

**Glen Canyon Dam Adaptive Management Program
Bottom Line Funding Needs – Fiscal Year 2004 (Rev. 2/25/02)**

I. PROGRAM ADMINISTRATION

A. ADAPTIVE MANAGEMENT WORK GROUP

1. Personnel Costs	178,000	
2. AMWG Member Travel Reimbursement	13,000	
3. Reclamation Travel	18,000	
4. Facilitation Contract	25,000	
5. Other	9,000	
Subtotal		243,000

B. TECHNICAL WORK GROUP

1. Personnel Costs	81,000	
2. TWG Member Travel Reimbursement	15,000	
3. Reclamation Travel	17,000	
4. TWG Chair Reimbursement	25,000	
5. Other	2,000	
Subtotal		140,000

C. SCIENCE ADVISORS

1. Program Manager		0
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D. COMPLIANCE DOCUMENTS

1. Biologist (0.25 fte)		26,000
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E. TEMPERATURE CONTROL DEVICE

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F. CONTRACT ADMINISTRATION

1. Contract Specialist (0.25 fte)		25,000
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II. TRIBAL CONSULTATION

A. COOPERATIVE AGREEMENTS WITH TRIBES

1. Hopi Tribe	80,000	
2. Hualapai Tribe	80,000	
3. Navajo Nation	80,000	
4. Pueblo of Zuni	80,000	
5. Southern Paiute	80,000	
Subtotal		400,000

B. RIVER TRIP LOGISTICS COSTS TO GCMRC

1. Hopi Tribe	15,000	
2. Hualapai Tribe	15,000	
3. Navajo Nation	15,000	
4. Pueblo of Zuni	15,000	
5. Southern Paiute	15,000	
Subtotal		75,000

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III. PROGRAMMAGIC AGREEMENT FOR CULTURAL RESOURCES

A. WORK PLAN ACTIVITIES

1. Completion of HPP	50,000	
2. Reclamation Administration	50,000	
3. Treatment & Monitoring Implementation	400,000	
Subtotal		500,000

IV. EXPERIMENTAL FLOW FUND (\$500,000 USGS Approps) 1,000,000

V. GCMRC SCIENTIFIC ACTIVITIES

A. TERRESTRIAL ECOSYSTEM ACTIVITIES

1. Monitoring & Inventory of Terrestrial Resources	495,000	
a. Tribal Participation	129,000	
2. Monitoring Kanab Ambersnail	86,000	
3. New Research in Terrestrial Ecosystems	69,000	
4. Mapping Holocene Deposits	113,000	
5. Cultural Data Base Plan	25,000	
6. Kanab Ambersnail Taxonomy (\$100k USGS Approps)....	126,000	
Subtotal		1,043,000

B. AQUATIC ECOSYSTEM ACTIVITIES

1. Aquatic Foodbase - External	180,000	
2. Aquatic Foodbase - In House	91,000	
3. Monitoring Downstream Fish	856,000	
4. Monitoring Lees Ferry Trout	162,000	
5. IWQP Downstream Activities	200,000	
6. IWQP Lake Powell (O&M Funding)	309,000	
7. Native and Non-Native Fish Interactions Research	77,000	
8. Captive Breeding Program Feasibility (\$100k Approps) ...	150,000	
Subtotal		2,025,000

C. INTEGRATED TERRESTRIAL & AQUATIC ECOSYSTEM ACTIVITIES

1. Monitoring Fine-grained Sediment Storage	462,000	
a. Beach Monitoring (cont. NAU work, Approps)	15,000	
2. Monitoring Streamflow & Fine Sediment Transport	609,000	
a. One-year Evaluation of In-Situ Continuous Monitoring of Suspended-Sed. Transport (Approps) ..	40,000	
b. Install Automated Pump Samplers (Approps)	25,000	
c. Adv. Warning Paria River Sediment Inputs (Approps)	30,000	
3. Monitoring of Coarse-Grained Sediment	145,000	
4. One-Dimensional Fine Sediment Routing Model	256,000	
5. Control Network	87,000	
6. Channel Mapping	126,000	
7. LCR Integrated Studies (Approps).....	200,000	
8. Adopt-a-Beach with Integration Report	10,000	
Subtotal		2,005,000

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D OTHER SCIENCE ACTIVITIES

1. Unsolicited Proposals	79,000	
2. AMWG/TWG Requests	64,000	
3. In-House Research	22,000	
4. Tribal Training, Science/Tribal Perspectives Integration/ Tribal Interns	35,000	
5. PEP/PA Stipulated Public Outreach/Involvement Plan	15,000	
6. Cultural Resources Synthesis and Status Report	11,000	
7. Cultural Affiliation Study	55,000	
Subtotal		281,000

VI. GCMRC ADMINISTRATIVE & TECHNICAL SUPPORT

A. ADMINISTRATIVE & MANAGEMENT

1. Administrative Operations	820,000	
2. Program Planning & Management	303,000	
3. AMWG/TWG Participation	55,000	
4. Independent Review Panels	170,000	
Subtotal		1,348,000

B. TECHNICAL SUPPORT SERVICES

1. Geographic Information Systems	147,000	
2. Data Base Management	100,000	
3. Library Operations (\$25,000 Approps).....	101,000	
4. Survey Operations	130,000	
5. Decision Support System (Approps)	150,000	
6. Systems Administration	261,000	
7. Aerial Photography	514,000	
8. Logistics (costs distributed to projects)		
Subtotal		1,403,000

TOTAL FY 2003 BUDGET 10,514,000

FY 2004 FUNDING REQUESTS

AVAILABLE FUNDS	AMOUNT
CRSP Power Revenues	\$ 8,545,000
DOI Tribal Funding Appropriations	475,000
O&M – IWOP Lake Powell Studies	309,000
USGS Appropriations	1,185,000
TOTAL	\$ 10,514,000

GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM
Project Descriptions for Fiscal Year 2004

I. PROGRAM ADMINISTRATION

- A. Adaptive Management Work Group (AMWG). This includes personnel costs required to administer the Adaptive Management Program (AMP), travel funds to reimburse members/alternates for attendance at AMWG, ad hoc, and other meetings, and a facilitation contract for meeting management and/or special ad hoc assignments.
- B. Technical Work Group (TWG). This includes personnel costs needed to administer the TWG, travel funds to reimburse members/alternates for attendance at TWG, ad hoc, and other meetings required in the completion of AMWG/TWG assignments, as well as reimbursement for the TWG Chairperson.
- D. Compliance Documents. This covers funding for preparation of compliance documents for AMP-proposed actions in order to comply with ESA, NEPA, and NHPA.
- F. Contract Administration. These are Reclamation personnel costs needed to administer the AMWG facilitation, TWG Chairperson, and Programmatic Agreement contracts.

II. TRIBAL CONSULTATION

- A. Cooperative Agreements with Tribes. Five tribes with demonstrated interests in effects of Glen Canyon Dam operations on resources of tribal concern will continue to be funded through cooperative agreements. The agreements provide \$80,000 per tribe (or consortium of tribes) annually. Funds cover salary, benefits, travel, and indirect costs to enable one official tribal representative to attend meetings wherein government-to-government consultation occurs on AMP activities, issues, and proposals. Funds also ensure the tribal representative maintain communication within their tribes regarding the AMP.
- B. Tribal Monitoring Trips. Each of the five tribes is allocated \$15,000 to monitor effects of dam operation or other management actions on resources of tribal concern. Tribes report their observations to the AMP and the Secretary. The funds are transferred from Reclamation to the GCMRC to pay for river guides, boats, fuel, food, etc.

III. PROGRAMMATIC AGREEMENT

- A-1. To be added.

A-2. Reclamation Administrative Costs for the PA. A total of \$50,000 is allotted for salary, benefits, travel, and indirect costs of administering the PA program and tribal cooperative agreements.

A-3. Treatment and Monitoring Implementation. The treatments and monitoring plan will be completed in FY03, so planned actions to resolve adverse effects of dam operations should begin in FY04. Costs are estimated.

IV. EXPERIMENTAL FLOW FUND

The TWG Experimental Flow Fund Ad Hoc Group has developed an integrated program of experimentation that addresses current information needs related to sediment conservation, riparian vegetation management, and Biological Opinion compliance. The Experimental Flow Fund would finance this program. A financial carry-over account has been established in Reclamation for these funds. Funds would be accumulated each year until there is a sufficient account balance to support the scientific objectives. Appropriated dollars are also being requested through the USGS to supplement this fund.

V. GCMRC SCIENTIFIC ACTIVITIES

Scientific Activities. Project descriptions and budget estimates have been built using information from current and draft information needs, recommendations contained in PEP reports, and existing monitoring and research activities that have been funded as multi-year projects. It is expected that as the revision to existing information needs and the AMP Strategic Plan is completed, the details for a given project may be revised. We believe the bottom-line budget figure presented here is a reasonable estimate of the funds needed for FY 2003 given existing information.

Project costs include contract costs, salaries for GCMRC staff, logistics, GIS and survey support, and other operational costs.

A-1. Monitoring & Inventory of Terrestrial Resources & Tribal Participation: Integrated biological monitoring of vegetation linking birds, foodbase and vegetative structure on reach and river-wide scale, using bird patch size as minimum sampling unit. Also linking hydrology to vegetation composition change and implementing PEP recommended sampling scheme for long-term monitoring of status and trends. New RFP in FY 2004 to include expanded effort in Lower Grand Canyon, downstream of Diamond Creek.

-- Tribal Participation: Intended to provide support to participating tribes to work with biologists on terrestrial monitoring to incorporate tribal perspectives within the integrated terrestrial resources monitoring program.

A-2. Monitoring Kanab Ambersnail: Sampling and estimating population status of snails at Vaseys Paradise. Includes measurement of habitat and refinement of sampling

procedures. Logistics support for supplemental population surveys above 100,000 cfs included.

- A-3. **Old High Water Zone Research:** This project will undertake an evaluation of the vegetation in the Colorado River ecosystem known as the Old High Water Zone (OHWZ). The area represents a unique corridor of vegetation comprised of mesquite and acacia as well as other species, which developed in the area above the zone of disturbance resulting from periodic high water in the predam period. Whether this community will persist over time, migrate down slope toward the New High Water Zone, senesce, or remain stable will be the focus of this research.
- A-4. **Holocene Mapping:** Continuation of approved work for FY 2002 to document Holocene deposits within the Canyon. Project purpose is to define the area potentially affected by dam operations relative to sediment deposits, cultural and recreational resources. Implements a cultural PEP recommendation. Scale of project defined by existing information and feasibility based on scoping meeting held early in FY 2002.
- A-5. **Cultural Data Base Plan.** Development of cultural resource data base plan as stipulated in the PEP recommendation and a component of the Historic Preservation Plan stipulated in the PA agreement. Plan development was postponed due to development of other HPP components.
- A-6. **Kanab Ambersnail Taxonomy:** Second year of multi-year project to resolve taxonomic issues associated with *Oxyloma* complex. This project will use a combination of molecular genetics techniques and morphometric measurements to determine the most appropriate taxonomic classification of snails at Vasey's Paradise. This will be done in the context of resolving the taxonomy for this species that will include examining related snails outside the Colorado River ecosystem.
- B-1. **Aquatic Foodbase Monitoring - External:** Data collection and analysis of algae and benthos to measure response to operations. This will be the second year of a three year contract to improve the statistical rigor of prior foodbase monitoring and done in a repeatable way to allow for determination of status and trends. Increased emphasis in Glen Canyon and in association with gauging stations in Grand Canyon. The project is integrated with downstream water quality, in house foodbase work, and measurements taken by the physical resources program. Project is responsive to aquatic PEP report.
- B-2. **Aquatic Foodbase Monitoring – In House:** This project was new in FY02 and represents an effort to better understand and establish trends in the dynamics and availability of aquatic food resources for higher organisms. The project will monitor and establish trends for the flux of organic carbon in the riverine portion of the CRE by measuring different size fractions of carbon from dissolved to particulate (including invertebrate drift) at fixed stations. The monitoring is closely coupled with downstream water quality work and measurements taken in the physical resources program.

- B-3. **Monitoring Downstream Fish:** New RFP to be issued for FY04 work. Data collection and analysis of fish populations in the mainstem and Little Colorado River likely involving 4 LCR trips and 6 mainstem trips that include 2 trips for estimates of trout (rainbow, brown) and 3 trips to develop native fish abundance estimates and for synoptic surveys to detect distribution changes. This project is intended to provide statistically reliable status and trend information for key native and non-native fish in the CRE. Initial efforts will be included to expand the sampling effort in the lower Grand Canyon, below Diamond Creek.
- B-4. **Monitoring Lees Ferry Trout:** New RFP for work in FY04 involving population estimates for Lees Ferry trout fishery including proportional stock density and condition factor of fish. Establishes status and trend information for the Lees Ferry trout fishery.
- B-5. **IWQP Downstream Activities:** Water quality monitoring in the CRE downstream of Glen Canyon dam. Monitoring provides status and trend information with respect to temperature and nutrient dynamics and is designed to integrate with foodbase monitoring efforts to improve understanding of the relationships between water quality and biological resources. Includes development of downstream water quality model to interface with Lake Powell model.
- B-6. **IWQP Lake Powell:** Water quality monitoring of reservoir, includes monthly and quarterly sampling and incorporation of modeling effort into monitoring program. Monitoring plan will be undergoing revision based upon knowledge gained from the simulation modeling effort and ability to predict reservoir dynamics and quality of downstream water releases based on reservoir stage, inflows, discharge, and seasonal dynamics.
- B-7. **Native and Non-native Fish Interactions Research:** Projects will include predator - prey interactions, competition, and bioenergetics model development. This research is intended to provide improved mechanistic understanding of the role of non-native fishes in the population dynamics of native species. Also includes design and technical assistance for non-native fish control efforts.
- B-8. **Captive Breeding Program Feasibility:** This new project is intended to examine the feasibility of establishing a hatchery-based captive-breeding program for native fishes in the CRE, particularly Humpback Chub. Establishment and maintenance of captive breeding programs is a potentially viable means of species preservation when wild populations are in very low abundance. Conservation of genetic integrity for a species as well as maintenance and production of fish for supplemental stocking or reintroduction to the wild would be among the goals of such a program if established.
- C-1. **Monitoring of Fine-Grained Sediment Storage:** This project is designed to annually assess the spatial distribution of sand- and finer-sized material stored within the main channel of the Colorado River ecosystem; specifically related to storage in eddy complexes and main-channel pools. Monitoring data shall reflect the relative changes

in total volume of sediment and grain-size distribution within a subset of representative reaches throughout the ecosystem, with emphasis on the first 100 miles below the dam. These data support information needs on the state of the available fine-sediment supply in the system subject to influence of dam operations. Related elements of this project include documenting changes in high-elevation sand storage (above 25,000 cfs) related to available campable areas, evolution of sand bar grain-size distribution, changes in the spatial distribution of channel-bed substrates, changes in the number and size of return-current channels within eddy complexes (backwater habitats) and changes in the size of pre-dam river terraces.

- C-2. **Monitoring Streamflow and Fine-Sediment:** This project provides data on streamflow and suspended-sediment transport on the gaged tributaries that provide fine-sediment to ecosystem (influx), and on suspended-sediment transport through critical reaches of the main channel of the Colorado River ecosystem (efflux). It has one research component related to advancing development of a protocol for tracking the fine-sediment budget in real time through a variety of integrated and remotely sensed input data.
 - 2a) **Formal Evaluation of Technologies for Continuous, In-Situ Suspended-Sediment Transport Monitoring:** One-year evaluation of in-situ instrumentation aimed at tracking continuous suspended-sediment transport (reach-scale export) between Glen Canyon Dam and Diamond Creek using laser-diffraction technologies (LISST). Initial evaluation will be conducted using installation of LISST-25 instrument at the Grand Canyon stream gage. Grain-size and concentration data for suspended sediment conditions derived from LISST will be verified using the daily-to-weekly samples collected as part of long-term monitoring. This evaluation will be conducted in collaboration between the GCMRC and the WRD of USGS.
 - 2b) **Advance Warning for Anticipating Paria River Sediment Inputs:** This consists mostly of hardware required for instrumentation of the Upper Paria River watershed so that sediment inputs to the main channel of the Colorado River can be better anticipated. The need for this system relates to a desire by managers to have sufficient lead time to allow high flows from Glen Canyon Dam to be released during or immediately following large sand inputs. This network would likely provide from 12-18 hours of advance notice before large Paria River floods reach the main channel.
- C-3. **Monitoring Coarse-Grained Sediment:** This project provides data on tributary inputs of coarse sediment introduced by debris flows annually, and information about how these inputs change the geomorphology of the main channel settings where sand storage, recreational, food base and fisheries resources exist.
- C-4. **One-dimensional Fine Sediment Routing and Sand-Bar Evolution Models:** This project results in a numerical simulation for routing sand inputs from the Paria and Little Colorado Rivers, downstream through main channel storage settings below

Glen Canyon Dam, including eddy complexes and main channel pools. The simulation uses modeled information on sand inputs, in combination with predictions of travel time and historical and model-derived local conditions of sand bar deposition and erosion.

- C-5. **Control Network.** The objective of this project is to develop a high precision survey control network throughout the CRE that can be used to georeference and geographically integrate field and remotely sensed monitoring and research data. The project will provide a suitable rim control network and line-of-site floor control network throughout the CRE with accuracies suitable for existing and projected GCMRC natural and cultural resource projects.
- C-6. **Channel Mapping.** The objective of this project is to develop a sub-aqueous topographic basemap of the Colorado River channel throughout the CRE at a resolution suitable for habitat mapping and monitoring of sediment load transported on the channel bottom.
- C-7. **LCR Integrated Studies:** Proposed as a new synthesis project of integrated research on the historical variability and change that has occurred with respect to physical, biological and cultural resources within the Little Colorado River drainage basin. The main objective of this research is to study relationships between changes in the physical processes and resources of the Little Colorado River drainage basin and associated biological and cultural resources. Topics of research concern include: issues related to introduction of non-native species and interactions with non-native fishes (primarily, humpback chub), trends in land use, depletions affecting hydrology of base flow (spring effluent), regulation impacts within the basin and any related affects on runoff "events," changes in basin hydrology and relations to climatic variability, and historical changes in sediment supply and sediment transport.
- C-8. **Adopt-a-beach.** Collection of repeat photographic data by volunteer boatmen at selected beaches throughout the Colorado River ecosystem. Increased emphasis on integration of project data to supplement quantitative data collected under other protocols. A project review is scheduled at the end of FY 2004 to evaluate the continued utility of this project in combination with other gcmrc related activities.
- D-1. **Unsolicited Proposals:** The GCMRC proposes to retain funds in support of unsolicited proposals that will allow for flexibility in the program and help ensure that GCMRC can address critical issues in a timely fashion. It will also provide GCMRC the ability to fund truly outstanding proposals that addresses a key concern that may be overlooked in the research planning process. All unsolicited proposals will be discussed with the TWG and will undergo independent, external peer review prior to funding.
- D-2. **AMWG/TWG Requests:** GCMRC budgets funding that can be used in support of requests that arise from the AMWG and TWG during the course of the year.

- D-3. **In-house Research:** The GCMRC supports in-house research by GCMRC Program Managers and scientific staff. In-house research is supported as a means of ensuring that GCMRC program managers and scientific staff remain subject area experts in their respective fields through the conduct of their own research on the Colorado River ecosystem. This also ensures that they are able to provide the highest quality of technical assistance in the form of expert analysis, opinion, and advice to the Chief, TWG and the AMWG as requested. In-house research may be in the form of original research or synthesis. In all cases, GCMRC in-house research proposals undergo the same independent external review as all GCMRC proposals.
- D-4. **Tribal Training, Science/Tribal Perspectives Integration/Tribal Interns:** Follow-on workshops for tribal training, science/tribal perspective integration workshop implementation, and use of tribal student interns. Purpose of work is to increase tribal participation within AMP for project development and implementation.
- D-5. **Public Outreach Involvement Plan Implementation.** Implementation of public outreach/involvement plan developed during FY 03 as stipulated in the PA agreement and recommended by the cultural PEP. Originally recommended as cultural plan, but as recommended by several stakeholders expanded to include all AMP resources.
- D-6. **Cultural Resources Synthesis and Status Report:** Incorporates data and reports developed by AMP cultural representatives to provide a general synthetic knowledge gained from projects and integrated across resource areas. Developed in-house by GCMRC with collaboration with AMP cultural representatives. Project provides current information within SCORE report.
- D-7. **Cultural Affiliation Plan.** An ethnographic project that is a companion plan to the Research Design Plan contracted in FY-01. This project forms a component of the Historic Preservation Plan and provides information on tribal histories and affiliation to the project area.

VI. GCMRC ADMINISTRATIVE & TECHNICAL SUPPORT

- A-1. **Administrative Operations:** These costs are for salary and other operating expenses in support of administrative operations and management of GCMRC. Included is salary of the Chief and administrative staff, space and facilities, travel, training, vehicles, office supplies and equipment and maintenance. Also included are costs for USGS local network and Flagstaff Science Center support, and USGS regional services including contracting and personnel. Includes salaries for GCMRC staff not otherwise assigned to project costs.
- A-2. **Program Planning and Management:** These costs are for salary and travel in support of program planning and management in the areas of Biological, Physical, and Cultural Resources, and Information Technologies.

- A-3. AMWG/TWG Participation: These costs are to cover salary and travel to attend and prepare for AMWG and TWG meetings.
- A-4. Independent Review Panels: Independent external review is at the heart of GCMRC's approach to program management and implementation. Independent external peer-review ensures the quality and objectivity of GCMRC's programs. All proposals, reports, programs, etc., are subject to independent peer review according to GCMRC's peer-review protocols. These costs cover all of the expenses related to the peer-review process, the Science Advisors, Protocol Evaluation Panels and the salary of the Review Coordinator. The Review Coordinator reports directly to the Chief.
- B-1. Geographic Information Systems: The GIS is a core information technology used by the GCMRC. Its purpose is to provide spatial analysis capabilities to GCMRC staff and stakeholders and maintain a library of GIS thematic coverages of the study area. The GIS is an important analytical tool for change detection of biological, cultural, and physical data relating to the operations of Glen Canyon Dam.
- B-2. Data Base Management: The purpose of the DBMS is to store and deliver tabular and other electronic data pertaining to the CRE. The need for a comprehensive database for maintaining this information was recognized by the National Academy of Sciences in their initial review of the GCES Program in 1987, and reinforced during a second review in 1990. Extensive data and information currently exists in the GCMRC collections relating to resource conditions, quality, and relationships to other resources. Potentially equal amounts of data and information exist within museums, universities, agencies, etc. However, much of this information has not been organized, managed or integrated into an analysis of the interrelationship among various resources and dam operations. The GCMRC data base management systems will, to the extent possible, integrate these vast and disparate data sets into a single ecologically integrated database that can be accessed by stakeholders, scientists, and the public interested in analyzing data pertaining to the Colorado River Ecosystem.
- B-3. Library Operations: Library operations are a core information technology used by the GCMRC ITP. Its purpose is to facilitate research by providing a centralized repository for hard copy information such as books, reports, maps, photography, and videos. The scope and purpose of the library is to collect, archive and deliver those materials that assist the center in its efforts to administer long-term monitoring and research.
- B-4. Survey Operations: The Survey department's mission is to provide survey support for spatial measurement and referencing of scientific data collected in the Colorado River ecosystem by GCMRC programs. This support may be in the form of precise measurement of geographic coordinates of a sample collected in the Canyon or in the generation of topographic maps used for erosion monitoring of terraces adjacent to the Colorado River. The Survey department is also responsible for establishing and maintaining accurate geographic control in the Canyon that is essential for accurate geo-referencing of remotely sensed data and change detection of resource data using

modern image processing and GIS technologies. These technologies are critical to the integration and analysis of the diverse scientific data that have been collected in the Canyon over the past 15 years.

B-5. Decision Support System Development: GCMRC provides objective, scientific information to the AMWG for use in making recommendations to the Secretary of the Interior regarding the effects of dam operations on the Colorado River ecosystem (CRE). In support of this effort, GCMRC is developing: (1) a conceptual (i.e., computer) model of the CRE, (2) a detailed map of the CRE, (3) GIS overlays for the CRE, and (3) an integrated Oracle database of research on the CRE. Missing from this equation is the decision-support system (DSS) overlay that can act to integrate these various efforts and support the AMWG in examining various management actions/policy changes that they may wish to recommend to the Secretary.

B-6: Systems Administration: The GCMRC computing environment is a complex system of servers, workstations, laptops, printers, plotters, modems, routers, hubs, switches, copy machines, FAX's, and telecommunications equipment networked together using 100baseT networking media. Most of the computers are of the PC type running the Windows NT/2000 operating system. In addition, over 50 applications are utilized by GCMRC scientists and support personnel in carrying out the collective mission of the GCMRC. Applications are primarily off-the-shelf products but in many cases are highly specialized. The system administrator develops, implements, and troubleshoots the infrastructure necessary to support the complex computer environment at GCMRC.

B-7: Aerial Photography:

(a) The GCMRC has been collecting annual aerial photography of the CRE for over ten years in support of biological, cultural, and physical research and monitoring activities related to the operations of the Glen Canyon dam. Until recently, the photography product delivered has been a nine by nine inch contact prints of black and white or color infrared film at an approximate scale of 1/4800. Photographs have been delivered without any rectification or geopositioning information. While useful for many past monitoring and research activities in the CRE, these products are largely being supplanted by high resolution multispectral digital products that include pointing and positioning parameters that allow convenient rectification and geopositioning. These products have much more utility and allow improved image analysis using automated computerized techniques. In addition, with the addition of LIDAR equipment, high accuracy topographic information can be acquired simultaneously in areas where volume information is desired.

(b) The Grand Canyon Monitoring and Research Center's library collection includes almost 32,000 aerial photographs of the Colorado River spanning a period of 65 years. Presently, the photo collection is at risk because it is not stored under fireproof and waterproof conditions. Transferring these images into a digital format will provide greater accessibility to researchers and better preservation of the original media. Photographs, including both black and white and color infrared images would

be selected, scanned, compressed, and archived onto GCMRC electronic data systems and DVD.

- B-8. Logistics: GCMRC provides all logistical support for monitoring and research projects conducted by contracted Principal Investigators whose work is administered by GCMRC Program Managers in physical, biological and social-cultural resource programs. GCMRC staff initiate some of their own in-house scientific activities, which require logistical support, including; the Integrated Water Quality Program, administrative trips for groups such as the TWG, AMWG, Science Advisors and program PEP panels. The GCMRC also supports logistical needs for the Bureau of Reclamation's activities conducted by Native American groups under the Programmatic Agreement program and activities conducted to meet Reclamation's needs concerning endangered species. In addition, GCMRC provides logistics support for any contingency plans or experimental floods. GCMRC logistics costs are accounted for under the specific projects, which they support.