENT ALTERNATIVE

Regulations implementing section 7 define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that (1) can be implemented in a manner consistent with the intended purpose of the action, (2) can be implemented consistent with the scope of the Federal agency's legal authority and jurisdiction, (3) are economically and technologically feasible, and (4) would, the Service believes, avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

The Service believes that elements of the reasonable and prudent alternative developed for this consultation meet the above four tests due to the following:

(1) There is an unique opportunity to conserve and protect endangered and other native fish fauna in an ecosystem designated as National Park Service lands for the preservation of these and other natural resource protection values from Glen Canyon Dam to Lake Mead. The Grand Canyon Protection Act of 1992 requires the Secretary of the Interior to "... protect, mitigate adverse impacts to, and improve values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established ..."

(2) Providing water storage and annual water releases of at least 8.23 maf to the lower basin States is a primary function of Glen Canyon Dam. The reasonable and prudent alternative will not conflict with this annual delivery of water. All flows requested in the reasonable and prudent alternative that are not part of the proposed action are within powerplant capacity. Lower basin deliveries of water are met from releases from Hoover Dam and, to a lesser extent, from Lake Mead and do not depend on daily or monthly releases from Glen Canyon Dam. Elements previously defined as conservation measures by Reclamation and the Service are presently being conducted within Reclamation's authority. A structure similar to the selective withdrawal structure identified here has been built and is being operated by Reclamation on Flaming Gorge Dam on the Green River.

(3) Elements of the reasonable and prudent alternative that address operations have been reviewed and included in the draft EIS as viable alternatives. Additional NEPA compliance would be necessary for a selective withdrawal structural element.

(4) The Service believes, that to prevent jeopardy to the endangered fish of Grand Canyon, restoration of the aquatic ecosystem by reducing, to the extent possible, known limiting factors and conducting appropriate research to identify and reduce suspected limiting factors will be necessary and can be accomplished with cooperation, innovative approaches, and elements of the following reasonable and prudent alternative.

ELEMENTS OF THE REASONABLE AND PRUDENT ALTERNATIVE

The following reasonable and prudent alternative contains elements that will focus on the community of endangered and native fish present in the Grand Canyon. The Service believes that actions for one native species should be supportive of other native species in the ecosystem. As the trend of more species becoming endangered or threatened continues in the Colorado River, the difficulties of recovering an ecosystem that is losing functional parts may become insurmountable. Therefore, the health of the entire native fish community will be crucial to the removal of jeopardy for the humpback chub and razorback sucker. We realize that not all of the elements can be implemented at once, and an implementation schedule has been noted for some elements. Those elements that can be accomplished without further verification or NEPA compliance should be implemented without delay. For some elements, such as the selective withdrawal structure, a schedule will be determined. Reclamation and the Service will meet at least annually to coordinate reasonable and prudent alternative activities. Such meetings will provide the Service an opportunity to determine whether sufficient progress is being made in accomplishing those actions set forth to remove jeopardy to federally-listed species impacted by operation of Glen Canyon Glen Canyon Dam.

Refinement of specific flows is dependent on continued studies, including a period of experimental flows, that identify mainstem habitats affected by flows and responses by endangered fishes to those habitats. Successful completion of the reasonable and prudent alternative is necessary to remove jeopardy to the humpback chub and razorback sucker from the proposed action. The reasonable and prudent alternative will be accomplished when all elements of the selected alternative have been effected and studies confirm compatibility between these species requirements and the operation of Glen Canyon Dam.

The draft EIS has seven elements common to all but the unrestricted fluctuating flow alternatives. Six of those EIS common elements that would influence native and endangered fish are adaptive management, flood frequency reduction measures, habitat and beach building flows, establishing a new population of humpback chub, further study of selective withdrawal, and emergency operations exception criteria. Three of the EIS common elements that were identified by Reclamation and the Service as conservation measures (see BACKGROUND) are research or long-term monitoring (adaptive management), flood frequency reduction, and the second spawning population of humpback chub. Development of a management plan for the LCR was another conservation measure being conducted by Reclamation through GCES.

Because of the importance of the EIS common elements and conservation measures to the continued existence of the humpback chub, razorback sucker, and other Colorado River native fish, many of the elements and measures are included below as elements of the reasonable and

prudent alternative to assist in identification of actions necessary to be included in any future modification of the preferred alternative.

1. Attainment of riverine conditions that support all life stages of endangered and native fish species is essential to the Colorado River ecosystem. Therefore, Reclamation shall develop an adaptive management program that will include implementation of studies required to determine impact of flows on listed and native fish fauna, recommend actions to further their conservation, and implement those recommendations as necessary to increase the likelihood of both survival and recovery of the listed species.

The Adaptive Management Program, an EIS common element, was still being formulated as we prepared this biological opinion. The Service supports adaptive management as an iterative approach to resource management. We recognize that the aquatic and terrestrial ecosystems below Glen Canyon Dam are still adjusting to impacts from dam operations that will continue into the future. Thus, the need for adaptive management. Actions taken through this approach must be based on integrated resource approach, and, as discussed by Hilborn (1992), an active rather than a passive learning system that includes deliberate experimental design.

A. A program of experimental flows will be carried out to include high steady flows in the spring and low steady flows in summer and fall during low water years (releases of approximately 8.23 maf) to verify an effective flow regime and to quantify, to the extent possible, effects on endangered and native fish. Studies of high steady flows in the spring may include studies of habitat building and habitat maintenance flows. Research design and hypotheses to be tested will be based on a flow pattern that resembles the natural hydrograph, as described for those seasons in the SASF.

Information from final GCES endangered fish reports, researchers who conducted those studies, and other knowledgeable individuals will be used to assist in determining an experimental flow regime of high spring flow and low summer and fall flow for endangered fishes and to develop hypotheses and studies to accompany those flows with final review and approval by the Service. Reclamation will provide technical assistance and funding.

Design of the experimental flows and associated studies will begin as soon as possible and be targeted for completion by October 1996. Unless the Service determines information provided seriously

questions the validity of experimental designs developed or contribution of the resulting data to remove jeopardy to the federally-listed aquatic fauna of the Grand Canyon, experimental flows will be initiated in April 1997. If sufficient progress and good faith effort is occurring towards initiating experimental flows, implementation of experimental flows may occur later in 1997. If the Service believes there is not sufficient progress, Glen Canyon Dam would be operated as SASF flows during spring through fall (April to October) beginning in 1998. If the Service determines a study design can not be developed that is expected to provided information to support removal of jeopardy to the razorback sucker and humpback chub populations in the Grand Canyon and associated tributaries, such will be considered new information and may be grounds for reinitating formal consultation.

This element is based on low release years (8.23 maf) occurring approximately 50% of the time. Further improvement of the means for determining a low water year that would initiate the implementation of research flows in a given year will be developed by Reclamation with concurrence by the Service. This may include, for example, methods based on content of water in Lake Powell at a given date. When implemented, experimental flows will be conducted for a sufficient period of time to allow for experimental design, biological processes to function, and for variability inherent in riverine ecosystems to be expressed. The number of years to conduct the experimental flows is, therefore, indeterminate.

During moderate and high release years, Reclamation shall operate Glen Canyon Dam according to requirements of the MLFF. Operations during moderate and high water years would assist in achieving some of the variability that was always present in the historic Colorado River and under which the endangered and other native fish evolved.

Following analysis of the data, appropriate operational flows will be determined by the Service and implemented by Reclamation in compliance with section 7(a)(2), Endangered Species Act.

B. Reclamation shall implement a selective withdrawal program for Lake Powell waters and determine feasibility using the following guidelines.

i. Review historic information and employ existing modeling with possible updates using alternative reservoir and operating conditions to prepare a set of possible scenarios of temperature changes in the mainstem.

ii. Determine from the literature, experimentation, and consultation with the AGFD, Native American Tribes, National Park Service, Service, and other native fish species experts the anticipated effects on native fish populations which may result from implementation of temperature changes from a selective withdrawal structure. Determine the range of temperatures for successful larval fish development and recruitment and the relationship between larval/juvenile growth and temperature.

iii. Assess the temperature induced interactions between native and non-native fish competitors and predators.

iv. Assess the effects of temperature, including seasonality and degree, on *Cladophora* and associated diatoms, *Gammarus*, aquatic insects, and fish parasites and disease.

v. Evaluate effects of withdrawing water on the heat budget of Lake Powell, effects of potentially warmer inflow into Lake Mead, and the concomitant effects on the biota within both reservoirs. Evaluate the temperature profiles along with heat budget for both reservoirs.

vi. Evaluate effects of reservoir withdrawal level on fine particulate organic matter and important plant nutrients to understand the relationship between withdrawal level and reservoir and downstream resources.

Installation of a selective withdrawal structure at Glen Canyon Dam may be essential in order to increase water temperatures downstream. Warmer mainstem temperatures are needed to ensure successful spawning and recruitment of endangered and native fishes in the mainstem. Research identified for this element should be integrated or combined with the research program specified in Element C. A selective withdrawal structure would provide considerable flexibility in managing the aquatic ecosystem downstream of Glen Canyon Dam. Management options, such as when to release warmer temperature water, seasonal pattern of releases to avoid establishment of permanent backwater areas, and use of floods, would all be available to limit expansion or invasion of non-native fish species.

The Service cautions the selective withdrawal structure should not be considered the only action needed to provide successful mainstem spawning and recruitment and ultimate recruitment for the humpback chub and razorback sucker. Aspects of the natural hydrograph, including low, steady releases in the summer, are considered necessary based on our present knowledge of the temperature capabilities of a selective withdrawal structure and habitat requirements of the species. Future studies might identify opportunities to operate Glen Canyon Dam in a manner that would alleviate conditions that jeopardize the continued existence of listed fish in the Grand Canyon and minimize impacts on water utilization for power production and other purposes. This program also is one of the EIS common elements.

C. Determine responses of native fishes in Grand Canyon to various temperature regimes and river flows of the experimental flows and other operations of Glen Canyon Dam. Studies will emphasize collection of information necessary to remove jeopardy to federally-listed species and identify actions necessary to enhance their recovery. Reclamation will provide technical assistance and funding for research to accomplish the following studies.

i. Determine the effects of water temperature on reproductive success, growth, and survivorship of Grand Canyon fishes.

ii. Determine relationships among tributary hydrology, reproductive success of fishes, and the abundance of fishes in mainstem rearing habitats.

iii. Determine the effects of mainstem hydrology on the number of nearshore rearing habitats, environmental conditions in these habitats, and their successful utilization by fishes.

iv. Assess biotic interactions between native and non-native fishes, particularly those that occur in nearshore rearing habitats affected by dam operations.

v. Determine humpback chub life history schedule for populations downstream of Glen Canyon Dam.

vi. Determine origins of fish food resources, energy pathways, and nutrient sources important to their production, and the effects of Glen Canyon Dam operations on these resources.

vii. Determine the effects of dam operations, including modifications to regulate water temperatures, on the parasites and disease organisms of endangered and native fishes in Grand Canyon.

Emphasis to be placed on experimental approaches using various flow and temperature scenarios to determine cause and effect relationships between dam operations and responses of the community of endangered and native fishes endemic to the Grand Canyon. Efforts should be hypothesis driven and specific in objectives. Explanation of the above research efforts is provided in Appendix 1 along with suggested hypotheses. The success of these research efforts will require sufficient flexibility in operations to design and carry out the experiments. Wherever feasible, off-site experiments should be

considered as a means of generating or supporting the testing of hypotheses to reduce on-site study time and complexity. Long-term measurements should more appropriately be incorporated into the monitoring program, but there must be an active synergism between the two efforts.

The long-term monitoring plan should define objectives and methods for tracking the status of native fishes in Grand Canyon. Relevant indices should be developed and measured in support of the long-term monitoring plan. A major advantage of the current intensive marking studies using passive integrated transponder tags is the ability to measure future movements, growth rates, and population sizes of these fishes. This legacy, and others made available by this period of intensive research effort, should be effectively incorporated into the long-term monitoring program for fishes. Adaptive management, an EIS common element, would likely include a number of the above research objectives.

2. Protect humpback chub spawning population and habitat in the LCR by being instrumental in developing a management plan for this river.

This element remains very important to the survival of the humpback chub in Grand Canyon. Reclamation has, through contracts with the Navajo Nation, developed an extensive database for use in developing the plan. Reclamation will work with the Service, Navajo Nation, Hopi Tribe, National Park Service, Bureau of Indian Affairs, AGFD, and others to develop a management plan that includes actions to avoid possible adverse impacts to humpback chubs and their spawning and rearing habitats in the LCR. The principle objective of this plan shall be the protection of humpback chub habitat in the Colorado River and LCR. A draft plan will be prepared within 2 years from the date of this biological opinion and transmitted to agencies, parties, and others having authority to implement the plan.

3. Develop actions that will help ensure the continued existence of the razorback sucker by first sponsoring a workshop within 1 year following the biological opinion to enlist the advise of species experts, endangered fish researchers in Grand Canyon, Native Fish Work Group biologists, and others, such as Colorado River Recovery Team members, to develop a management plan for the species in the Grand Canyon. Following review of the workshop results, the Service will recommend a course of action and develop a Memorandum of Understanding with Reclamation and other entities who may wish to participate. The memorandum will provide detail on development of the management plan and implementation of actions identified in the plan.

Activities establishing razorback suckers in the Grand Canyon might include development of spawning and rearing areas that would function like flooded river bottom lands. Opportunities for such actions could be at (1) Lee's Ferry in a former gravel storage area along the mainstem and Paria River or (2) near the inflow area of the Colorado River into Lake Mead (Lake Mead National Recreation Area and Hualapai Indian Reservation). Cooperation of land managing agencies, such as the National Park Service and Hualapai Indian Tribe would be necessary.

4. Establish a second spawning aggregation of humpback chub downstream of Glen Canyon Dam.

Baseline information on possible tributary use or suitability for use by spawning humpback chub is being collected. Using that information, information from other Grand Canyon endangered fish research, and information from studies of *Gila* taxonomy, Reclamation, in consultation with the Service, National Park Service, AGFD, and land management agencies such as the Havasupai Tribe, will make every reasonable effort through funding, facilitating, and provide technical assistance to establish a program for additional spawning aggregations (or populations depending on genetic status) in the mainstem or tributaries. This effort has been identified as one of the EIS common elements.

ANALYSIS OF JEOPARDY AND ADVERSE MODIFICATION

The Service's biological opinion on operation of Glen Canyon Dam is based the current status of the species, environmental baseline, effects of the proposed action, and cumulative effects on listed species. To jeopardize the continued existence of a species, as defined in regulations implementing section 7 of the Act, is to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by further reducing the reproduction, numbers, or distribution of that species. Survival is defined as the ability of a species to persist into the future with sufficient resilience to recover from endangerment. Conditions of survival are found in the LCR for the humpback chub: sufficiently large population, represented by all age classes, genetic heterogeneity, and a number of sexually mature individuals producing viable offspring, that exists in an environment providing all requirements for completion of the species' entire life cycle. The concern with the LCR is that all humpback chub use is in the lower 14.5 km of the LCR; thus, the species and its habitat are extremely vulnerable to chronic or catastrophic threats. The 470 km reach of the mainstem Colorado River downstream of Glen Canyon Dam (to upstream boundary of Lake Mead National Recreation Area) apparently does not provide for survival all age classes nor an environment for successful spawning and recruitment of young to adult humpback chub. For the razorback sucker, only minimal support for the adult life stage has been identified in the mainstem reach downstream of Glen Canyon Dam.

Jeopardy also relates to recovery. Recovery is the process by which the quality and quantity of ecosystems are restored so they can support self-sustaining and self-regulating populations of listed species as persistent members of native biotic communities. The proposed action is anticipated to improve conditions over NA for the humpback chub, but the likelihood of recovery in the mainstem Colorado River is still appreciably reduced. While limited evidence of mainstem spawning has occurred during interim flows, survival and recruitment of those larvae is not known. Studies by GCES during NA and interim flow (similar to MLFF) conditions report occurrence of humpback chub in the mainstem is primarily limited to the reach centered on the LCR.

The final analysis of whether an action is likely to jeopardize a species is to consider the aggregate effects of everything that has led to the species' current status, all future non-Federal activities, and the proposed action. Determination if an action is likely to destroy or adversely modify critical habitat is an assessment of whether all the aggregate effects on the critical habitat and its constituent elements will appreciably diminish the value of critical habitat in sustaining its role in the survival and recovery of the species. Thus, while other actions may be responsible for the humpback chub and razorback sucker being in decline before Glen Canyon Dam, or that cold water releases and reduction in sediment further impacted the native fishery, the Department of the Interior, with the Bureau of Reclamation as lead, is still responsible for the impacts of the proposed action of operation of Glen Canyon Dam as MLFF.

ATTACHMENT 5

Programmatic Agreement on Cultural Resources

PROGRAMMATIC AGREEMENT
AMONG
THE BUREAU OF RECLAMATION, THE ADVISORY COUNCIL ON HISTORIC PRESERVATION, THE NATIONAL PARK SERVICE,
THE ARIZONA STATE HISTORIC PRESERVATION OFFICER, HAVASUPAI TRIBE, HOPI TRIBE, HUALAPAI TRIBE, KAIBAB PAIUTE TRIBE, NAVAJO NATION, SAN JUAN SOUTHERN PAIUTE TRIBE, SHIVWITS PAIUTE TRIBE AND ZUNI PUEBLO
REGARDING
OPERATIONS OF THE GLEN CANYON DAM

WHEREAS, the Secretary of Interior has directed the preparation of an Environmental Impact Statement (EIS) on the effects of the operation of the Glen Canyon Dam on the downstream environmental and ecological resources, and historic properties of Glen Canyon and Grand Canyon; and

WHEREAS, the Grand Canyon Protection Act of 1992 (PL 102-575 Title XVIII) mandates the continued monitoring and management of resources located within the area of impact covered by this agreement and requires completion of the EIS by October 1994; and

WHEREAS, the purpose of the EIS is to ". . . reevaluate the operation of the Glen Canyon Dam to determine specific options that could be implemented to minimize—consistent with law—adverse impacts on the downstream environmental and cultural resources and Native American interests in Glen and Grand Canyons." (Interim Preliminary Draft EIS 7/92); and

WHEREAS, the Bureau of Reclamation (Reclamation), Upper Colorado Regional Office, administers the releases of water from the Glen Canyon Dam and has determined that the operation of the Dam (the Program) may have effects upon properties included in or eligible for inclusion in the National Register of Historic Places and has consulted with the Advisory Council on Historic Preservation (Council), the National Park Service (NPS), and the Arizona State Historic Preservation Officer (SHPO) pursuant to 36 CFR § 800.13 of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (ACT) (16 U.S.C. 470f); and

WHEREAS, Reclamation is the lead Federal agency for the Program for purposes of Section 106; and

WHEREAS, the NPS is responsible for the administration and management of historic properties within the boundaries of the Glen Canyon National Recreation Area and the Grand Canyon National Park pursuant to Section 110 of the Act; and

WHEREAS, given their mutual responsibilities Reclamation and the NPS have determined to coordinate their respective roles in the management and consideration of historic properties which may be affected by the Program: and

WHEREAS, the Hualapai Tribe is responsible for the administration and management of historic properties within the boundaries of its reservation lands affected by the Program; and WHEREAS, prior to performing any work required under the terms of this Agreement within the boundaries of the Hualapai Indian Reservation, Reclamation or the NPS shall notify the Hualapai Tribe of such work

and obtain appropriate Tribal permits before entering the boundaries of the Hualapai Indian Reservation. The Tribe will require that a Hualapai Tribe member monitor be present when necessary for any culturally sensitive work, as determined by the Tribe.

WHEREAS, the Navajo Nation is responsible for the administration and management of historic properties within the boundaries of the Navajo Nation pursuant to the Cultural Resources Protection Act (CMY-19-88); and

WHEREAS, the Navajo Nation agrees to NPS administration and management of any Navajo Nation historic properties which may be included under the terms of this agreement until such time as the Navajo Nation assumes such responsibility; and

WHEREAS, the Havasupai Tribe, Hopi Tribe, Hualapai Tribe, Kaibab Paiute Tribe, Navajo Nation, San Juan Southern Paiute Tribe, Shivwits Paiute Tribe and the Zuni Pueblo (the Tribes) participated in consultation and are signatories to this Programmatic Agreement;

NOW, THEREFORE, Reclamation, the Council, NPS, SHPO, and the Tribes agree that the Program shall be administered in accordance with the following stipulations to satisfy Reclamation's Section 106 responsibilities for all individual aspects of the Program.

Stipulations

Reclamation, as lead Federal agency for purposes of the Program, shall ensure that the following stipulations are carried out.

1. IDENTIFICATION AND EVALUATION

a. The NPS has identified a total of 313 contributing properties, referred to as the Grand Canyon River Corridor District (District), within the Area of Potential Effects (APE). Nine additional properties within the boundaries of the District remain unevaluated. The NPS shall assist Reclamation in obtaining the necessary information to complete the evaluation of these nine sites for determining their eligibility for listing on the Nationa, Register as contributing properties to the District or as eligible on their own merits. Reclamation shall submit such evaluations to the SHPO for determinations of eligibility. In the event that Reclamation and SHPO do not agree on the eligibility of any property, or if the Council or Keeper so request, Reclamation shall obtain a formal determination of eligibility from the Keeper of the National Register in accordance with 36 CFR § 800.4(c). Determinations of eligibility for the remaining nine properties shall be completed by August 1993.

b. Reclamation and the NPS, in consultation with SHPO, shall identify and evaluate historic properties in the remaining 37 miles of the APE not previously intensively inventoried (Attachment A). Properties identified within the 37 mile corridor shall be evaluated on their own merits and as contributing elements to the District pursuant to 36 CFR § 800.4(c). An intensive inventory of the entire APE shall be completed by August 1993. Ongoing identification and evaluation efforts shall be a part of the management program identified at Stipulations 2 and 3.

c. In consultation with the Tribes and SHPO, Reclamation and the NPS shall identify and evaluate properties within the APE which retain traditional cultural values. Such properties shall be evaluated under criteria A, B, C, and D of the National Register Criteria pursuant to 36 CFR Part 60, and taking into consideration "National Register Bulletin 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties".

(1) Traditional Cultural Properties shall be identified by Reclamation and the NPS through the conduct of ethnographic studies. Ethnographic studies shall solicit and include the participation of and consultation with the Tribes to collaborate in the identification and evaluation of traditional cultural properties.

(2) Reclamation shall submit such evaluations to the SHPO for determinations of eligibility. In the event that Reclamation and SHPO do not agree on the eligibility of any property, or if the Council or Keeper so request, Reclamation shall obtain a formal determination of eligibility from the Keeper of the National Register in accordance with 36 CFR § 800.4(c). Such study and evaluations shall be completed by October 1994.

2. MONITORING AND REMEDIAL ACTION

a. Within three months of the execution of this Programmatic Agreement, Reclamation and the NPS, in consultation with the SHPO and Tribes, shall develop a Plan for monitoring the effects of the Glen Canyon Dam operations on historic properties within the APE and for carrying out remedial actions to address the effects of ongoing damage to historic properties. The purpose of the Monitoring and Remedial Action Plan shall be to generate data regarding the effects of Dam operations on historic properties, identify ongoing impacts to historic properties within the APE, and develop and implement remedial measures for treating historic properties subject to damage. Such data shall be incorporated into Reclamation's Long-term Operating and Monitoring Plans governing dam releases identified in the EIS, The EIS is scheduled for completion in October 1994.

b. The Monitoring and Remedial Action Plan (Plan) shall provide for the identification and evaluation of previously unrecorded properties overlooked by previous surveys or exposed subsequent to the surveys, and include measures by which any adverse effects identified during the monitoring effort shall be avoided or minimized. Remedial measures shall be implemented to mitigate ongoing adverse effects and may include, but not be limited necessarily to, bank stabilization, check dam construction and data recovery, as appropriate. The Plan shall specify an expedited consultation process among the parties to this agreement to accommodate situations requiring remedial actions.

c. Reclamation shall submit a draft of the Plan to the parties in this agreement for review and comment. Each party shall have 60 days from receipt of the Plan to comment. Reclamation may assume the concurrence of any party which does not issue comments within 60 days of their receipt of the Plan.

(1) Reclamation shall take into consideration all comments received in their development of a final draft Plan, and submit the final draft Plan to the reviewing parties for a second review opportunity. Each reviewing party shall have 2O days from receipt to review the final draft Plan and issue comments to Reclamation.

(2) If any reviewing party objects to the adequacy of the final draft Plan, Reclamation shall consult with the objecting party, and the other parties to this Programmatic Agreement as necessary to resolve the objection pursuant to Stipulation.

(3) When all objections are resolved, Reclamation shall implement the Monitoring and Remedial Action Plan.

3. MANAGEMENT

a. Reclamation and the NPS shall incorporate the results of the identification, evaluation, and monitoring and remedial action efforts into a Historic Preservation Plan (HPP) for the long-term management of the Grand Canyon River Corridor District and any other historic properties within the APE. The HPP shall be developed in consultation with the parties to this Programmatic Agreement.

The HPP shall integrate Reclamation's lead agency role pursuant to Section 106 of the Act and the NPS's stewardship role pursuant to Section 110 of the Act. Specifically, the HPP shall provide management direction responsive to the NPS's responsibilities under Sections 110(a)(1) and 110(a)(2); and NPS's and Reclamation's responsibilities under Sections 110(b) and 110(d).

b. The HPP shall establish consultation and coordination procedures, long term monitoring and mitigation strategies, management mechanisms and goals for long term management of historic properties within the APE.

c. Reclamation and the NPS shall submit a draft of the HPP to the parties to this agreement for 60 days review. The parties to this agreement shall have 60 days from receipt to issue comments to Reclamation and the NPS regarding the adequacy of the HPP. Reclamation and the NPS may assume the concurrence of any party which does not issue comments within 60 days of receipt of the HPP.

(1) Reclamation and the NPS shall take into consideration all comments received in their development of a final draft HPP, and submit the final draft HPP to the reviewing parties for a second review opportunity. Each reviewing party shall have 30 days from receipt to review the final draft HPP and issue comments to Reclamation and the NPS.

(2) If any reviewing party objects to the adequacy of the final draft HPP, Reclamation and the NPS shall consult with the objecting party, and the other parties to this agreement as necessary to resolve the objection pursuant to Stipulation 4. When all objections have been resolved, Reclamation and the NPS shall implement the HPP.

d. The development, and review of the HPP shall be completed prior to the issuance of a Record of Decision for the GCD-EIS, or December 1994, whichever comes first. Upon issuance of a Record of Decision, the HPP shall be reviewed by the parties to this agreement and revised, if necessary, based on the decision. The review of a revised HPP shall be conducted in accordance with the procedures of Stipulation 3.C.1. and 2.

4. DISPUTE RESOLUTION

a. Should any party to this agreement object within 30 days to any plans, specifications, or actions proposed pursuant to this agreement, Reclamation and the NPS shall consult with the objecting party to resolve the objection. If any party involved in the dispute determines that the dispute cannot be resolved, Reclamation shall forward all documentation relevant to the dispute to the Council. Within 30 days after receipt of all pertinent documentation, the Council will either:

(1) Provide Reclamation and the NPS with recommendations, which Reclamation will take into account in reaching a final decision regarding the dispute; or

(2) Notify Reclamation and the NPS that it will comment pursuant to 36 CFR § 800.6(c)(2) with reference to the subject of the dispute.

Any recommendation or comment provided by the Council will be understood to pertain only to the subject of the dispute; Reclamation's responsibility to carry out all actions under this agreement that are not the subjects of the dispute shall remain unchanged.

b. At any time during implementation of the measures stipulated in this agreement should an objection to any such measure or its manner of implementation be raised by a member of the public, Reclamation and the NPS shall take the objection into account and consult as needed with the objecting party, SHPO, the Tribes, or the Council to resolve the objection.

5. REVIEW OF THE AGREEMENT

a. The Council, SHPO, NPS and Tribes may review activities carried out pursuant to this Programmatic Agreement. and the Council will review such activities if so requested. Reclamation will cooperate with the Council, SHPO, NPS and Tribes in carrying out their reviewing activities.

b. Reclamation and the NPS shall cooperatively provide bi-annual summary reports of their progress toward completing the terms of this agreement to each of the parties to this agreement. The biannual reports shall identify accomplishments and actions completed and provide schedules completion of all remaining tasks. The first biannual report shall be submitted to the parties of this agreement six (6) months after the date of the Council's signature on this agreement and every six months thereafter until the HPP has been implemented.

c. A yearly meeting will be held among the signatories to review the agreement and the results of the monitoring and remedial actions.

6. AMENDMENT

Any party to this Programmatic Agreement may request that it be amended, whereupon the parties will consult in accordance with 36 CFR § 800.13 to consider such amendment.

7. TERMINATION

Any party to this Programmatic Agreement may terminate this agreement by providing 30 days written notice to the other parties, provided that the parties will consult during the period prior to termination to seek agreement on amendments or other actions that would avoid termination. In the event of termination, Reclamation will comply with 36 CFR § § 800.4 through 800.6 with regard to individual undertakings covered by this Programmatic Agreement.

8. FAILURE TO CARRY OUT TERMS

In the event Reclamation and the NPS do not carry out the terms of this Programmatic Agreement, Reclamation will comply with 36 CFR § § 800.4 through 800.6 with regard to individual undertakings covered by this Programmatic Agreement.

ADVISORY COUNCIL ON HISTORIC PRESERVATION

BY: Robert D. Bish Date: 2/8/94

Executive Director

BUREAU OF RECLAMATION

BY: Robert Peterson Date: 8/12/93

Title: Regional Director

ARIZONA STATE HISTORIC PRESERVATION OFFICER

BY: James W. Garrison Date: 8/17/93

Title: State Historic Preservation Officer

NATIONAL PARK SERVICE, WESTERN REGION

BY: Stanley L. Albright DATE: 11/23/93

Title: Regional Director, Western Region

NATIONAL PARK SERVICE, ROCKY MOUNTAIN REGION

BY: R. Earnest Jr DATE: DEC 7 1993

Robert M. Baker, Regional Director, RMR

HAVASUPAI TRIBE

BY: Date:

Title:

HOPI TRIBE

BY: James Duckstah Date: 8-30-94

Title: Chairman

HUALAPAI TRIBE

BY: _____ Date: 02-15-94

Title: Chairman, Hualapai Tribal Council

KAIBAB PAIUTE TRIBE

BY: _____ Date: 4/12/94

Title: Tribal Chairperson

NAVAJO NATION

BY: _____ Date: 1/3/94

Historic Preservation Officer

SAN JUAN SOUTHERN PAIUTE TRIBE

BY: _____ Date:

PAIUTE INDIAN TRIBE OF UTAH FOR:
SHIVWITS PAIUTE TRIBE

BY: _____ Date: April 20, 1994

Tribal Chairman

ZUNI PUEBLO

BY: _____ Date: 7-6-93

Title: Governor, Pueblo of Zuni

ATTACHMENT 6

Supporting Data on Alternatives

A. Formula for determining minimum and maximum flows under the Moderate and Seasonally Adjusted Fluctuating Flow Alternatives (October-May). Minimum and maximum flow restrictions would be determined from the mean release for the month (Qmean). Qmean would be determined from the scheduled monthly release volume using the following equation.

$$Qmean = \frac{Volume}{No.\ days\ per\ month} \times \frac{43{,}560\ ft^2 \bullet day}{86{,}400\ acre \bullet sec}$$

Where volume is the scheduled monthly release volume in acre-feet per month and Qmean is the equivalent release in cfs

The minimum (Qmin) and maximum (Qmax) flows would be determined by the following equations.

for Qmean ≤ 9,091 cfs Qmin = 5.000 cfs
for Qmean ≥ 9,091 cfs Qmax = Qmean – C

for Qmean ≤ 25,500 cfs Qmax = Qmean + C
for Qmean ≥ 25,500 cfs Qmax = 31,500 cfs

where

for Qmean ≤ 13,333 cfs C = 0.45 x Qmean
for Qmean ≥ 13,333 cfs C = 6,000 cfs

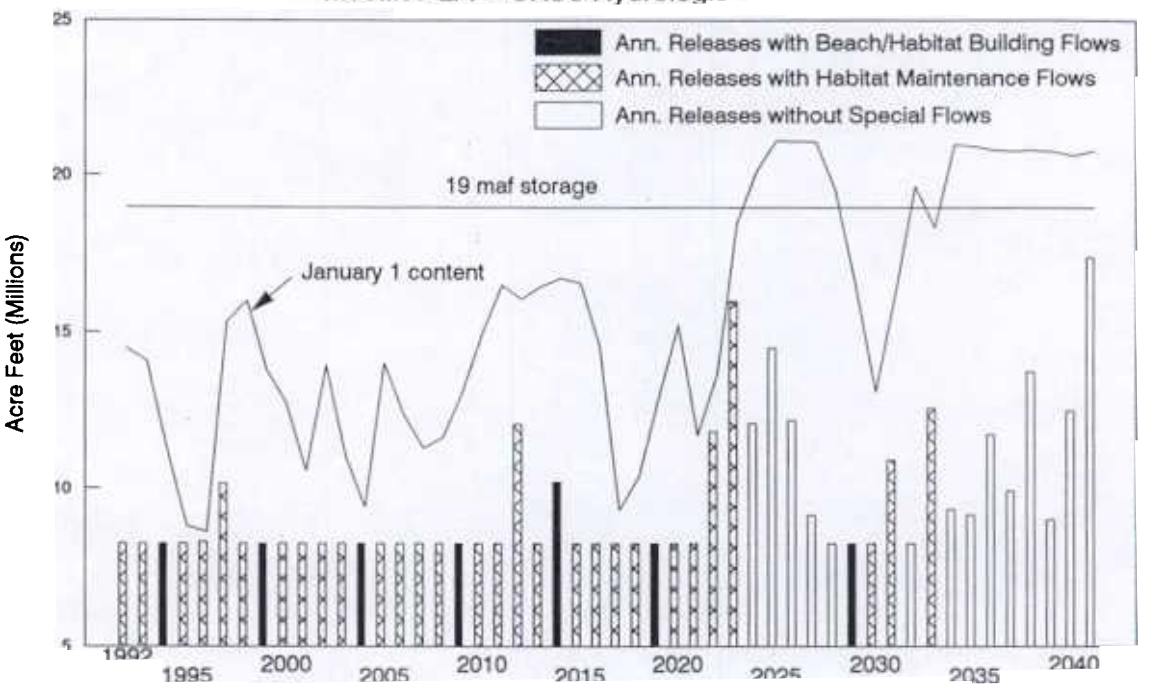
Releases rates would be allowed to fluctuate daily and hourly between the minimum and maximum limits.

B. Monthly release volumes for alternatives incorporating the habitat maintenance flow, example water year 1989 (8.2 million acre-feet) in thousand acre-feet

Month	No Action	Moderate and Modified Low Fluctuating Flow	Seasonally Adjusted Steady Flow
Oct	520	484	499
Nov	616	580	477
Dec	644	608	500
Jan	760	724	655
Feb	671	635	587
Mar	607	1,006	1,086
Apr	548	512	723
May	540	504	1,073
Jun	763	727	1,037
Jul	841	805	682
Aug	884	848	474
Sep	823	787	449

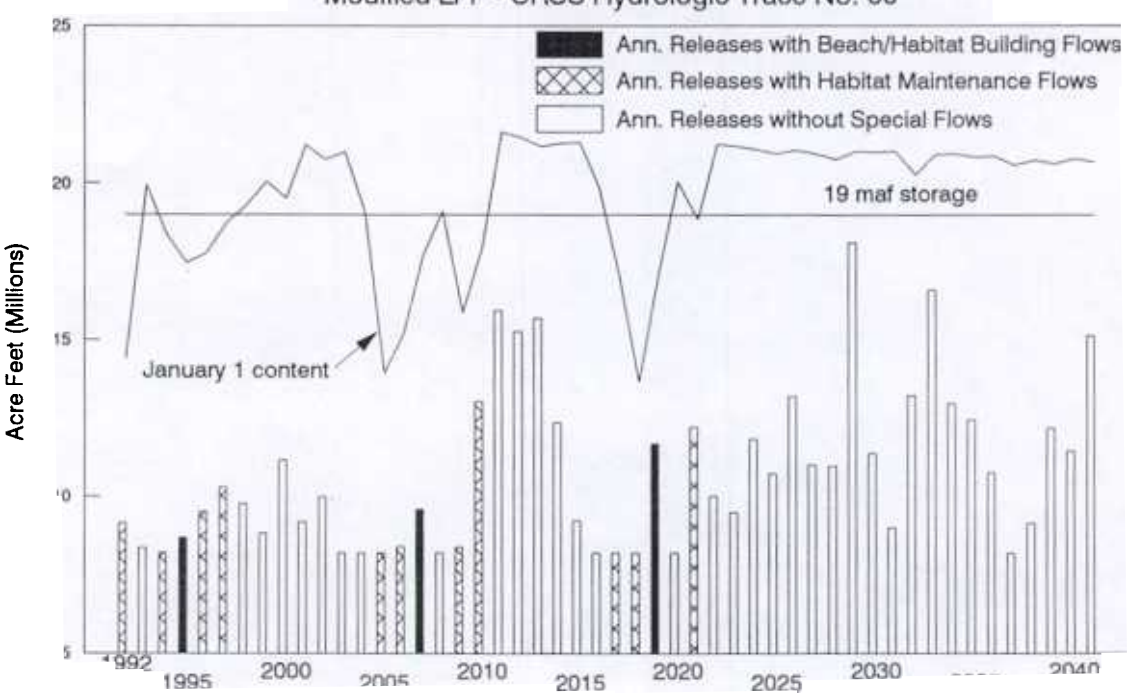
Example Scheduling of Special Flows

Modified LFF - CRSS Hydrologic Trace No. 48



Example Scheduling of Special Flows

Modified LFF - CRSS Hydrologic Trace No. 60



Emergency Operations Guidelines

Inflow Forecasting

National Weather Service inflow projections, received twice a month, are used to project a 3- to 4-month period. This data comes from a satellite telemetered network of more than 100 Upper Colorado River Basin data collection points. These points gather snow water content, precipitation, temperature, and streamflow information. The water year begins in October, with later adjustments made for anticipated targets such as annual volumes and flood control elevations. Starting on January 1, forecasts are made for the April through July inflow, the peak runoff period. These early forecasts may contain large errors due to climatic variability as well as modeling and data uncertainties. Uncertainty decreases as the snow accumulation period progresses into the runoff season. As the runoff season progresses, monthly scheduled releases are modified to accommodate projected runoff changes.

Operational Emergencies

The North American Electrical Reliability Council (NERC) has established guidelines for emergency operations of interconnected systems. These guidelines apply to Glen Canyon Dam operations and may account for operational changes outside of those identified in descriptions of the alternatives. These changes in operations are intended to be of short duration as a result of emergencies at the dam or within the transmission network. NERC provides the following guidelines for system emergencies. Because of the technical nature of the descriptions, only examples are given here.

Insufficient Generation Capacity. When a control area has an operating capacity emergency, it must promptly balance its generation and interchange schedules to its load, without regard to financial cost, to avoid prolonged use of the assistance provided by interconnection frequency bias. The emergency reserve inherent in frequency deviation is intended to be used only as a temporary source of emergency energy and must be promptly restored so the interconnected systems can withstand the next contingency A control area unable to balance its generation and interchange schedules to its load must remove sufficient load to permit correction of its Area County Error.

If a control area anticipates an operating capacity emergency, it must bring on all available generation, postpone equipment maintenance, schedule interchange purchases well in advance, and prepare to reduce load.

An example of insufficient generation capacity and the appropriate response would be as follows: if any coal-fired powerplant in Western's load control area were unexpectedly lost, the response would be an increase in Colorado River Storage Project (CRSP) generation or imports to cover the change in anticipated generation within the control area.

Transmission (Overload, Voltage Control). If a transmission facility becomes overloaded or if voltage levels are outside of established limits and the condition cannot be relieved by normal means (such as adjusting generation or interconnection schedules) and a credible contingency under these conditions would adversely impact the interconnection, appropriate relief measures, including load shedding, shall be implemented promptly to return the transmission facility to within established limits. This action shall be taken by the system, control area, or pool causing the problem if it can be identified; or by other systems or control areas, as appropriate, if identification; cannot be readily determined.

An example of a response to an overloaded transmission system would be automatic relay tripping and taking a transmission line, such as the Glen Canyon-Flagstaff 345-kilovolt line, out of service. This action would cause Glen Canyon powerplant generation to be reduced instantaneously to a predetermined level based on the capacity of the line taken out of service.

Load Shedding. After taking all other steps, a system or control area whose integrity is in jeopardy due to insufficient generation or transmission capacity shall shed customer load rather than risk an uncontrolled failure of interconnection components.

An example requiring the extreme step of load shedding could occur if there were an interruption of the transmission capacity between the heavy load areas of Southern California and Arizona and the heavy generation areas of the Pacific Northwest, Colorado, Wyoming, and Montana. In this situation, Glen Canyon would be isolated with the heavy load areas. The response would be for Glen Canyon to swing from existing generation levels to maximum powerplant capacity. Then the automatic relay protection would open the transmission lines to the heavy load area, reducing the generation at Glen Canyon.

System Restoration. After a system collapse, restoration shall begin when it can proceed in an orderly and secure manner. Systems and control areas shall coordinate their restoration actions. Restoration priority shall be given to the station supply of powerplants and the transmission system. Even though the restoration should be expeditious, system operators should avoid premature action to prevent a recollapse of the system.

Customer load shall be restored as generation and transmission equipment becomes available, while keeping load and generation in balance at normal frequency as the system is restored.

Emergency Information Exchange. A system control area or pool experiencing or anticipating an operating emergency should communicate its current and future status to neighboring systems, control areas, or pools and throughout the interconnection. Systems able to provide emergency assistance must make known their capabilities.

Special System or Control Area. Because the facilities of each system may be vital to the interconnection's secure operation, systems and control areas shall make every effort to remain connected. However, if a system or control area determines that it is endangered by remaining interconnected, it may take action as necessary to protect its system.

If a portion of the interconnection becomes separated from the remainder of the interconnection, abnormal frequency and voltage deviations may occur. To permit resynchronizing, relief measures should be applied by those separated systems contributing to the frequency and voltage deviations.

An example of when Western might choose to disconnect the Glen Canyon Powerplant from the interconnected system would be in the case of a search and rescue operation in the canyon when there would be a need to control the releases.

Although the situations are infrequent, they do occur and require immediate, short-term changes in dam operation. In general, changes resulting from emergencies at Glen Canyon would result in decreases in flows. Emergencies in the system away from the dam would result in increases in flows.

Humanitarian Situations

There are occasions when managing agencies and local authorities, such as the police, request that the flows from the dam be reduced so that search and rescue procedures can be conducted or fatalities can be recovered from the river. In these situations, flows will be reduced for an agreed upon period of time. When returning to normal operations, flows will be brought up quickly to the minimum flow identified in the alternative and then may be increased at the ramping rate identified in the alternative.

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