GRAND CANYON MONITORING AND RESEARCH CENTER'S

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM

MARCH 22, 2007

PREFACE

Following is the Grand Canyon Monitoring and Research Center's (GCMRC) Fiscal Year 2006 Annual Accomplishment Report. This is a new product to provide the Technical Work Group (TWG) with a summary of accomplishments, shortcomings and recommendations related to projects included in GCMRC's FY 06 work plan for the Glen Canyon Dam Adaptive Management Program. The report is intended to inform the TWG's decisions and recommendations related to the development of the FY 08 work plan. Since this is a new product that GCMRC intends to produce annually, comments on the usefulness of this report are welcome.

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM

TABLE OF CONTENTS

A. PHYSICAL SCIENCE, MODELING, AND DASA PROGRAM

B. BIOSCIENCES

E. INFORMATION TECHNOLOGY SUPPORT

F. ADMINISTRATIVE AND MANAGEMENT

PROJECT A.1 ONGOING PROVISIONAL MONITORING – LAKE POWELL QUALITY-OF-WATER (NOTE: FUNDED UNDER AGREEMENT NO. 05-AA-40-2385, SUPPORT OF INTEGRATED WATER QUALITY PROGRAM STUDIES FOR LAKE POWELL)

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC - Grand Canyon Monitoring & Research Station
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, A.1 (GCMRC No. BNE0A)
(3.) PROJECT TITLE:	Lake Powell Quality-of-Water

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	M.Andersen/B.Vernieu, USGS	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	mandersen@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7379	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Water quality refers to the physical, chemical, and biological characteristics of water. The components affect higher-level community composition, quality, and interactions and represent a cornerstone resource upon which all other downstream aquatic and terrestrial resources depend. The water quality parameters are linked to upper basin inflows, reservoir dynamics, and operations of Glen Canyon Dam, and downstream tributary inputs. The relationship between operations of Glen Canyon Dam and water quality variables affecting downstream resources is a management concern. Of special concern is the current draw-down condition in Lake Powell, resulting from several years of drought. Total storage has been reduced 50%, resulting in warm releases, deltaic sediment resuspension, and reduced dissolved oxygen concentrations in reservoir releases.
(6.) OBJECTIVES:	- Determine status and trends of physical, chemical, and biological components of water quality in the Lake Powell reservoir as a function of regional hydrologic conditions and their relation to downstream releases. These components include temperature, specific conductance, dissolved oxygen, pH, turbidity, major ions, nutrients, trace elements, chlorophyll, plankton, and organic matter. - Determine stratification, convective mixing patterns, and behavior of advective currents in Lake Powell and their relation to Glen Canyon Dam operations to predict seasonal patterns and trends in downstream releases. - Determine status and trends of physical, chemical, and biological components of water quality in Glen Canyon Dam releases. - Evaluate quality and collection methods of existing data and determine where monitoring activities should be implemented, augmented, revised, decreased, or discontinued.
(7.) RELATIONSHIP TO MRP:	Related to Goal 7.
(8.) METHODOLOGY:	The monitoring program for Goal 7 will characterize changes in the quality of water in the Lake Powell reservoir potentially available for release from Glen Canyon Dam, the quality of water in the Glen Canyon Dam tailwater, and changes that occur to the quality of

	water in its travel through Grand Canyon. The geographic scope of Lake Powell water-quality monitoring is from Glen Canyon Dam upstream to the inflow areas of its three major tributaries, the Colorado River, the San Juan River, and the Escalante River. The geographic scope of the tailwater is the reach below Glen Canyon Dam to Lees Ferry. Water quality is monitored in Grand Canyon to Spencer Creek, at River Mile 246. Forebay monitoring in Lake Powell, in the area immediately upstream from Glen Canyon Dam, is conducted on a monthly basis. Monitoring of the entire Lake Powell reservoir is conducted on a quarterly basis. Continuous measurements of water-quality conditions are made within the Glen Canyon Dam power plant, in its tailrace, and downstream at Lees Ferry. Chemical and biological samples are collected from these sites on a monthly basis. Instantaneous measurements of water temperature, specific conductance, dissolved oxygen concentration, pH, turbidity, and redox potential are collected below Glen Canyon Dam, at Lees Ferry, and throughout the water column at up to 30 sites on Lake Powell. At selected reservoir sites and at both tailwater locations, chemical samples are collected for the determination of major ionic constituents and nutrient (total phosphorus, soluble reactive phosphorus, total nitrogen, nitrite-nitrate nitrogen, and ammonia nitrogen) concentrations. Biological samples for chlorophyll concentration and plankton identification and enumeration are collected at selected reservoir sites and both tailwater locations.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Continuous monitoring of water quality in the Glen Canyon Dam tailwater includes monthly download, calibration, and servicing of YSI 6902 multiparameter sondes at three locations and the maintenance of a real-time telemetry system in the Glen Canyon Dam tailrace. Water-quality monitoring surveys of the Glen Canyon Dam forebay and tailwaters (2.4 river kilometers upstream of Glen Canyon Dam) are conducted monthly, and include measurements of physicochemical parameters throughout the water column and collection of chemical and biological samples. Water-quality monitoring surveys of the entire Lake Powell reservoir are conducted quarterly and include measurements of physicochemical parameters throughout the water column at up to 30 locations on Lake Powell and collection of chemical and biological samples at selected locations. Information from field surveys and laboratory analyses is processed and incorporated into the long-term relational database of Lake Powell water-quality conditions. Information is disseminated by regular water-quality updates; presentations to TWG, AMWG, the Lake Powell Cooperators Group, and other interested parties; and periodic web page updates and publications.
(10.) PROGRESS STATEMENT:	Recent drought conditions at Lake Powell have resulted in lower

(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)	reservoir elevations, increased release temperatures, and decreased dissolved concentrations in Glen Canyon Dam releases. The telemetry system below Glen Canyon Dam has provided valuable real-time information during this period. The relational water quality database is complete and current. An USGS data report is in development for publication in 2007, describing the 42-year history of Lake Powell water-quality monitoring.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Draft USGS Data Report of Lake Powell historical water-quality information is in preparation. The relational water quality database is complete and current. Short-term patterns in Glen Canyon Dam releases are being tracked and reported through real-time telemetry system. Presentations on Lake Powell water-quality issues have been given to the TWG/AMWG and the Lake Powell Cooperators Group. Coordination with model development by Reclamation is ongoing.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Final USGS Data Report of Lake Powell historical water-quality information is anticipated in 2007. A Biological Monitoring Plan is in development to provide a preliminary analysis of existing plankton data and a reduction in the current backlog of biological samples. Boat repair and maintenance of the Uniflite vessel is planned for 2007.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	The biological monitoring plan will provide useful information to develop a budget and appropriate levels of analysis for the current backlog of plankton samples. The analysis of these samples and other existing data will provide an important baseline of plankton community structure, on which to evaluate effects of a potential selective withdrawal device or possible exotic species invasion. Further evaluation of the 42-year historical data set could lead to a restructuring of the existing sampling program to maximize efficiency and cost-effectiveness.

(14.) FY2006 BUDGET REPORT			**FINANCIAL INFORMATION COLLECTION DATE:**		09/30/2006
FY PLANNED GROSS BUDGET:		$218,994	**FISCAL YEAR NET AVAIL BAL:**		$188,376
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	Carryover funds will be used to supplement the FY2007 agreement where neither personnel costs nor burden have been renegotiated to their current rates.		**FISCAL YEAR EXPENDITURES:**		$183,962
			FISCAL YEAR OBLIGATIONS:		$00
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$4,414**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/28/2007

PROJECT A.2 ONGOING PROVISIONAL MONITORING – DOWNSTREAM QUALITY-OF-WATER FOR PHYSICAL, BIOLOGICAL AND CHEMICAL SAMPLING (INCLUDES PEER REVIEW AND FOLLOW-UP R&D (FLOW AND SEDIMENT-TRANSPORT MODELING DEVELOPMENT)) *(REPORT 1 OF 2)*

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007
(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center	
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, A.2 *(Report 1 of 2)* (GCMRC No. BNE2A)	
(3.) PROJECT TITLE:	Ongoing Provisional Monitoring – Downstream Quality-of-Water for Physical, Biological and Chemical Sampling (includes R&D (modeling))	

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Theodore S. Melis / David J. Topping, Steve Wiele	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	tmelis@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7282	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:

Glen Canyon Dam has altered the character of the water that is released downstream into the Colorado River. The supply of fine sediment has been reduced to nearly zero, which has impacted fine sediment deposits and turbidity in Glen, Marble, and Grand Canyons. The thermal regime of the releases has changed from seasonal variations that followed air temperatures to nearly constant release temperatures throughout the year, which are colder in the summer and warmer in the winter than pre-dam temperatures. These changes, as well as changes in the downstream delivery of minerals, nutrients, and carbon have altered the ecosystem of the Colorado River downstream from Glen Canyon Dam. The Lake Powell Project characterizes the water quality of the lake and downstream releases. This project monitors how the releases affect the downstream ecosystem and develops tools to assist decision-makers in the management of Glen Canyon Dam.

The primary linkage between dam operations and the response of the physical, biological, and cultural resources in the Colorado River ecosystem between Glen Canyon Dam and Lake Mead is through the discharge and quality of water in the Colorado River. At the 2004 AMWG priority-setting workshop, questions relating specifically to water discharge and quality were three of the top five priorities of the AMP, and water discharge and quality issues influence the outcomes of every AMP goal. Releases from Glen Canyon Dam provide the principal control on the discharge of water in the Colorado River between Glen Canyon Dam and Lake Mead. This reach is hereafter referred to as the Colorado River ecosystem (CRE). Only during periods of large tributary floods do tributaries exert any substantial control on the discharge of the Colorado River in the CRE. Quality of water, using standard definitions, consists of temperature and the dissolved and suspended (inorganic and organic) material in the water column. Water temperature,

	dissolved salts, dissolved oxygen, suspended-sediment concentration and grain size, and suspended organic material therefore all contribute to water quality. Water quality in the CRE is driven in decreasing order of importance by dam operations, tributary activity, and mainstem biological activity (e.g., algal effects on turbidity).
(6.) OBJECTIVES:	The downstream Integrated Quality of Water Program (IQWP) characterizes the water discharge and water quality of the Colorado River and key tributaries between Glen Canyon Dam and the upper reaches of Lake Mead (River Miles –15 to 274). This project has two major components. The first component is focused on monitoring and modeling the mass-balance of fine sediment in the CRE. The second component of the downstream IQWP is focused on characterizing other water quality components of the ecosystem, such as water temperature, oxygen, nutrients, and carbon. Each component has monitoring and research elements as described below. **Downstream Monitoring Components:** **Fine sediment mass balance**: Use of laser-acoustic system and conventional suspended-sediment samples to monitor transport at several locations along the mainstem Colorado River and on key tributaries. Monitoring data are used to provide a continuous accounting of the mass-balance (input minus export) of sand and fine sediment in Marble and Grand Canyons and to assess the impacts of experimental flows on the mass-balance. **Continuous water quality monitoring:** Temperature, conductivity, dissolved oxygen, and pH are monitored at several locations along the mainstem Colorado River and key tributaries. Most sites are coincident with the mass-balance monitoring locations. Temperature monitoring in selected backwater habitat areas. Data are used to characterize the thermal regime and longitudinal gradient in mineral and oxygen content of the river, and to calibrate and validate numerical models. **Research Components:** **Numerical model development and application**: Fine sediment transport models are currently in use and under development. Research includes flume studies and detailed flow measurements of sediment transport dynamics. Water temperature model development is underway. Research includes detailed measurements of heat exchange between the river and the atmosphere; water temperature dynamics in backwater habitat areas. **Real-time two-way telemetry**: A system is being developed to provide two-way telemetry between the office and instrumentation in the Canyon. The two-way communication not only provides real-time access to data, but also allows the user full control of the instrument from the office. The system is being developed in a generic fashion to allow use with any instrument that uses serial communications.

(7.) RELATIONSHIP TO MRP:	Project A.2 in the 2006 annual work plan
(8.) METHODOLOGY:	Surface water measurements (i.e. stage and discharge) are made using standard USGS methods (described in *Techniques of Water-Resources Investigations of the U.S. Geological Survey, Book 3, Section A*) at the following sites: Colorado River at Lees Ferry, Paria River at Lees Ferry, Little Colorado River near Cameron, Little Colorado River near mouth, Colorado River at Grand Canyon, and Colorado River near Diamond Creek. At all sites, 15-minute data is available in approximate real-time (every 4 hours) through the USGS National Water Information System (NWIS) database (http://waterdata.usgs.gov/az/nwis/rt). The surface water gages are maintained and operated by the USGS Water Resources Discipline Arizona Water Science Center. Discharge-release data from Glen Canyon Dam are also estimated by the Bureau of Reclamation (http://www.wapa.gov/crsp/operatns/gcSCADAdata.htm). In addition, stage and suspended-sediment concentration and grain size are monitored every 15 minutes using laser-acoustic technologies at the following sites: 30-mile, 61-mile, 87-mile, and 226-mile. Water temperature and conductivity in the mainstem and major tributaries are monitored using a combination of Onset Hobo Water Temp Pro Loggers and YSI 6920 Multi-Parameter Loggers. Water temperature is monitored at eight mainstem locations: below the dam, Lees Ferry, 30-mile, 61-mile, 87-mile, 166-mile, 226-mile, and 246-mile. The Lees Ferry, 87-mile, and 226-mile sites correspond to existing surface water gages. Water temperature is also monitored on selected tributaries. The mainstem water temperature data is currently being used to calibrate and test a one-dimensional temperature model. Specific conductance is monitored below the dam, at Lees Ferry, 30-mile, 61-mile, 87-mile, and 226-mile. Spikes in specific conductance allow the downstream fate of more-saline water introduced by tributaries during floods (and therefore potentially the organic and washload components of the flux introduced by these tributaries) to be tracked in the Colorado River. Dissolved oxygen and pH are monitored continuously below the dam and at Lees Ferry. Other water-quality parameters (including full water chemistry) are measured four times annually at the Colorado River Lees Ferry gaging station by the Arizona Water Science Center as part of the Arizona Department of Environmental Quality (AZDEQ) program, and seven times annually at the Colorado River above Diamond Creek gaging station by the Arizona Water Science Center as part of the National Stream Quality Accounting Network program. The tributary supply of sediment to the Colorado River is computed using a combination of physically based models and measurements. On a near real time basis, the concentration and grain-size distribution of the sand and finer material supplied by the major tributaries (Paria and Little Colorado Rivers) are computed using a geomorphically coupled flow and sediment-transport model. Sediment-transport measurements are collected on these on two

	major tributaries by conventional and pump methodologies by the USGS WRD-Arizona Water Science Center and provided to our laboratory. As sediment-transport data become available from our laboratory, the predictions from this model are verified (to within the error in the measurements). Inputs of suspended sand (with grain size) and suspended silt and clay from the lesser tributaries are computed based on stage and sediment data collected in a network we established beginning in 2000. This network now covers 55% of the formerly ungaged tributary area between Glen Canyon Dam and the Little Colorado River. Sediment-transport data collected under the downstream integrated quality-of-water (IQW) project are used to compute flux-based "mass-balance" sediment budgets for the following reaches of the CRE: river-miles –15 to 0 (Glen Canyon), river-miles 0 to 30 (upper Marble Canyon), river-miles 30 to 62 (lower Marble Canyon), river-miles 62 to 88 (upper or eastern Grand Canyon), river-miles 87 to 226 (lower or western Grand Canyon).
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Monitoring activities described above are ongoing and scheduled to continue. Analysis of the November 2004 high-flow test data is scheduled to continue into FY2006. Completion of the initial phase of suspended-sediment transport model development is scheduled to be completed in FY2005 with continued refinement and submission of a journal article in FY2006. Water quality model development to continue with scheduled completion of the water temperature component in FY2006. During FY2006, compilation and reporting on the 1990-1991 National Canyon suspended-sediment data will be completed. Several USGS data reports and several peer-reviewed interpretive reports are to be completed during FY2006.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	During FY2006, all stage equipment and quality-of-water (QW) probes operated normally. Sediment-transport data collected during FY2006 on the tributaries to the CRE have been processed, finalized, and delivered to the GCMRC. Sediment-transport data collected during FY2006 on the mainstem Colorado River are now in the final stages of being processed and will be delivered to the GCMRC by March 2007. Other QW data collected during FY2006 are now in the final stages of being processed and will be delivered to the GCMRC by March 2007. Much of the National Canyon data were compiled and a draft report was written. The report was completed in early FY2007 and will be made available on-line. When available, the final report will be e-mailed to GCMRC. Substantial progress has been made on (1) posting the real-time sediment-transport data collected under this project to the World-Wide-Web, and (2) serving these data through Oracle; these two tasks will be completed during mid-2007. The two-way satellite telemetry system is now considered operational. Updates of the mass-balance sediment budgets have been computed and delivered to the GCMRC, TWG, and AMWG. The final reports from the sediment-transport modeling component of this project have been delivered to the GCMRC. During FY2006, results from the downstream IQW project were presented at (1) the 2005 Fall Meeting of the American Geophysical Union, San Francisco, California, December 5-9, 2005; and (2) 8th Federal Inter-Agency Sedimentation Conference, Reno, Nevada, April 2-6, 2006. The

	basic 1D Colorado River sand-transport model was completed, and a journal article submitted for publication in FY2006. Testing and calibration of the model has continued. The model we developed fits the model described in our proposal that was reviewed, selected, and funded by the GCMRC. The model is a reach-averaged, event-driven sand-transport model intended primarily to route sand inputs from the main tributaries over weeks to a few months. The root model in its uncalibrated state generally shows good agreement with data in an application that is long (7 months) and covers a wide range of flow and sand supply. Model predictions of cumulative sand volume at Phantom Ranch are close to or within measurement error estimated by the GCMRC. The uncalibrated model shows excessive sensitivity to sand inputs from the Paria, however, which affects transport rates and predicted grain sizes in transport. Calibration by Scott Wright has improved the model predictions.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Presentations were made to the TWG on May-24-25, 2006, on the results from the 2004 BHBF test and the results from the development and evaluation of "High-Resolution Monitoring of suspended-sediment concentration and grain size in the Colorado River using laser-diffraction instruments and a three-frequency acoustic system." A presentation was made to the TWG on August 2-3, 2006, on the results of studies of sand transport during steady and low-fluctuating flows. Topping gave an invited lecture on June 8, 2006, at the USGS-WRD Central Region Science Workshop, Lakewood, Colorado, with a presentation entitled "Collection of more accurate high-resolution sediment-transport data using laser diffraction and multi-frequency acoustic instruments" The following dissertation, five papers and two abstracts were either published during FY2006 or are currently in press. Fisk, G.G., Duet, N.R., McGuire, E.H., Roberts, N.K., Castillo, N.K., and Smith, C.F., 2006, Water resources data, Arizona, water year 2005: U.S. Geological Survey Water-Data Report AZ-05-1, accessed January 8, 2007, at http://pubs.usgs.gov/wdr/2005/wdr-az-05-1/ Grams, P.E., 2006, Sand transport over a coarse and immobile bed: The Johns Hopkins University, unpublished Ph.D. thesis, 163 p. Melis, T.S., Jain, S., Topping, D.J., Pulwarty, R.S., and Eischeid, J.K., 2005, Critical climate controls and information needs for the Glen Canyon Adaptive Management Program and environmental assessment in the Grand Canyon region: EOS, Transactions, American Geophysical Union, v. 86, n., 52, p. F627. Topping, D.J., Rubin, D.M., Schmidt, J.C., Hazel, J.E., Wright, S.A., Melis, T.S., and Kaplinski, M., 2005, Comparison of sediment-transport and bar-response results from the 1996 and 2004 controlled-flood experiments on the Colorado River in Grand Canyon: EOS, Transactions, American Geophysical Union, v. 86, n., 52, p. F906. Topping, D.J., Rubin, D.M., Schmidt, J.C., Hazel, J.E., Jr., Melis, T.S., Wright, S.A., Kaplinski, M., Draut, A.E., and Breedlove, M.J., 2006, Comparison of sediment-transport

	and bar-response results from the 1996 and 2004 controlled-flood experiments on the Colorado River in Grand Canyon: CD-ROM Proceedings of the 8th Federal Inter-Agency Sedimentation Conference, Reno, Nevada, April 2-6, 2006, ISBN 0-9779007-1-1. Topping, D.J., Wright, S.A., Melis, T.S., and Rubin, D.M., 2006, High-resolution monitoring of suspended-sediment concentration and grain size in the Colorado River using laser-diffraction instruments and a three-frequency acoustic system: CD-ROM Proceedings of the 8th Federal Inter-Agency Sedimentation Conference, Reno, Nevada, April 2-6, 2006, ISBN 0-9779007-1-1. Topping, D., Rubin, D., and Melis, T., in press, Coupled changes in sand grain size and sand transport driven by changes in the upstream supply of sand in the Colorado River: Relative importance of changes in bed-sand grain size and bed-sand area: Sedimentary Geology. Topping, D.J., Wright, S.A., Melis, T.S., and Rubin, D.M., in press, High-resolution measurements of suspended-sediment concentration and grain size in the Colorado River in Grand Canyon using a multi-frequency acoustic system: Proceedings of the Tenth International Symposium on River Sedimentation, August 1-4, 2007, Moscow, Russia. Wiele, S.M., Wilcock, P.R., and Grams, P.E., in press, Reach-averaged sediment routing of a canyon river: Water Resources Research.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	A manuscript by Grams and Wilcock entitled "Equilibrium transport of fine sediment over a coarse immobile bed" was submitted to the AGU journal Water Resources Research during 2006 and is currently being revised. The annual water-year 2006 data report is being finalized by the USGS-WRD Arizona Water Science Center (AWSC) and will be available during spring 2007. A USGS Open-File Report describing the 1991 suspended-sediment data-collection program on the Colorado River at National Canyon has been authored by Hornewer and others. The citation for this report is: Hornewer, N.J. and Wiele, S.M., 2007, Flow Velocity and Sediment Data Collected During 1990 and 1991 at National Canyon, Colorado River, Arizona: U.S. Geological Survey Data Series Report XXX, xx p. [expected to be available in March or April 2007]. A USGS Data-Series Report describing the water-temperature data collected in the CRE by GCES and GCMRC during the 1980s and 1990s has been authored by Voichick and Wright. Both of these two USGS reports have been reviewed and are to be published during spring 2007. A two-part article by Topping and others entitled "Evaluation of conventional sampling, laser diffraction, and acoustics for measuring suspended-sediment concentration and grain size 1. Errors associated with conventional depth-integrated sampling *and* Evaluation of conventional sampling, laser diffraction, and acoustics for measuring suspended-sediment concentration and grain size 2. Development and evaluation of a laser-acoustic system" is to be submitted to the Journal of Geophysical Research in summer 2007. Refinements have been made to the 1D Colorado River sand-transport model this FY, and testing and application is ongoing in collaboration with Scott Wright and Peter Wilcock. Funding through this agreement (two pay

	periods for Wiele) for modeling has been spent.				
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	This project has been externally peer reviewed (SEDS-PEP, August 2006) and is being proposed as core monitoring in 2007 as part of the recommendation report on long-term sediment monitoring to the TWG. It will also be reviewed internally by the USGS Office of Surface Water during spring/summer 2007.				
(14.) FY2006 BUDGET REPORT	**FINANCIAL INFORMATION COLLECTION DATE:**				09/30/2006
FY PLANNED GROSS BUDGET:	$ 817,947		**FISCAL YEAR NET AVAIL BAL:**		$764,562
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	The following report's budget is also contained in this budget.		**FISCAL YEAR EXPENDITURES:**		$698,660
			FISCAL YEAR OBLIGATIONS:		$65,902
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PM / PI.)	/S/ Theodore S. Melis	**TITLE:**	Physical Sciences Program Manager	**DATE:**	02/03/2007

PROJECT A.2 ONGOING PROVISIONAL MONITORING – DOWNSTREAM QUALITY-OF-WATER FOR PHYSICAL, BIOLOGICAL AND CHEMICAL SAMPLING (INCLUDES R&D (MODELING)) *(REPORT 2 OF 2)*

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, A.2 *(Report 2 of 2)* (GCMRC No. BNE2A)
(3.) PROJECT TITLE:	Ongoing Provisional Monitoring – Downstream Quality-of-Water for Physical, Biological and Chemical Sampling (includes R&D (modeling))

(4.) PRINCIPLE INVESTIGATOR INFORMATION:

Prin. Investigator:	Theodore S. Melis / Steve Wiele/Nancy Hornewer-USGS	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	tmelis@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7282	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	See previous report.
(6.) OBJECTIVES:	See previous report.
(7.) RELATIONSHIP TO MRP:	Project A.2 in the 2006 annual work plan
(8.) METHODOLOGY:	See previous report.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	• Monitoring streamflow on the Colorado River at Lees Ferry and Grand Canyon, and on the Paria River and Little Colorado River. Monitoring water temperature and specific conductance at Lees Ferry. Collecting suspended-sediment samples on the Paria River and Little Colorado River. • Compile National Canyon data from 1990-1991 and complete report. • The 1D sand transport model was refined and a journal article submitted.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	• Stage equipment working fine on the mainstem and tributary gages. Water-quality probe at Lees Ferry is also working fine. Sediment samples were collected during storms and given to GCMRC for processing. • Much of the National Canyon data were compiled and a draft report was written. The report was completed in early FY07 and will be made available on-line. When available, the final report will be e-mailed to GCMRC. • The basic 1D sand transport model, funded under a separate agreement, was completed, and a journal article submitted for publication in FY06. Testing and calibration of the model has continued. The model we developed fits the model described in our proposal that was reviewed, selected, and funded by the GCMRC. The model is a reach-averaged, event-driven sand-transport model intended primarily to route sand inputs from the main tributaries over weeks to a few months. The root model in its uncalibrated state generally shows good agreement with data in an application that is long (7 months) and covers a wide range of flow and sand supply. Model predictions of cumulative sand volume at Phantom Ranch are

	close to or within measurement error estimated by the GCMRC. The uncalibrated model shows excessive sensitivity to sand inputs from the Paria, however, which affects transport rates and predicted grain sizes in transport. Calibration by Scott Wright has improved the model predictions.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Annual Data Report WY05 was published: Fisk, G.G., Duet, N.R., McGuire, E.H., Roberts, N.K., Castillo, N.K., and Smith, C.F., 2006, Water resources data, Arizona, water year 2005: U.S. Geological Survey Water-Data Report AZ-05-1, accessed January 8, 2007, at http://pubs.usgs.gov/wdr/2005/wdr-az-05-1/ Modeling - a paper titled: Reach-averaged sediment routing model of a canyon river by Wiele, S.M., P.R. Wilcock, and P.E. Grams that describes the model and its application was submitted to Water Resources Research in FY06. It has been published in FY07 by WRR. A pdf copy was sent to the GCMRC.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	*Annual Data Report WY06 – should be available by the end of April 2007. *National Canyon Report: Hornewer, N.J. and Wiele, S.M., 2007, Flow Velocity and Sediment Data Collected During 1990 and 1991 at National Canyon, Colorado River, Arizona: U.S. Geological Survey Data Series Report XXX, xx p. [expected to be available in March or April 2007] *Modeling - Refinements have been made to the model this FY, and testing and application is ongoing in collaboration with Scott Wright and Peter Wilcock. Funding through this agreement (two pay periods for Wiele) for modeling has been spent.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	- Streamflow/Sediment – continue operation of gages and collection of sediment samples. - Modeling - Scott Wright, formerly the GCMRC Physical Resources modeling program manager, now with the CA WSC, and Peter Wilcock, Johns Hopkins University, have been running the model to further test and calibrate it. Wright and Wilcock have the necessary expertise and should continue to be supported in applying the model.

(14.) FY2006 BUDGET REPORT			**FINANCIAL INFORMATION COLLECTION DATE:**		09/30/2006
FY PLANNED GROSS BUDGET:		NA	**FISCAL YEAR NET AVAIL BAL:**		NA
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	Refer to previous report for budget information.		**FISCAL YEAR EXPENDITURES:**		NA
			FISCAL YEAR OBLIGATIONS:		NA
			END OF FISCAL YEAR AVAILABLE BALANCE:		NA
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Theodore S. Melis	**TITLE:**	Physical Sciences Program Manager	**DATE:**	02/28/2007

PROJECT A.3 COMPLETION OF RESEARCH & DEVELOPMENT IN SUPPORT OF MONITORING CHANGES IN FINE-SEDIMENT STORAGE ALONG THE MAIN CHANNEL & SHORELINES OF THE CRE

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007
(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center	
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, A.3 (GCMRC No. BNE2D)	
(3.) PROJECT TITLE:	Completion of Research & Development in Support of Monitoring Changes in Fine-Sediment Storage along the Main Channel & Shorelines of the CRE	

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Theodore S. Melis / David M. Rubin	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	tmelis@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7282	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:

Sandbars and other sandy deposits in and along the Colorado River in Grand Canyon National Park (GCNP) were an integral part of the pre-dam riverscape, and are still important for habitat, protecting archeological sites, and recreation. These deposits have eroded substantially following the 1963 closure of Glen Canyon Dam that reduced the supply of sand at the upstream boundary of GCNP by about 94%; sandbars in Marble Canyon have decreased in size by about 25% during the last 15 years. Results from the geomorphic synthesis project have shown that the deeper portions of eddies and the channel pools also contain about 25% less sand, silt, and clay than they contained in the early 1990s.

Relationships between Glen Canyon Dam operations, fine-sediments from tributaries below the dam, and interrelated downstream biological, socio-cultural resources are of primary management concern. This is true owing to the fact that sand bars are the primary substrate along many shoreline areas of the ecosystem. Monitoring data on fine-grained (sand and finer) deposits, linkages with physical habitats, and relationships to non-physical resources and processes offer insight on the effectiveness of the Secretary's 1996 Record-of-Decision (ROD), relative to management objectives.

Annual-to-biennial monitoring of fine-grained sediment storage provides information: (1) on the status of near-shore aquatic and terrestrial habitats where vegetation and associated fauna, socio-cultural resources are of management concern; (2) on the availability of fine-grained sediment that can be periodically manipulated through controlled floods to preserve and sustain downstream resources dependent on fine sediment; (3) on identification and interpretation of linkages between dam operations and changes in physical habitats and related ecosystem resources. All three areas of information support science-based evaluations of large-scale flow experiments (e.g., the Secretary's actions), and associated decision responses

	required for adaptive management to succeed. Fine-grained deposits (sand and finer) of the main channel constitute a major storage component of the Colorado River ecosystem's sediment budget. Glen Canyon Dam operations influence fine deposits in ways that affect aquatic and terrestrial habitats over both short and long periods. The emphasis of this long-term monitoring project is to document system-wide changes in fine-grained deposits relative to dam operations and natural inputs, with emphasis on key storage settings within critical reaches. This project was initiated through release of a competitive solicitation in October 2000. The first phase of this project was scheduled for completion at the end of FY2005, but has been extended through FY2006 owing to the additional field data collection campaign around the November high-flow test, and will be externally reviewed through the PEP process. In addition, the project is also focused on researching the fate of campsite areas on an annual basis, as well as the fate of sand bars reworked by wind in the vicinity of archeological preservation sites. Two other subcomponents of this project include monitoring sediment deposition in arroyos near archaeological sites and monitoring changes at campable beach areas owing to experimental high flows. These projects are described in the *Two-Year Science Plan for Experimental Flow Treatments and Mechanical Removal Activities in WY'S 2002-2004*.
(6.) OBJECTIVES:	The goals of this work are: (1) to monitor, quantify, and interpret changes in sand storage in the Colorado River Ecosystem, including changes in sand bar morphology, volume, area, and grain-size in selected bars and reaches, (2) to relate observed changes to dam releases and tributary sediment input, (3) to relate changes in grain size of fine sediment on the bed to changes in suspended sediment observed by the mass balance project, (4) and to provide advice on timing, magnitude, duration, and ramping rates for artificial floods.
(7.) RELATIONSHIP TO MRP:	Project A.3 in the 2006 annual work plan
(8.) METHODOLOGY:	**Overall Methodology—**Determine the change in sediment storage in selected study reaches, each approximately 3 to 5 km long, in the Grand Canyon ecosystem using a wide range of traditional and new methods to make measurements of changes in the volume and characteristics of fine sediment stored on the bed, in eddies, and in channel margins. A combination of ground-based field surveys, hydrographic field surveys, photogrammetrically derived topographic data, and topographic data determined from LIDAR measurements will be used to detect topographic changes within the study reaches. **Topographic Surveys—**Spatial geo-referencing of control for remotely sensed data and other instrumentation requires cm-scale accuracy. The data collected during this effort will have a point data accuracy on the order of $\pm$0.1 m horizontally and $\pm$ 0.05 m vertically. Survey accuracy in the field will be maintained by horizontal and vertical checks of positional error between known reference points in the GCMRC control catalog utilizing the Arizona State Plane Coordinate System.

	Hydrographic Surveying Using Multibeam—Previous investigations have demonstrated the utility of single beam hydrographic surveying to detect bed elevation changes at the pool scale (Andrews and others, 1999; Hazel and others, 1999). Recent advances in hydrographic survey have made it possible to implement a multibeam system in the relatively shallow-water, logistically difficult environment of the Colorado River. **Airborne Remotely Sensed Data—**This project cannot be completed without accurate digital overflight imagery such as LIDAR to accurately depict the terrestrial topography of the sub-reaches. **Change Detection Analysis—**The combination of field based surveys, multibeam data, and processed LIDAR derived topographic points will be combined into one data set to detect topographic changes within the selected sub-reaches. **Spatial Distribution of Fine Sediment—**Project will evaluate the advantages and disadvantages of side-scan sonar, multibeam topography, multibeam backscattering, underwater video transects, and underwater microscope for mapping distribution of fine sediment on the riverbed. **Grain Size of Fine Sediment—**This will be measured using thousands of digital images collected by underwater microscope (in the channel) and hand-held camera (on sand bars). Quality control will be assured by collecting a smaller number of physical samples for traditional lab analyses. **Eolian/archaeology work—**final reports will be completed.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	- Develop an integrated spatial data base time series for FIST analysis activities covering the time periods: August, 2000; September, 2000; May, 2002; May, 2004; November, 2004; December, 2004 and May, 2005. - Acquire, develop, and test data-processing methodologies and software packages for processing and analyzing data acquired for this project. Develop data processing and analysis techniques for underwater imagery surveys, LIDAR, multibeam sonar, and aerial photography. - Conduct spatial analyses. - Write paper detailing the methodologies for creating the composite surfaces and the composition of those surfaces. - Compare 1996 and 2004 flood results with respect to sediment transport and bar response to be submitted to JGR-Earth Surface or similar journal. - Complete processing and interpretation of digital imagery grain-size analysis. - Compile results of work in a memo to managers. - Complete final report on eolian/archaeology work.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	Topographic, bathymetric, and remote-sensing data from reach-based fieldwork in 2002, 2004, and before and after the November 2004 BHBF test were processed, finalized, and delivered to GCMRC-DASA. Aeolian sand-transport data collected during 2005 were delivered to the GCMRC; final report on this work was

	completed. Sandbar topographic and campsite-area data from fieldwork in 2001, 2002, 2003, 2004, and 2005 were also delivered to the GCMRC. During FY2006 and early FY2007, results from the FIST project were presented at (1) the 2005 Annual Meeting of the Geological Society of America, Salt Lake City, Utah, October 16-19, 2005; (2) the 2005 Fall Meeting of the American Geophysical Union, San Francisco, California, December 5-9, 2005; (3) 8th Federal Inter-Agency Sedimentation Conference, Reno, Nevada, April 2-6, 2006, and (4) the 2006 Fall Meeting of the American Geophysical Union, San Francisco, California, December 11-15, 2006. The project is now in its final stages with articles being prepared for publication.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Presentations were made to the TWG on May 24-25, 2006, on the results from the 2004 BHBF test and the results of the aeolian sand-transport/archaeology component of this project. The following four papers and five abstracts were published during FY2006: Breedlove, M.J., Hazel, J.E., Kaplinski, M.A., Schmidt, J.C., Topping, D.J., Rubin, D.M., Fuller, A.E., Tusso, R., and Gonzales, F.M., 2005, Using an integrated, remote-sensing methodology to evaluate the effects of dam operations on fine-grained sediment storage and sand bar restoration in Marble Canyon: EOS, Transactions, American Geophysical Union, v. 86, n., 52, p. F614. Draut, A.E., and Rubin, D.M, 2006, Measurements of Wind, Aeolian Sand Transport, and Precipitation in the Colorado River Corridor, Grand Canyon, Arizona -- January 2005 to January 2006: U.S. Geological Survey Open-File Report 2006-1188, 88p, http://pubs.usgs.gov/of/2006/1188/ Draut, A. E. and Rubin, D. M. 2007. The role of aeolian sediment in the preservation of archaeological sites in the Colorado River corridor, Grand Canyon, Arizona-Final report on research activities, 2003-2006: U.S. Geological Survey Open-File Report 2007-1001, 141 pages, http://pubs.usgs.gov/of/2007/1001/ Rubin, D.M., Chezar, H., Harney, J.N., Topping, D.J., Melis, T.S., and Sherwood, C.R., 2006, Underwater microscope for measuring spatial and temporal changes in bed-sediment grain size: U.S. Geological Survey Open-File Report 2006-1360, http://pubs.usgs.gov/of/2006/1360/ Rubin, D.M., Topping, D.J., Wright, S.A., and Melis, T.S., 2006, Incorporating bed-sediment grain size in predictions of suspended-sediment concentration: Three approaches tested using 20,000 bed-sediment grain-size measurements from the Colorado River in Grand Canyon: EOS, Transactions, American Geophysical Union, v. 87, n., 52, CD-ROM Fall Meeting Supplement, Abstract OS31A-1631.

	Schmidt, J.C., Topping, D.J., Grams, P.E., and Hazel, J.E., 2005, System-wide changes in the distribution of fine sediment in the Colorado River corridor of Grand Canyon National Park: Geological Society of America Abstracts with Programs, v. 37, n. 7, p. 331. Schmidt, J.C., Topping, D.J., Rubin, D.M., Breedlove, M.J., Hazel, J.E., Kaplinski, M.A., Wright, S.A., Fuller, A.E., and Melis, T.S., 2005, High releases from Glen Canyon Dam cause short-term eddy-bar aggradation if timed to coincide with significant input of sediment from tributaries: EOS, Transactions, American Geophysical Union, v. 86, n., 52, p. F913. Topping, D.J., Rubin, D.M., Schmidt, J.C., Hazel, J.E., Wright, S.A., Melis, T.S., and Kaplinski, M., 2005, Comparison of sediment-transport and bar-response results from the 1996 and 2004 controlled-flood experiments on the Colorado River in Grand Canyon: EOS, Transactions, American Geophysical Union, v. 86, n., 52, p. F906. Topping, D.J., Rubin, D.M., Schmidt, J.C., Hazel, J.E., Jr., Melis, T.S., Wright, S.A., Kaplinski, M., Draut, A.E., and Breedlove, M.J., 2006, Comparison of sediment-transport and bar-response results from the 1996 and 2004 controlled-flood experiments on the Colorado River in Grand Canyon: CD-ROM Proceedings of the 8th Federal Inter-Agency Sedimentation Conference, Reno, Nevada, April 2-6, 2006, ISBN 0-9779007-1-1.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	A multi-part USGS Open-File Report describing data and methods is to be finalized during early 2007 (authors Hazel, Kaplinksi, and Breedlove). Two to three interpretive journal articles will be finalized during the spring-summer of 2007 (authors Rubin, Schmidt, and Topping).
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Final presentations, with recommendations for future monitoring, will be made to the TWG and AMWG during summer 2007. Findings of the project will be included in the recommendations report to the TWG in 2007 on long-term sediment monitoring.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:	$ 271,625	**FISCAL YEAR NET AVAIL BAL:**			$257,348
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.	**FISCAL YEAR EXPENDITURES:**			$27,951
		FISCAL YEAR OBLIGATIONS:			$229,397
		END OF FISCAL YEAR AVAILABLE BALANCE:			**$ 00**
SIGNATURE: (Must be signed or submitted by PM / PI.)	/S/ Theodore S. Melis	**TITLE:**	Physical Sciences Program Manager	**DATE:**	02/02/2007

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	SUBMISSION DATE:	*02/20/2007
(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center	
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, A.4 (GCMRC No. BNE4A)	
(3.) PROJECT TITLE:	Ongoing Support of Provisional Monitoring Remote Sensing Data Acquisition	

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Glenn E. Bennett	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	gbennett@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7378	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Sediment and vegetation data are important at various scales to numerous scientists and resource managers. Past monitoring efforts have focused on expensive, large-scale, manual data collection aimed at small areas of the CRE. These were supplemented by collecting hard-copy aerial photography to help in manual interpretation. In FY2004, further development was made in automated processing of multi-spectral digital imagery to accurately map the two-dimensional distribution of fine-grained sediment deposits (sand) above 8,000 cfs on a canyon-wide basis. These products were derived from the system-wide digital overflight collected in May 2002, which offered a spatial resolution of 44 cm for the red, green, and blue color bands, 22 cm for the panchromatic band, and a horizontal accuracy (RMSE) of 30 cm. Digital elevation data accompanying the imagery provided 1-meter resolution with a vertical accuracy (RMSE) of approximately 40 cm as measured against survey data. An FY 2005 airborne remote-sensing mission to replicate these data on a system-wide scale collection provides the necessary inputs to determine changes to the resources in the CRE between May 2002 and May 2005. Efforts in FY 2006 will focus on management of these digital data and preparation for serving both the 2002 and 2005 imagery so that change detection analyses can be accomplished in 2007 through 2008. The next system-wide overflight is proposed for FY 2009.
(6.) OBJECTIVES:	In accordance with the DASA program's long-term monitoring goals, an airborne mission to collect digital imagery for the entire CRE from Glen Canyon Dam down to Lake Mead was implemented in May 2005. Those data, along with the 2002 imagery fulfill the proposal currently offered by GCMRC to collect system-wide aerial imagery approximately every 4 years as outlined in the draft Core Monitoring Plan. The main objective is to work with the providers of the digital overflight data to ensure that proper delivery requirements are upheld, and to check data delivered against GCMRC data standards. The May 2005 dataset is similar to that collected in May 2002, using digital sensors mounted in a fixed-wing aircraft to collect data for the red, green, and blue (RGB) bands in the visible spectrum as well as near-

	infrared data. A Digital Surface Model (DSM) with a 1-meter pixel resolution will also be a part of the dataset from this mission.
(7.) RELATIONSHIP TO MRP:	Goal 12
(8.) METHODOLOGY:	Data delivered by contractors must follow GCMRC guidelines as outlined in the "Data Standards and Delivery Requirements" document given to contractors of airborne remote sensing data. Initially data checking involves basic components such as the presence/absence, image formatting, file naming convention and readability of delivered files. Then data are viewed in both GIS (ESRI ArcMap) and remote sensing (ERDAS Imagine) software packages and analyzed for adherence to spatial data requirements such as proper image registration, spatial projection, image resolution, data value ranges for each band, ortho-rectification issues, and sufficient image overlap presence. Discrepancies and errors are documented and forwarded back to the remote sensing contractor for reworking and correction. Finally, an accuracy assessment of the final data delivery is performed for both the horizontal and vertical positioning of the remote sensing data using the GCMRC Geodetic Network Control (see Project D.3 – Logistics).
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	The system-wide remote sensing mission occurred in May 2005 (with another flight proposed for 2009) and products expected to be delivered by the end of September 2005. During the first half of FY 2006, a quality and accuracy period will immediately follow the receipt of all deliverables and should take approximately 1-4 months, after which time existing automated procedures will be adapted for the newly acquired data and used to perform a variety of spatial analyses designed to determine changes to the resource over time. During the remainder of FY2006, the DASA staff will upgrade the various servers associated with the Oracle data base, so as to prepare for management and serving of the 2005 imagery. Some limited analyses of the imagery, relating to the November 2004 Experimental High-Flow Test, will also occur during FY2006, within the context of final analysis and reporting by the Fine-Grained Storage research project.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	Due to unforeseeable and uncontrollable climatic events (Hurricanes Katrina and Rita), the New Orleans-based contractors (3001, Inc.) were severely disadvantaged to carry on normal company operations and were unable to meet delivery deadlines of the May 2005 remote sensing data sets. Every effort was given on the part of GCMRC to accommodate those affected while continuing to assist the contractor in seeing the project through to the data delivery phase. By the close of FY2006, 18 months after data collection, approximately 95% of data for the May 2005 overflight had been delivered to GCMRC. These data were expected by the close of FY2005, and so the full assessment of the remote sensing mission was impossible to complete prior to the end of FY2006. An initial accuracy assessment was performed in July 2006 for some of the available data; however, due to the late delivery of the full data set, a final accuracy assessment will now be completed in FY2007. Several servers, including the Oracle database server, were upgraded to allow for more data storage for GIS and remote sensing work, including more storage space for the May 2005

	imagery and elevation data sets.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Despite all the contractual delivery issues, the following datasets are now available on GCMRC servers: 1. Canyon-wide, Color Infra-Red (CIR) digital imagery (18cm) 2. Canyon-wide, Red-Green-Blue (RGB) digital imagery (18cm) 3. Canyon-wide, digital surface model (DSM) at 1-meter resolution. Images that fall within FIST reaches were assigned top priority and made available for analyses relating to the November 2004 Experimental High-Flow Test for the second half of FY2006. Additionally, an initial accuracy assessment poster for the May 2005 data was presented at the 26th Annual ESRI International User Conference, August, 2006, San Diego Convention Center, San Diego, CA.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	All final data from the May 2005 overflight and resultant metadata will be stored in TIF format on a GCMRC server as well as loaded into the Oracle database and made available via GCMRC's Internet Map Server (IMS). [See DASA Database and GIS projects in FY2007 for more information]. A comprehensive accuracy assessment of the May 2005 remote sensing data will completed in FY2007.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	It is recommended that future core monitoring remote sensing activities include travel for GCMRC on-site visits of contractors both before and after the data collection process to ensure that data standards and delivery requirements are followed from the onset through to completion of the contract. Additionally, 1 -2 GCMRC personnel should attend appropriate training relating to the writing and handling of large remote sensing contracts. Post-processing of raw data into GIS usable formats by GCMRC staff may potentially provide products with higher accuracy standards than those typically returned by contractors. A new term position is recommended to process Remote Sensing Data.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:	$32,877	**FISCAL YEAR NET AVAIL BAL:**			$84,396
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	GCMRC contributed a significant portion of appropriated funding toward this effort in FY 2006.	**FISCAL YEAR EXPENDITURES:**			$84,396
		FISCAL YEAR OBLIGATIONS:			$00
		END OF FISCAL YEAR AVAILABLE BALANCE:			**$ 00**
SIGNATURE: (Must be signed or submitted by PM / PI.)	/S/ Glenn E. Bennett	**TITLE:**	DASA Program Manager	**DATE:**	02/02/2007

PROJECT A.5A SCIENCE SUPPORT OF ALL DATA STORAGE WITHIN GRAND CANYON INTEGRATED (ORACLE) DATABASE MANAGEMENT SYSTEM (DASA)

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007
(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center	
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, A.5a (GCMRC No. BNE4C)	
(3.) PROJECT TITLE:	Science Support of All Data Storage within Grand Canyon Integrated (Oracle) Database Management System (DASA)	

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Glenn E. Bennett	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	gbennett@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7378	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	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.
(6.) OBJECTIVES:	The purpose of the GCMRC Database Management System (DBMS) is to store and deliver all tabular and spatial data, via our Spatial Data Engine (SDE), gathered as the result of GCMRC investigations and legacy data. Developing the DBMS requires inventorying, organizing, archiving, and developing delivery systems for many years worth of environmental data collection activities representing a vast array of disparate data including physical, biological, cultural, socio-economic, and climatic information.
(7.) RELATIONSHIP TO MRP:	Goal 12
(8.) METHODOLOGY:	Management of the Oracle database for GCMRC follows industry-standard relational database methodologies for database design and schema development, data entry, data storage, database back-ups, and data access elements. This is achieved through both manual and automated procedures, with new data management routines and greater accessibility to the data being implemented each year.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Many datasets have been integrated into our DBMS with additional datasets in working progress. The additional data yet to be included in our DBMS are organized in Microsoft Excel files, Microsoft Access databases, SAS, or other proprietary formats. The DBMS program is currently working on bringing together years of disparate historical data, collected by multiple entities located in databases across the southwest, in an organized fashion and then deliver it transparently to stakeholders and

	researchers for decision making and modeling purposes. Delivering data in an automated fashion is key to the success of the DBMS. Accommodating such a task will be done utilizing database driven web pages and ArcIMS, a web accessible tool to allow access to our spatial data. These technologies can be integrated to deliver tabular and spatial data referenced through the Oracle relational database.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	Access to the Oracle database has been greatly increased within GCMRC during FY2006, allowing staff scientists to work more closely with their data as it is stored in the database. A new Aquatic Food Base schema was developed and hands-on training was provided to GCMRC staff and associated contractors to streamline data entry and analysis. Existing database tables were updated in the sediment and water schemas, including a reload of legacy data from sediment and LCR gages appended to the database. The water access page was revamped in FY2006 and is once again providing water data from several gages throughout the Grand Canyon basin. Additionally, a significant effort was made to eliminate errors from existing databases and new field submissions, especially the native and nonnative fish data, which in turn has improved upon the response time for generating the Humpback Chub Assessment. Historical tag linking was achieved that extended the time line beyond any previous efforts; this allows an unprecedented view into the life history of endangered fish.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	• Aquatic Food Base schema developed • Water Access page repaired and once again operational and several hundred thousand new values added. • Sediment database schema updated • LCR gage information added to existing water schema • Fish database errors resolved, historical tag linking accomplished
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Future products will include increased web access to GCMRC database and new schemas to accommodate new datasets not yet incorporated into the GCMRC Oracle database.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	The Grand Canyon Integrated Databases is currently understaffed owing to the DBMS position being vacated in January 2007, This position is necessary for basic database maintenance as well as the development of new procedures that will allow increased access to the database for scientists, resources managers, and the public alike.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:		$157,105	**FISCAL YEAR NET AVAIL BAL:**		$138,928
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$128,457
			FISCAL YEAR OBLIGATIONS:		$10,471
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or	/S/ Glenn E. Bennett	**TITLE:**	DASA Program Manager	**DATE:**	02/02/2007

submitted by PM / PI.)					

PROJECT A.5B ONGOING DATA CONVERSION & LIBRARY OPERATIONS (DASA)

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007
(1.) SUBMITTING AGENCY:	USGS – Grand Canyon Monitoring & Research Station	
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, A.5b (GCMRC No. BNE4F)	
(3.) PROJECT TITLE:	Ongoing Data Conversion & Library Operations (DASA)	

(4.) PRINCIPLE INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Glenn Bennett / Stephanie Wyse	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	gbennett@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7378	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	The scope and purpose of the library is to collect, archive, and deliver materials that assist GCMRC in its efforts to administer long-term monitoring and research. Many of these materials are archival, meaning only one copy exists, and are at risk of loss or damage. The library program also coordinates GCMRC's peer review process to ensure the high quality of the scientific information it produces. The GCMRC library acts as the physical repository for reports and data generated by GCMRC scientists as well as materials related to the Colorado River, Grand Canyon, and Adaptive Management.
(6.) OBJECTIVES:	Library operations facilitate monitoring and research by providing a centralized repository for hard copy information such as books, reports, maps, photography, and videos. The library has undertaken a project to convert all materials in the library to digital format and make them accessible and searchable on the GCMRC website. Having materials available through the website will allow multiple users to access data concurrently from remote locations as well as protect unique items from damage or loss. Coordinate independent scientific peer review at all levels of GCMRC scientific activities -- proposals, ongoing programs, publications, and other products -- providing a mechanism for ensuring the quality, credibility, and objectivity of GCMRC's scientific activities.
(7.) RELATIONSHIP TO MRP:	The library provides support to the GCMRC science programs and the adaptive management program and addresses all MOs and RINs.
(8.) METHODOLOGY:	The library catalogs all new materials that come from staff scientists, contractors, and cooperators as well items related to Grand Canyon, the Colorado River, and Adaptive Management. Library staff provides support to cooperators, contractors, and staff scientists by researching and obtaining current and legacy articles and reports related to science projects. Staff coordinates the peer review process for proposals and reports submitted to the GCMRC, by soliciting reviewers, tracking materials and timelines and ensuring confidentiality and lack of conflicts of interest. The scanning conversion project involves: - Scanning and converting paper reports into digital pdf files, making the documents searchable by using Optical Character

	Recognition (OCR) software, and then posting the files in the library database on the GCMRC website. - Scanning all analog aerial film and photos using the Vexcel Ultrascan 5000. Digital results can then be used for 2D and 3D change detection. - Digitizing flight line maps to provide a searchable mechanism to locate individual scanned aerial photos. - Converting VHS tapes to DVDs - Scanning all legacy slides to create digital images using the Nikon SuperCoolScan scanner		
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	The Library continues to maintain an on-line library catalog which provides access to more than 8,000 publications, catalog records of all materials, and provides monthly updates of new reports received in the library. Additionally, assistance is made available to cooperators, stakeholders, media contacts and the public by providing access to reports, aerial photos, maps, slides and photos in hardcopy and digital form. Library staff also uses research skills in locating contemporary and legacy materials, while the physical library location offers a research facility for visiting scientists, GMCRC employees, cooperators and the public.		
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	Numerous new holdings have been added to the library in FY2006, ranging from hard copy texts to digital versions of research reports and peer-reviewed journal articles produced from GCMRC science and the Adaptive Management process. The GCMRC librarian also coordinates review activities for Protocol Evaluation Panels (PEPs) and research proposals and reports funded by the Center. In FY2006 this included 1PEP (sediment), 4 research proposals and 26 research reports. In the second half of FY2006, DASA library staff responded to a BOR data call, producing an inventory of all information collected in conjunction with adaptive management process since 1995.		
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Access to 8,000 hardcopy reports, 8000 photos and slides, and 700 videos in broadcast and VHS format. In additional, once the library scanning project is complete, this information will be available in digital format from the library via digital media such as DVD and on-line via the World Wide Web.		
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Continued effort towards providing entire holdings with web access.		
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	In addition to coordinating GCMRC's peer review process and normal library operations, continue conversion of hardcopy reports for web access, conversion of aerial photography for scientific analysis and change detection.		
(14.) FY2006 BUDGET REPORT	**FINANCIAL INFORMATION COLLECTION DATE:**		09/30/2006
FY06 PLANNED GROSS BUDGET:	$168,005	**FISCAL YEAR NET AVAIL BAL:**	$168,038

COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	Additional appropriated funds contributed toward this effort.		**FISCAL YEAR EXPENDITURES:**		$56,541
			FISCAL YEAR OBLIGATIONS:		$111,497
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Glenn E. Bennett	**TITLE:**	DASA Program Manager	**DATE:**	02/02/2007

PROJECT A.6 ONGOING SUPPORT GIS GENERAL SUPPORT FOR INTEGRATED ANALYSES AND PROJECTS (DASA)

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007
(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center	
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, A.6 (GCMRC No. BNE4E)	
(3.) PROJECT TITLE:	Ongoing Support GIS General Support for Integrated Analyses and Projects (DASA)	

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Glenn E Bennett / Thomas Gushue	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	gbennett@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7378	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	The traditional role of the GIS Program is inherently service-oriented, providing spatial database development, programming, and analysis support to the science programs and their cooperators on both a planned and an as-needed basis. To continue functioning in this capacity, it is imperative to factor in designated blocks of time to maintain and, in some cases, improve the level of GIS support. There is also a need for a higher level of support for more specific GIS application development and analysis of available spatial data. Additionally, a need exists to allow access for staff scientists, contractors, managers, and the public to spatial data collected and stored as part of GCMRC's mission.
(6.) OBJECTIVES:	A main objective of GIS general support is to provide GCMRC staff, contractors, and managers with reliable, accurate spatial data that assists other GCMRC projects with their goals and objectives. It includes the maintenance and support of GIS and remote sensing software required to develop data sets, perform analyses, and create useful outputs used by other projects. General support also encompasses the access of spatial data via the World Wide Web in the form of internet mapping services that are developed for both focused scientific efforts and the public alike.
(7.) RELATIONSHIP TO MRP:	Goal 12
(8.) METHODOLOGY:	The collection of spatial data is achieved through a variety of methods that include, but are not limited to, remote sensing data collection missions, traditional survey and GPS operations, field mapping using hardcopy map or pen tablet computers, on-screen digitizing using previously collecting remote sensing data as source information, and through other standard data entry methods. Spatial data are generally stored in one of the standard ESRI file types (shape file, coverage, geodatabase) as well as in ASCII format. Methods used for spatial data processing and analysis will vary depending on the questions that need to be answered. General support for geographic information systems (GIS) uses

	industry-standard best practices for new GIS data development, management, and storage of existing data, quality control of spatial data, preparation of data for analysis, and exporting data in various outputs including hard copy maps, river atlases for field use, and digital cartographic products for inclusion into peer-reviewed publications and professional presentations.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Work performed by GIS personnel for physical, biological, and cultural resource projects include but are not limited to the following: Data entry and GIS database development, analysis of new and existing spatial data, map and graphic generation for field collection, presentation and publication purposes. This project also manages GCMRC's Internet Map Server (IMS) site, provides support for operation of GIS and remote sensing software applications, serves as a technical lead in the realm of spatial data collection, analysis, preparation, and metadata development as these concepts apply to other projects, and works closely with other DASA projects to mold a cohesive data management team.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	Great strides in the realm of field map development were achieved in FY2006, allowing for the automation of customized river atlases to support specific projects in the field. Examples of projects benefiting from this improved support include the Aquatic Food Base project and the Campsite Mapping project. This new development is also applicable to any GCMRC project in need of field maps for river trips. Improvements in the IMS system were also made during FY2006, including the development of a new research-based internet map service for the Fine-grained Integrated Sediment Team (FIST). This site was made available to FIST members and added features previously not possible, such as the integration of text documents, spreadsheets, and charts with the spatial data served through the website. This allowed team members stationed at different locations to view and query spatial and tabular data related to the project simultaneously.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Numerous digital map outputs were created for peer-reviewed publications (~15 maps), as well as several map products created for professional presentations by GCMRC technical staff, scientists, and managers. New GIS data layers were created for several projects including Aquatic Food Base, LCR HBC Monitoring, and Campsite Monitoring. Also, a new customized application for creating river trip maps was deployed in the July / August 2006 to improve on the quality and efficiency of river atlas production.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Once all data and metadata from May 2005 remote sensing mission has been received and thoroughly checked, these data will then be included into the Oracle Spatial Database Engine and made available via GIS (for GCMRC staff) and IMS (for outside parties).
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or*	In FY2007, the GIS general support will work on upgrading the GIS software to a new version (9.2) and begin testing the applicability of a newly available module called ArcGIS Server. This module is expected to greatly improve on GMCRC's ability to serve not only large spatial datasets, but also linked tabular data from Oracle, spatial analyses developed by GCMRC staff and

future program guidance, etc.)	various usable outputs including maps, charts and graphs related to project-specific data in the Oracle database.				
(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2007
FY PLANNED GROSS BUDGET:	$186,017	**FISCAL YEAR NET AVAIL BAL:**			$167,852
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.	**FISCAL YEAR EXPENDITURES:**			$125,932
		FISCAL YEAR OBLIGATIONS:			$41,920
		END OF FISCAL YEAR AVAILABLE BALANCE:			**$ 00**
SIGNATURE: (Must be signed or submitted by PM / PI.)	/S/ Glenn E. Bennett	**TITLE:**	DASA Program Manager	**DATE:**	02/02/2007

PROJECT A.7 COMPLETION OF CHANNEL-MAPPING PROJECT (DASA)

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, A.7 (GCMRC No. BNE4G)
(3.) PROJECT TITLE:	Completion of Channel-Mapping Project (DASA)

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Glenn E. Bennett	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	gbennett@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7378	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	A need exists to complete the processing of multi-beam sonar hydrographic data collected in 2001, including translating and rotating of these data into GCMRC's modern geodetic control and preparation for inclusion into GIS / Oracle database.
(6.) OBJECTIVES:	This project is intended to provide full channel geometry map coverage of the portions of the main channel between Glen Canyon Dam and Phantom Ranch. The FY 2006 effort is intended to complete the channel mapping work that was initially started in FY 2001. The remaining work mostly consists of manipulating the previously processed hydrographic data to fit the modern geodetic control network and then using GIS procedures to combine the terrestrial portion of the topographic data derived system-wide from the May 2002 overflight with the multi-beam bathymetric (aquatic) topographic data collected by the Remote-Sensing Coordinator. Once completed, these combined topographic channel models are used to support flow and sediment model simulations aimed at prediction of physical habitat conditions that evolve under differing scenarios of dam releases and fine-sediment supply conditions. These topographic models can also be used to determine changes in sediment storage in the main channel when repeat mapping is conducted for similar areas in the future (related to either experimental research or long-term monitoring).
(7.) RELATIONSHIP TO MRP:	Goal 12
(8.) METHODOLOGY:	Methods for completing this project involve finalizing the processed hydrographic data and performing a standard translation and rotation into the modern geodetic control for all processed data. Additionally, metadata is to be developed for each HyPack project (or pool) and exported to X, Y, Z text files. Completed and adjusted text files can than be imported into GIS (ESRI format) and incorporated into automated procedures designed to combine topographic and hydrographic data sets into one channel map surface.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate*	Specific tasks include any final processing required for the hydrographic data using HyPack software, translating and rotation the X, Y, Z positional values from the older 2001 GCES survey control into the modern geodetic control currently used by GCMRC. Documentation of this work should occur at the same

and helpful.)	time, and lead to the development of Federal Geographic Data Committee (FGDC)-compliant metadata that sufficiently captures the procedures involved in this portion of the project. The final adjusted data is to then be exported at defined resolutions (2-meter, 50 cm, 25 cm) into a GIS-friendly, ASCII text format. From there data will be incorporated into existing GIS automated procedures that combine the hydrographic data with existing topographic data (May 2002) to form channel map surfaces.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	These data have been processed and this project closed with FY2006. All data developed from this project will be handled by the GIS general support and Integrated Analysis and Modeling projects in FY2007.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	No reports have been generated in association with this project.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	None planned.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Single and Multi-beam sonar hydrographic data have proven useful for Sediment and Flow modeling, and have a potential to help Foodbase studies. If this project was funded and wrapped into the recommended internal Overflight processing position, a continuum of institutional processing knowledge could be created in one staff position.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2007
FY PLANNED GROSS BUDGET:	$32,877	**FISCAL YEAR NET AVAIL BAL:**			$32,585
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.	**FISCAL YEAR EXPENDITURES:**			$11,174
		FISCAL YEAR OBLIGATIONS:			$21,411
		END OF FISCAL YEAR AVAILABLE BALANCE:			**$ 00**
SIGNATURE: (Must be signed or submitted by PM / PI.)	/S/ Glenn E. Bennett	**TITLE:**	DASA Program Manager	**DATE:**	02/02/2007

PROJECT B.1 ONGOING PROVISIONAL MONITORING – TERRESTRIAL ACTIVITIES (KAS AND SWWF)

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, B.1 (GCMRC No. BNE1A)
(3.) PROJECT TITLE:	Ongoing Provisional Monitoring – Terrestrial Activities (KAS and SWWF)

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Matthew Andersen / Dan Cox, AGFD Project Coordinator	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	mandersen@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7379	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	To address the AMWG needs associated with KAS requires site visits to Vasey's Paradise. Snails are associated with specific types of vegetation and particular locations at the spring. Knowing the extent of available habitat is necessary to determine snail densities and for the development of a biological opinion in the event of a high flow. Changes in snail numbers can be associated with changes in vegetation. By monitoring the vegetation at Vasey's Paradise, the snails are indirectly monitored, because if the preferred habitat is present then one might assume that snails are present. Total habitat can be measured using remote methods, but the composition of the habitat may still require on-the-ground sampling. Sampling at Vasey's Paradise can also provide spring data in support of Goal 6, which is related to the protection and improvement of riparian and spring communities.
(6.) OBJECTIVES:	To determine extent and kind of vegetation that exists as habitat for the Kanab ambersnail and to track the abundance and distribution of KAS at Vasey's Paradise.
(7.) RELATIONSHIP TO MRP:	Related to Goal 5
(8.) METHODOLOGY:	The standardized methods of Stevens and others (1997) will be used to conduct population and habitat surveys at the site during biannual surveys. In addition, the Autumn survey will sample the upper vegetation zone snail population above 100,000 cfs (2,833 cms) stage discharge height. Less-invasive sampling techniques as proposed by Grand Canyon Monitoring and Research Center (GCMRC) and in Sorensen (2001) will be used as requested. Field data will be entered into a Microsoft Excel spreadsheet and/or Access database, and adhere to GCMRC data standards.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Sample vegetation plots at Vasey's Paradise to determine patch composition and extent (Spring and Fall of each year). Sample for the presence of snails in plots. Survey vegetated area using traditional survey methods. Document area of habitat and individual patches (Spring and Fall of each year). Enter data and conduct quality control on data entry. Provide data to GCMRC for vegetation analysis.
(10.) PROGRESS STATEMENT:	Surveys of habitat were completed in spring and fall of 2006.

(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)	Survey data are being reduced and mapping of area is in progress. Annual report pending completion of survey data. Attended Kanab Ambersnail Working Group meeting in Spring 06.				
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Annual report in preparation. Presentation to Grand Canyon River Guides annual meeting in March 2006				
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Final report expected to be completed March 30, 2007				
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Maintain biannual monitoring of Kanab ambersnail in Grand Canyon				
(14.) FY2006 BUDGET REPORT	**FINANCIAL INFORMATION COLLECTION DATE:**				09/30/2006
FY PLANNED GROSS BUDGET:	$88,832	**FISCAL YEAR NET AVAIL BAL:**			$79,163
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	The cooperative agreement came in approximately $6,800 less than was expected adding to the FY 2006 carryover balance.	**FISCAL YEAR EXPENDITURES:**			$60,472
		FISCAL YEAR OBLIGATIONS:			$11,885
		END OF FISCAL YEAR AVAILABLE BALANCE:			**$6,806**
SIGNATURE: (Must be signed or submitted by PM / PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/05/2007

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, B.2 *(Report 1 of 2)* (GCMRC No. BNE9A)
(3.) PROJECT TITLE:	Continued Research and Development – Aquatic Productivity, Organic Mass Balance, and Food Web Linkage Studies (Linking whole-system carbon cycling to quantitative food webs in the Colorado River)

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Matthew E. Andersen / Kennedy, GCMRC Hall, Univ of WY Rosi-Marshall, Loyola Univ., Baxter, Idaho St.	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	mandersen@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928)556-7379	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	The carbon budget for the CRE and trophic linkages that connect basal resources with invertebrates and fishes need to be resolved before GCMRC can develop an effective and efficient food base monitoring program.
(6.) OBJECTIVES:	Determine carbon budget and quantitative food webs for the CRE. Quantitative food webs identify trophic linkages connecting basal resources with top predators and also flux along these trophic pathways.
(7.) RELATIONSHIP TO MRP:	Related to Goal 1.
(8.) METHODOLOGY:	This project incorporates stable isotope and diet analysis of invertebrates and fish to identify trophic pathways. Flux along trophic pathways will be quantified by calculating invertebrate densities and estimating production and growth, and also estimating rates of food consumption by fish using bioenergetic approaches. Whole stream metabolism, terrestrial litter inputs from the riparian corridor, and allocthonous inputs from tributary flooding events will be measured to assess the carbon budget for the CRE. Lastly, these data will be incorporated into a bioenergetics model for the aquatic ecosystem.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Monthly sampling of algal and invertebrate biomass, benthic organic matter, whole system metabolism, and transported organic matter will be conducted at Glen Canyon and Diamond Creek. Transported organic matter will be sampled on the Paria River during episodic flooding events. Four times per year the above samples will be collected at sites within the CRE during river trips. Four times per year samples of basal resources, invertebrates and fishes will be collected from all sites (Glen Canyon, Diamond Creek, and sites in the Grand Canyon) and analyzed for stable isotopes and gut contents to determine trophic

	linkages. Invertebrate growth rates will be assessed seasonally at Diamond Creek and Glen Canyon to facilitate calculation of invertebrate production. All of these data will be used to develop a bioenergetics model for the CRE.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	Site selection and sampling methodology was finalized in April 2006. All of the field sampling tasks were completed as planned in FY06. Initial findings are: 1) that open-system metabolism measurements are feasible in the CRE and algae production is always high in Glen Canyon and considerably lower along downstream reaches, 2) tributary inputs of organic matter dominate the carbon budget for downstream reaches, and 3) invertebrate biomass and production is extremely high in Glen Canyon and extremely low in downstream reaches.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	None. Work on this project was started in February 2006.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Draft annual report will be completed by Feb. 28, 2007. A presentation of results will be made at the winter meeting of the American Society of Limnology and Oceanography in February. At least five presentations of results will be made at the annual meeting of the North American Benthological Society.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Continue project. If hydrogen stable isotope analysis proves to be a useful tracer of trophic linkages (see report for Coop Agreement # 04HQAG0122), it is recommended that the budget for this project be increased by $10,000 annually to cover the additional cost of analyzing samples for hydrogen stable isotopes.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:	$403,898	**FISCAL YEAR NET AVAIL BAL:**			$373,670
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	This budget is for both this report and the following report for Project B.2, Aquatic Food Base. Year end funds are a result of partially funding a cooperative agreement with prior year funds resulting in a savings for FY06.	**FISCAL YEAR EXPENDITURES:**			$159,293
		FISCAL YEAR OBLIGATIONS:			$69,625
		END OF FISCAL YEAR AVAILABLE BALANCE:			**$144,752**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/02/2007

PROJECT B.2 CONTINUED RESEARCH AND DEVELOPMENT – AQUATIC PRODUCTIVITY, ORGANIC MASS BALANCE, AND FOOD WEB LINKAGE STUDIES (ELUCIDATING AQUATIC AND TERRESTRIAL CONTRIBUTIONS OF ORGANIC CARBON TO THE COLORADO RIVER ECOSYSTEM USING STABLE HYDROGEN ISOTOPES) 2 OF 2

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, B.*2 (Report 2 of 2)* (GCMRC No. BNE9A)
(3.) PROJECT TITLE:	Continued Research and Development – Aquatic Productivity, Organic Mass Balance, and Food Web Linkage Studies (Elucidating Aquatic and Terrestrial Contributions of Organic Carbon to the Colorado River Ecosystem Using Stable Hydrogen Isotopes)

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Matthew E. Andersen / Kennedy, GCMRC Sabo, ASU	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	mandersen@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7374	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Linkages connecting carbon sources (i.e., algae, leaf litter, macrophytes, etc.) with higher trophic levels need to be resolved in order to develop an effective and efficient food base monitoring program. Stable isotopes of carbon and nitrogen are a tool that is commonly used to resolve these trophic linkages, but if algae and terrestrial carbon sources have similar isotopic signatures this technique will not work. Stable isotopes of hydrogen might be a useful tracer of trophic linkages because algae and terrestrial carbon sources tend to have different hydrogen isotope signatures.
(6.) OBJECTIVES:	Validate utility of hydrogen stable isotopes as a tracer of trophic linkages
(7.) RELATIONSHIP TO MRP:	If hydrogen stable isotopes prove to be a useful tracer of trophic linkages, the larger food base project (Dr. Robert Hall, PI) will incorporate use of this technique into their project.
(8.) METHODOLOGY:	Collect samples of basal resources, invertebrate consumers, and top predators (fish) and process them for carbon, nitrogen, and hydrogen stable isotope signatures and determine whether hydrogen stable isotopes can be used to resolve trophic linkages connecting carbon sources with invertebrate and fish consumers.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate*	Collect samples of basal resources, invertebrate consumers, and top predators from 10 sites throughout the canyon during clear water conditions and again during turbid water conditions. During clear water conditions algae is likely to be plentiful and may be an

and helpful.)	important food resource for invertebrates and ultimately fishes. During turbid water conditions terrestrial carbon is likely to be plentiful and may be an important food resource for invertebrates and ultimately fishes.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	Samples of basal resources, invertebrate consumers, and top predators were collected from 10 sites throughout the canyon in June (clear water) and in September (turbid water). Samples were collected on an already scheduled food base river trip to minimize logistical costs of this project. Samples are currently being processed and analyzed for stable isotope ratios.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	None. Work was begun late in FY06.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	A presentation of results will be made at the winter meeting of the American Society of Limnology and Oceanography in February. A draft final report is expected by September 30, 2007. At least two peer-reviewed publications are expected to be produced as a result of this research.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	This is a 1-year project. If hydrogen stable isotopes prove to be a useful tracer of trophic linkages, it is recommended that the main food base project (Dr. Robert Hall, PI) use this technique, in addition to already planned use of carbon and nitrogen stable isotopes and gut content analysis, to aid their research on trophic linkages. Cost of adding hydrogen stable isotope analysis to main food base project would be approximately $10,000 annually.

(14.) FY2007 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:	See above.	**FISCAL YEAR NET AVAIL BAL:**			NA
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	Refer to budget in previous report.	**FISCAL YEAR EXPENDITURES:**			NA
		FISCAL YEAR OBLIGATIONS:			NA
		END OF FISCAL YEAR AVAILABLE BALANCE:			NA
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/02/2007

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	SUBMISSION DATE:	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center (Cooperating with USFWS, AGFD, and SWCA)
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, B.3 (GCMRC No. BNE8A)
(3.) PROJECT TITLE:	Ongoing Provisional Monitoring – Status And Trends Of Downstream Fish Community

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager/ Principal Investigator:	Matthew E. Andersen / Coggins, USGS Sponholtz, USFWS Persons, AGFD Lauretta, SWCA	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	mandersen@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7379	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	The downstream fish community is an assemblage of native and nonnative fish that occur in the Colorado River ecosystem. This assemblage is exclusive of the trout fishery that is managed in Glen Canyon by the Arizona Game and Fish Department. The constituents include four native fish and introduced competitors/predators like rainbow trout, brown trout, channel catfish, carp, and other nonnative forms. The status and trends of the fishery are regulated by biotic and abiotic mechanisms that may in turn be affected by the operations of Glen Canyon Dam. Monitoring basic population statistics including recruitment, abundance, and distribution of native and nonnative fishes provide the fundamental information necessary to assess the status of these resources and the attainment of program goals and objectives.
(6.) OBJECTIVES:	Provide a baseline of fish abundance indices that can be used for long-term, species, and community-based change detection. Obtain mark-recapture information for humpback chub abundance estimation.
(7.) RELATIONSHIP TO MRP:	Related to Goal 2
(8.) METHODOLOGY:	Sampling in the mainstem Colorado River is conducted using electrofishing, trammel netting, hoopnetting, and seining. Sampling in the Little Colorado River is conducted using hoopnetting. Data are utilized to compute abundance indices and presence/absence by species and major geomorphic reach. Mark-recapture data are used to compute humpback chub abundance estimates according to methods summarized in Coggins and others, 2006.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Five sampling trips in the mainstem Colorado River and four sampling trips in the Little Colorado River to collect data on fish abundance indices, species composition, length composition, and mark-recapture information.

(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	All sampling trips occurred as scheduled and data have been incorporated into the GCMRC long-term fish monitoring database. Results continue to suggest depressed relative abundance of rainbow trout and increased abundance of flannelmouth sucker and bluehead sucker relative to previous years.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Trip reports have been submitted to GCMRC. Preliminary data from 2006 were incorporated into an update given by Rogers to the AMWG in 2006.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Draft final report received from US Fish and Wildlife Service. Remaining annual reports will be submitted in early 2007.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Downstream monitoring will be modified during 2007 to allow for sampling in association with a concurrent abundance estimator of the LCR population of humpback chub.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:		$917,884	**FISCAL YEAR NET AVAIL BAL:**		$827,436
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$125,008
			FISCAL YEAR OBLIGATIONS:		$702,428
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/02/2007

PROJECT B.4 ONGOING PROVISIONAL MONITORING – STATUS & TRENDS OF LEES FERRY TROUT

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center with cooperation from Arizona Game and Fish Department
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, B.4 (GCMRC No. BNE8B)
(3.) PROJECT TITLE:	Ongoing Provisional Monitoring – Status & Trends of Lees Ferry Trout

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Matthew E. Andersen / W. Persons	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	mandersen@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7879	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	The Lees Ferry trout fishery refers to the tailwaters portion of the Colorado River ecosystem managed by Arizona Game and Fish Department. This fishery represents an important recreational and economic resource. Flannelmouth suckers and carp coexist with rainbow trout. Ecology of nonnative rainbow trout in the tailwater is strongly influenced by operations of Glen Canyon Dam.
(6.) OBJECTIVES:	Direct and derived metrics for assessing status and trends of the Lees Ferry rainbow trout fishery are estimated for the purpose of long-term monitoring. These metrics include catch-rate, length frequency, proportional stock density, and condition factor of fish.
(7.) RELATIONSHIP TO MRP:	Related to Goal 4
(8.) METHODOLOGY:	Primary method uses electrofishing as the sampling method over multiple nights, which occurs tri-annually. Electrofishing equipment and trained operators are contracted personnel through the GCMRC logistical contract. As of FY01 this monitoring project has used a random stratified sampling approach based on shoreline habitat characteristics for site selection. Randomly selected sites (27) of this augmented, serially alternating sampling design are intended to afford representative estimates of fishery status, whereas fixed components (9) ensure continuity with trend data from previous years.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Conduct tri-annual trips to collect information on the relative abundance, length frequency, proportional stock density, and condition factor, diet, growth, and fish health of rainbow trout in the Lees Ferry reach.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	All sampling trips occurred as scheduled and data have been incorporated into the GCMRC long-term fish monitoring database. Results continue to show depressed relative abundance of rainbow trout and increased condition factor.
(11.) REPORTS/PRODUCTS COMPLETED:	

(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)	Trip reports have been submitted to GCMRC. Data have been incorporated into the GCMRC long-term database.				
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Annual report will be submitted in early 2007.				
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Continue long-term monitoring, conduct Protocol Evaluation Panel in 2007.				
(14.) FY2006 BUDGET REPORT	**FINANCIAL INFORMATION COLLECTION DATE:**				09/30/2007
FY PLANNED GROSS BUDGET:	$156,492		**FISCAL YEAR NET AVAIL BAL:**		$142,712
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$69,111
			FISCAL YEAR OBLIGATIONS:		$73,601
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/02/2007

PROJECT B.5 COMPLETION OF HABITAT MAP AND INVENTORY IN SUPPORT OF MONITORING

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, B.5 (GCMRC No. BNE8U)
(3.) PROJECT TITLE:	Completion of Habitat Map and Inventory in Support of Monitoring

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Matthew E. Andersen / Barbara Ralston, Biologist	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	mandersen@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7379	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Because riparian vegetation contributes to aquatic productivity and serves as a host to terrestrial invertebrates and vertebrates (e.g., lizards, birds), knowing the distribution and cover of riparian vegetation can help explain changes observed in vertebrate abundance. Changes in riparian vegetation are associated with dam operations and can include the propagation of exotic species like tamarisk. Distribution of vegetation also affects the area available for recreation.
(6.) OBJECTIVES:	Provide a baseline of vegetated and open terrestrial habitat that can be used for long-term, community-based change detection. Provide a vegetation map of the river corridor that uses a uniform hierarchical vegetation classification system that is compatible with NPS park units and AMP program purposes. The vegetation data will be compared with historic aerial photographs to detect and study changes.
(7.) RELATIONSHIP TO MRP:	Related to Goal 6
(8.) METHODOLOGY:	Community identification will be done using releve′ plots in the field that are used to record relative cover. Cover scales use a Daubenmire scale. Data are recorded as categorical data, but height of the dominant plant species is also recorded. Number of samples for each plot is dependent on the abundance of the vegetation type. A minimum of 20 samples will be taken for each community (12 types identified in 2002). These data will be analyzed using multivariate statistics (ordination techniques) to identify the dominant communities along the river corridor. Vegetation classification will use supervised classification routines that are available in an image processing software package (ENVI, 2005). Training areas will be selected from previous ground-truthed sections of base map. Classes that will likely be used for this effort include tamarisk, baccharis/salix, marsh/wetlands, mesquite/acacia, arrowweed and bare ground. User and producer accuracies will be determined and class aggregation may be required to meet national vegetation mapping standards.

	Quantification of changes in riparian communities will be done using a Geographic Information Systems (GIS) platform (ArcMap, ESRI, Inc. 2002).
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Complete digital map and corresponding report explaining methods and results
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	Digital map is complete except for metadata. Written report in draft form waiting for co-author comments. Mapping effort identified six vegetation classes for the river corridor. Total vegetated area varies by reach. Tamarisk covered 494 ha., wetland covered 227 ha., and Baccharis/coyote willow covered 94 ha. Reach based effects appear to override patterns observed previously, which showed distance from dam affected vegetated area, at least with respect to marsh communities. The long-term loss of sediment in the system may have reduced this previously reported downstream pattern.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Draft final report in prep. Map used to estimate annual allochthonous inputs to the Colorado River. Allochthonous inputs results presented at International River Science Meeting in August 2006. Allochthonous inputs results developed into manuscript for peer review publication, to be submitted in 2007. Final report anticipated as Open File report and parts submitted for peer review journal. Vegetation database forms a basemap of riparian vegetation for river corridor. May be utilized by GRCA for park vegetation mapping program.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Final report anticipated as Open File report in 2007. Portions of report to be submitted for peer review journal. Vegetation database forms a basemap of riparian vegetation for river corridor. May be utilized by GRCA for part park vegetation mapping program.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Use 2005 imagery to determine feasibility of change detection as a monitoring tool for woody riparian vegetation.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:		$16,632	**FISCAL YEAR NET AVAIL BAL:**		$15,801
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$15,800
			FISCAL YEAR OBLIGATIONS:		$00
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 01**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/02/2007

PROJECT B.6 COMPLETION OF EXPERIMENTAL TREATMENT - SPAWNING REDDS AND SUPPRESSION MECHANISMS

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	SUBMISSION DATE:	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center in cooperation with Ecometric Research
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, B.6 (GCMRC No. BNE8V)
(3.) PROJECT TITLE:	Completion of Experimental Treatment - Spawning Redds and Suppression Mechanisms

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Matthew E. Andersen / Josh Korman	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	mandersen@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7379	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Experimental flows from 2003 – 2005 targeted survival rate of young rainbow trout through increased daily fluctuations in flow from January through March. A study was conducted during this period to measure the impact of the flows on the early life stages of rainbow trout below Glen Canyon Dam. The study measured timing and distribution of redd excavation across elevations, quantified spawning habitat preferences with depth, velocity, and substrate relative to changes in discharge, estimated trends in trout fry recruitment and survival in Glen Canyon, and lastly surveyed for redd and fry in the mainstem below Lees Ferry to the Little Colorado River confluence to evaluate natural reproduction in the mainstem. The results and conclusions provide hypotheses about the influence of fluctuating flows that will be tested during a return to MLFF operations in 2006.
(6.) OBJECTIVES:	There are three main objectives of this project: 1) To estimate the additional incubation mortality that resulted from the higher daily fluctuations of the 2003-2005 Jan.-Mar. experimental flows relative to normal fluctuations over those months under ROD; and 2) To document the growth, habitat use, movement, and survival rates of age-0 rainbow trout in the Lees Ferry reach, and to relate these dynamics to flow regulation from Glen Canyon Dam; 3) To provide annual estimates of the number of egg deposition and the size of the age-0 population in the Lees Ferry reach. Over time, this time series will be very helpful for interpreting changes in the adult population.
(7.) RELATIONSHIP TO MRP:	Related to Goals 4 and 2
(8.) METHODOLOGY:	Methods detailed in Korman and others, 2005. Eleven redd surveys were conducted in 2006 between Jan. 19th and June 8th. Intergravel temperature measurements were collected at two sites over the entire spawning and incubation season. Five age-0

	surveys were conducted between July 9th and Nov. 6th. Daily age estimates are being determined from a sample of 150 fish based on otolith microstructure.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Eleven redd surveys and five fry surveys were conducted in 2006. Ageing estimates are currently being conducted.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	All sampling trips were conducted as planned. Ageing estimates were delayed because we investigated using another ageing lab. Age estimates will be completed by Mar. 2007. Analysis of available data is underway.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	A summary of redd count and age-0 densities and spatial distribution has been provided to GCMRC, presented to the TWG during a summer meeting in 2006, and presented to GCMRC staff at an integrated science planning meeting in fall of 2006.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	A total of four manuscripts will be delivered to GCMRC by Dec. 31, 2007
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Recommend continuing this work in 2007.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:		$157,732	**FISCAL YEAR NET AVAIL BAL:**		$144,214
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$62,870
			FISCAL YEAR OBLIGATIONS:		$81,344
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/02/2007

PROJECT B.7 MECHANICAL REMOVAL OF NONNATIVE FISH

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	SUBMISSION DATE:	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center with cooperation from AZGFD
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, B.7 (GCMRC No. BNE8D)
(3.) PROJECT TITLE:	Mechanical Removal of Nonnative Fish

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Matthew E. Andersen / L. Coggins	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	mandersen@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7879	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Trends in the abundance and recruitment of the Little Colorado River population of humpback chub suggest this population has been in decline for over a decade. Factors contributing to this decline are unknown but may include: interaction (predation and/or competition) with nonnative fishes, infection by nonnative parasites, sub-optimal mainstem water temperatures, hydrological conditions in the mainstem Colorado and Little Colorado Rivers, and decline of near-shore rearing habitat in the mainstem Colorado River. Though it is unknown which factor(s) are most responsible for humpback chub mortality, it is likely that interactions with nonnative fish are a contributing element.
(6.) OBJECTIVES:	In conjunction with a blocked experimental design with treatments including GCD operations, release temperatures, and nonnative removal, evaluate the effect of nonnative fish on humpback chub population dynamics Evaluate the efficacy of nonnative control in the Colorado River Evaluate the diet and piscivory of nonnative fishes in the removal reaches of the Colorado River.
(7.) RELATIONSHIP TO MRP:	Related to Goal 2
(8.) METHODOLOGY:	Sample near-shore habitats with standard electrofishing methods in a depletion framework to estimate species composition, length frequency, abundance, and capture probability. Euthanize all captured nonnative fishes. Sample near-shore habitat using hoop nets to estimate species composition, length-frequency, and relative abundance.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	During 2006, conduct six trips to remove nonnative fish from specific reaches of the Colorado River. Estimate species composition, relative abundance, and length frequency distribution.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation*	The mechanical removal project was an experimental effort scheduled for implementation for 4 years in the mainstem Colorado River above and below the mouth of the Little Colorado River. The year 2006 was the 4th year of the project. The project was initiated

from the AWP Scope of Work.)	because rainbow trout in this reach were thought to pose a significant threat to native fishes, especially humpback chub. While all nonnative fishes captured during this project were removed, the majority of fish captured and removed were rainbow trout. Hoop nets were also deployed in the reach in order to monitor small bodied fishes not usually captured by electrofishing, the primary method employed. In 2006, the numbers of rainbow trout captured dropped dramatically as compared to previous years. For example, by August 2005, 2,171 rainbow trout had been captured and removed by this project. A total of 2,422 rainbow trout were removed in 2005. By comparison, by August 2006, only 945 rainbow trout had been captured and removed. Therefore, the decision was made to not conduct electrofishing on the final trip of the year in September 2006, although hoop nets were deployed to continue the small bodied fish monitoring. The total number of rainbow trout removed over the 4 years of the project was 20,636.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	All data have been incorporated into the GCMRC data base. Presentation of preliminary results made at the Upper Colorado River Researchers Meeting.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Final report of all 4 years to be prepared in 2007. Presentation of results to be made at national AFS meeting in September. Final results to be included in Coggins' dissertation and associated manuscripts.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Continuation of project only as dictated by long-term experimental planning.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:	$795,192	**FISCAL YEAR NET AVAIL BAL:**			$669,963
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.	**FISCAL YEAR EXPENDITURES:**			$369,922
		FISCAL YEAR OBLIGATIONS:			$273,372
		END OF FISCAL YEAR AVAILABLE BALANCE:			$26,669
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/02/2007

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	SUBMISSION DATE:	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – Grand Canyon Monitoring & Research Station
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, B.8 (GCMRC No. BNE8F)
(3.) PROJECT TITLE:	Ongoing Humpback Chub Action – Translocation of Humpback Chub

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Matthew E. Andersen / U.S. Fish and Wildlife Service	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	mandersen@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7379	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	As identified by the AMWG ad hoc committee on humpback chub (HBC) and the December 2002 US Fish and Wildlife Service (FWS) Biological Opinion, the first phase of this project is aimed at increasing the survival and expanding the geographic range of humpback chub in the Little Colorado River (LCR) by translocating small fish above a natural barrier in the LCR. Following 3 years of successful translocations of humpback chub, a mark recapture experiment was initiated in FY2006 to estimate the population size and incorporate these estimates into those for the lower part of the LCR.
(6.) OBJECTIVES:	The primary objective of this study was to collect data to conduct mark-recapture population estimates of humpback chub residing above Lower Atomizer Falls; however, this study also offered an opportunity to examine migration patterns, growth rates, and spawning activity of humpback chub residing within this upper LCR corridor.
(7.) RELATIONSHIP TO MRP:	Related to Goal 2
(8.) METHODOLOGY:	Hoop nets (50-60 cm in diameter, 100 cm long, a single 10 cm throat, and covered with 6 mm nylon mesh netting) were the sole fishing gear used in this study, and were all baited near their cod ends by attaching nylon mesh bags (30 x 30 cm, 6 mm mesh) filled with ~160 g AquaMax™ Grower 600 for Carnivorous Species (Purina Mills Inc., Brentwood, MO) to maximize fish captures.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	In July of 2003, 2004, and 2005, small humpback chub (HBC) (HBC, 50-100 mm TL) were captured near the Little Colorado River confluence and translocated to the river corridor above Chute Falls, near river kilometer 16.2. As a result of these translocations, a total of 1,129 HBC have been moved above

	Chute Falls. It was hoped that these translocations would increase HBC recruitment to adulthood by allowing them an opportunity to exploit the abundant food resources, warm water temperatures, and reduced competition/predation by fewer large-bodied fishes associated with this area. This project was a voluntary conservation measure as a result of the mechanical "exotic fish" removal activities and modified mainstem flows occurring in the Colorado River. During subsequent monitoring of these translocated HBC, we found that many of the 2003 translocated individuals had grown to adult sizes (Stone and Sponholtz, 2004). Hence, in addition to continuing yearly augmentations of this population, a stock assessment of translocated adults is proposed. If accomplished in 2006, a stock assessment of the HBC above Chute Falls would result in valuable baseline data of this population for long term monitoring purposes. In addition, the resulting population estimates could be incorporated into ongoing stock assessments occurring below Chute Falls to provide an overall stock assessment of the entire LCR population.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	The U.S. Geological Survey's Grand Canyon Monitoring and Research Center (GCMRC) contracted the U.S. Fish and Wildlife Service (USFWS) to conduct a May (May 23-26, 2006) and a June (June 28–July 3, 2006) monitoring trip from above Lower Atomizer Falls (13.57 river kilometers) to 18.1 rkm within the Little Colorado River. The two Chute Falls trips were primarily used to conduct mark-recapture efforts to estimate the abundance of HBC ≥ 125 mm between the top of Lower Atomizer Falls and the base of Chute Falls (13.57 to 14.1 rkm), and from the top of Chute Falls to 18.1 rkm in the LCR, where sampling activities ended. The results of the effort from Lower Atomizer Falls to Chute Falls (lower reach) indicated that there were 707 (SE = 42) HBC ≥ 125 mm during the late May to early July of 2006. Of these fish, it is estimated that there were 328 (SE = 25) HBC ≥ 150 mm, and 206 (SE= 18) HBC ≥ 200 mm. The results of the effort from above Chute Falls (14.1 rkm) to 18.1 rkm (upper reach) indicated that there were 440 (SE = 35) HBC ≥ 125 mm during the late May to early July of 2006. Of these fish, it is estimated that there were 255 (SE = 11) HBC ≥ 150 mm, and 125 (SE= 15) HBC ≥ 200 mm. During both trips combined, a total of 299 hoop net sets were deployed, yielding 6,993 hours of fishing effort. A total of 13,954 fish were captured, of which 1,430 were HBC, and 12,263 were speckled dace (*Rhinichthys osculus).* Catch per unit effort (CPE) for HBC was 0.179 fish/net-hour. Nonnative fishes comprised 1.9% of the catch. Sixty-two ripe male HBC and one ripe female HBC were captured. Three black bullhead had fish remains in their stomachs (speckled dace or unidentifiable fish). Percent occurrence of the external anchorworm (*Lernaea cyprinacea*) on HBC was 0.5%. The management plan for this area is now being drafted by Dexter National Fish Hatchery and will be included in their genetics management plan for HBC. This plan will help determine when additional translocations are necessary**.**

(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	A report titled "Monitoring of Humpback Chub (*Gila cypha*) and other Fishes above Lower Atomizer Falls of the Little Colorado River, Arizona" and data entered into an access database was submitted to GCMRC in December 2006. A final report titled " Stock Assessment and Fisheries Monitoring Activities in the Little Colorado River within Grand Canyon during 2006" that includes the population estimates for this project was submitted to GCMRC in January 2007.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	N.A., all deliverables submitted for GCMRC review
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Continue with mark recapture efforts in spring to estimate population size above Chute Falls. Perform additional translocations when deemed necessary via the genetics management planning effort underway by Dexter National Fish Hatchery.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:		$53,550	**FISCAL YEAR NET AVAIL BAL:**		$49,496
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$36,977
			FISCAL YEAR OBLIGATIONS:		$12,519
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/02/2007

PROJECT B.9 WARM WATER FISH MONITORING WORKSHOP (PREVIOUSLY COMPLETION OF HUMPBACK CHUB ACTION – DAM OPERATIONS)

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007
(1.) SUBMITTING AGENCY:	USGS – SBSC - Grand Canyon Monitoring & Research Station	
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, B.9 (GCMRC No. BNE8C)	
(3.) PROJECT TITLE:	Warm Water Fish Monitoring Workshop (Previously Dam Operations)	

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Matthew E. Andersen/ Lew Coggins	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	mandersen@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7379	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Due to regional drought, warmer than average water was being released from Glen Canyon Dam 2000-2004, some of the warmest temperatures observed since the closing of the dam in 1963. A selective withdrawal structure is proposed for GCD to increase water temperatures to benefit native fishes. In light of increased water temperatures, the potential for risk from nonnative fishes has increased, increasing the need to control nonnatives.
(6.) OBJECTIVES:	Develop recommended management actions and research program for warm water nonnative fishes.
(7.) RELATIONSHIP TO MRP:	Associated with AMP Goal 2.
(8.) METHODOLOGY:	Conduct a workshop convening fisheries professionals from within and from outside of the AMP to address existing and potential issues associated with warm water nonnative fish species.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Convene fisheries professionals from within and outside of the AMP to gather recommendations for management actions and an associated research program.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	The workshop was conducted in December 2005 in Flagstaff, AZ.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Management actions and a draft research program were developed following the recommendations of the workshop participants.
(12.) REPORTS/PRODUCTS	Reports/products complete.

PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*					
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Develop a research program and long-term nonnative control plan to address threats from warm water nonnative aquatic species.				
(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			9/30/2007
FY PLANNED GROSS BUDGET:		$27,600	**FISCAL YEAR NET AVAIL BAL:**		$28,049
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	Additional appropriated funds were contributed to this project.		**FISCAL YEAR EXPENDITURES:**		$10,590
			FISCAL YEAR OBLIGATIONS:		$17,459
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/02/2007

PROJECT B.10 COMPLETION OF HUMPBACK CHUB ACTION - MONITORING FISH DISEASE AND PARASITES IN THE COLORADO RIVER ECOSYSTEM

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007
(1.) SUBMITTING AGENCY:	USGS – SBSC - Grand Canyon Monitoring & Research Station	
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, B.10 (GCMRC No. BNE8I)	
(3.) PROJECT TITLE:	Completion of Humpback Chub Action - Monitoring Fish Disease and Parasites in the Colorado River Ecosystem	

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Matthew E. Andersen/ Cole, USGS Persons, AZGFD	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	mandersen@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7379	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	With the advent of increased river warming as reservoir water levels fall, and particularly with the operation of a temperature control device, increased fish disease and parasitism may occur. As disease could represent a significant mortality threat to fishes within the Colorado River ecosystem (CRE), it is important not only to monitor the future incidence of parasitism and disease, but to document a baseline condition before initiation of a temperature control device (TCD).
(6.) OBJECTIVES:	1) Document distribution and prevalence of parasites of fish in the Colorado River and selected tributaries. 2) Document distribution and prevalence of selected aquatic invertebrates, which are an intermediate host of fish parasites, in the Colorado River and selected tributaries. 3) Develop a plan for monitoring changes in parasite communities as water temperatures increase.
(7.) RELATIONSHIP TO MRP:	Related to Goal 2
(8.) METHODOLOGY:	A survey of the parasites of fish of the Colorado River and selected tributaries was conducted in June-July 2006. Fish were collected by AZGFD fish biologists using a combination of electroshocking (boat and backpack), seining, minnow trapping, trammel netting and hoop netting. Specimens were necropsied by parasitologists from the National Wildlife Health Center (NWHC), Madison, WI, on site. Parasite samples collected were preserved and transported back to the NWHC for identification and enumeration. Aquatic invertebrate samples were collected at each sample site to assess the ability of intermediate hosts to spread into the mainstem as water temperature increases.

(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	One sampling trip occurred in 2006. All specimen samples were collected. Laboratory analysis, monitoring protocol development, and report preparations are in progress.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	Fish were collected and field necropsies conducted during the June-July field trip. Laboratory work is underway to complete sample processing.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	No products have been received by GCMRC at this time.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	A draft final report is due to GCMRC September 30, 2007.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	There are no recommendations at this time.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			9/30/2007
FY PLANNED GROSS BUDGET:		$23,400	**FISCAL YEAR NET AVAIL BAL:**		$18,650
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$15,858
			FISCAL YEAR OBLIGATIONS:		$2,792
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/02/2007

PROJECT B.11 COMPLETION OF HUMPBACK CHUB ACTION – TEMPERATURE CONTROL DEVICE (WATER TEMPERATURE MODEL DEVELOPMENT (NOTE: FUNDED UNDER AGREEMENT NO. 02-AA-40-6750, ENIVRONMENTAL RESOURCES AND COMPLIANCE)

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC - Grand Canyon Monitoring & Research Station
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, B.11 *(Task 1 of 3)* (GCMRC No. BNEQ8)
(3.) PROJECT TITLE:	Completion of Humpback Chub Action – Temperature Control Device (Water Temperature Model Development)

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Matthew E. Andersen / S.A. Wright, USGS	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	mandersen@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7379	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Glen Canyon Dam has altered the thermal regime of the Colorado River downstream in Grand Canyon. Because water temperature is an important variable in many biological processes, the altered thermal regime has affected the aquatic ecosystem in Grand Canyon. The ability to predict downstream temperatures is needed in order to evaluate the effects of various dam operations and/or dam modifications (e.g. temperature control device) in support of the Glen Canyon Dam Adaptive Management Program.
(6.) OBJECTIVES:	Develop and calibrate a one-dimensional model (hourly time step) of water temperature for the Colorado downstream from Glen Canyon dam (to Diamond Creek).
(7.) RELATIONSHIP TO MRP:	Related to Goal 7
(8.) METHODOLOGY:	Use the existing one-dimensional unsteady flow model (UNSTEADY) in combination with the USGS Branched-Lagrangian Transport Model (BLTM) for water temperature dynamics; calibration with existing mainstem water temperature data.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Tasks: - Write routines to reformat UNSTEADY output for BLTM - Develop BLTM input files - Calibrate and validate model using years 2000 and 2005 - Document the model calibration/validation in a publication - Apply model to evaluate LTEP option (not in original work plan) - Develop a model of monthly average mainstem temperatures below the dam (not in original work plan)
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize*	The first three tasks listed above were completed in FY06. Documentation of the model was delayed by the experimental

initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)	options analyses, which were extensive. The model was briefly documented in the experimental options report. More extensive documentation of the model is currently underway as a conference paper for this years' American Institute of Hydrology meeting. The final task above was made possible by publication of the long-term mainstem water temperature dataset as part of the Integrated Quality-of-Water project.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	- Completed one-dimensional (hourly) model of downstream temperatures - 1D model documentation nearly complete - LTEP analyses, contributions to LTEP report - Multiple presentations at August TWG meeting - Monthly average temperature model completed; related documentation in progress.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	- 1D hourly model conference paper – April 2007 - Monthly average model journal article – Summer 2007
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	- Continue work on development of a nearshore water temperature model (ongoing in FY07)

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:		NA	**CURRENT GROSS BAL:**		NA
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	Refer to Task 3 of 3 under Project B.11, Completion of Humpback Chub Action – Temperature Control Device for Budget (Funded under Agrmt #02-AA-40-6750)		**FISCAL YEAR EXPENDITURES:**		NA
			FISCAL YEAR OBLIGATIONS:		NA
			END OF FISCAL YEAR AVAILABLE BALANCE:		NA
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/02/2007

PROJECT B.11 COMPLETION OF HUMPBACK CHUB ACTION – TEMPERATURE CONTROL DEVICE (ORGANIC AND NVERTEBRATE DRIFT EXCHANGE BETWEEN MAINSTEM AND BACKWATERS; FUNDED UNDER AGREEMENT NO. 02-AA-40-6750, ENVIRONMENTAL RESOURCES AND COMPLIANCE)

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, B.11 *(Task 2 of 3)* (GCMRC No. BNER8)
(3.) PROJECT TITLE:	Completion of Humpback Chub Action – Temperature Control Device (Organic and Invertebrate Drift Exchange between Mainstem and Backwaters)

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Matthew E. Andersen / Kennedy, GCMRC Wright, GCMRC	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	mandersen@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928)556-7379	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Models of invertebrate production in backwaters must make various simplifying assumptions about the exchange of organics and invertebrates between the main channel and backwaters. For example, a recent model developed for the Green River assumed one-way transport of invertebrates out of backwaters, and did not address the exchange of organic matter which may be used as food by invertebrates. Further, the fraction of planktonic invertebrates, as opposed to on the benthos, must be specified in order to compute the export of invertebrates from the backwater. If movement of water from the mainstem and into backwaters is significant, then the mainstem might be a large source of organic matter in backwaters. Estimating the supply of organic matter to backwaters requires accurate estimates of organic matter concentrations for the mainstem. It is logistically challenging to make enough traditional sample collections (i.e., nets) to accurately characterize organic matter concentrations in the mainstem. The Physical Sciences program has developed a method for estimating concentrations of suspended sediment using hydroacoustics; it is possible that the same technology could be used to estimate concentrations of suspended organic matter.
(6.) OBJECTIVES:	• Determine whether rates of exchange (water, organic matter, etc.) between backwaters and the mainstem differ under steady flows relative to low fluctuating flows • Determine whether benthic invertebrate and organic matter biomass differs under steady flows relative to low fluctuating flows • Determine whether the concentration and total load of drifting organic matter in the mainstem differs under steady flows relative to low fluctuating flows • Test the feasibility of using hydroacoustics to continuously

	monitor concentrations of drifting organic matter
(7.) RELATIONSHIP TO MRP:	Goal 1
(8.) METHODOLOGY:	During each month, comprising two 2-week blocks of fluctuating and steady flows, we investigated a single channel/backwater complex through the use of multiple acoustic instruments for monitoring drift. These instruments allowed for monitoring drift in the mainstem as well as water and organic/invertebrate exchange with the backwater. We calibrated the acoustic signal to organics and invertebrate drift by collecting periodic physical samples in the main channel and backwater inlet. After the first month, the instrumentation was moved to a second backwater with significant contrast in size and geometry. We quantified invertebrate biomass in three backwaters before and after each operational change. Temperature monitors were also deployed to provide calibration data for the water temperature modeling effort.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to th extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	During each month, comprising two 2-week blocks of fluctuating and steady flows, we investigated a single channel/backwater complex through the use of multiple acoustic instruments for monitoring drift. These instruments allowed for monitoring drift in the mainstem as well as water and organic/invertebrate exchange with the backwater. We calibrated the acoustic signal to organics and invertebrate drift by collecting periodic physical samples in the main channel and backwater inlet. After the first month, the instrumentation was moved to a second backwater with significant contrast in size and geometry. We quantified invertebrate biomass in three backwaters before and after each operational change. Temperature monitors were also deployed to provide calibration data for the water temperature modeling effort.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	Most samples/data were collected and analyzed as planned. Deviations from the proposed sampling include: • A single backwater was instrumented with hydroacoustics for the entire 2-month study. We had proposed instrumenting a backwater for the 1st treatment block and then moving the instruments to a different backwater for the 2nd treatment block. We elected not to do this because we could only find one backwater in Glen Canyon with geometry that was suitable for an acoustic instrument. • Only three backwaters were sampled, not the five we had planned. There are only three backwaters in Glen Canyon. All samples have been processed for organic matter and invertebrate density and biomass, as planned. Mainstem drift data have been analyzed and we have found that there is a relationship between acoustic backscatter and organic matter concentrations. Analysis of benthic organic matter and invertebrate data from backwaters is ongoing.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the*	Kennedy gave a presentation of research results to the TWG on August 2, 2006.

AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)					
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	A report will be delivered to BOR by July 31, 2007.				
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Using hydroacoustics to continuously monitor organic drift in the Lees Ferry reach looks very promising. We recommend future studies focus solely on calibrating the acoustic-organic relationship.				
(14.) FY2006 BUDGET REPORT	**FINANCIAL INFORMATION COLLECTION DATE:**				09/30/2006
FY PLANNED GROSS BUDGET:	NA		**FISCAL YEAR NET AVAIL BAL:**		NA
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	Refer to Task 3 of 3 under Project B.11, Completion of Humpback Chub Action – Temperature Control Device for Budget (Funded under Agrmt #02-AA-40-6750)		**FISCAL YEAR EXPENDITURES:**		NA
			FISCAL YEAR OBLIGATIONS:		NA
			END OF FISCAL YEAR AVAILABLE BALANCE:		NA
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/02/2007

PROJECT B.11 COMPLETION OF HUMPBACK CHUB ACTION – TEMPERATURE CONTROL DEVICE (COMPARE NEAR-SHORE NATIVE FISH HABITATS UNDER STEADY/FLUCTUATING FLOWS; FUNDED UNDER AGREEMENT NO. 02-AA-40-6750, ENIVRONMENTAL RESOURCES AND COMPLIANCE)

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center in cooperation with SWCA Environmental Consultants Inc.
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, B.11 *(Task 3 of 3)* (GCMRC No. BNES8)
(3.) PROJECT TITLE:	Completion of Humpback Chub Action – Temperature Control Device (Compare Near-Shore Native Fish Habitats Under Steady/Fluctuating Flows)

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Matthew E. Andersen / Barbara Ralston, USGS	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	mandersen@usgs.gov	State:	Arizona	Zip Code:	86001
Telephone:	(928) 556-7379	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Determine how near shore habitats change under steady vs. low fluctuating flow discharges.
(6.) OBJECTIVES:	Collect water quality, macroinvertebrate and fish data in backwaters and near shorelines to determine if habitat parameters change under different discharge patterns.
(7.) RELATIONSHIP TO MRP:	Related to Goal 1 & 2
(8.) METHODOLOGY:	Using appropriate equipment for each element, collect data in backwaters and along shorelines during fall steady flow and fluctuating flow releases. Density and diversity were measured for phytoplankton and macroinvertebrates, CPUE, and diversity were measured for fishes. Data were compared using t-tests assuming unequal variances.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Using appropriate equipment for each element, collect water quality, macroinvertebrate, and fish data in backwaters and near shorelines to determine if habitat parameters change under different discharge patterns. Collection to occur in Fall 2005.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation*	Data were collected between September 3 and October 22, 2005. Data and report were analyzed and written in 2006. Draft report submitted to GCMRC for internal review in September 2006. Results indicate that of the variables measured, there were no

from the AWP Scope of Work.)	significant differences between the flows. But antecedent conditions and inherent variability of organisms sampled and system as whole results in recommendation that results are viewed cautiously.				
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Revised final report in review. Results presented to Technical Work Group meeting in September 2006.				
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Final report anticipated as Open File report in 2007.				
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Recommend that laboratory studies be used to address these types of questions in the future.				
(14.) FY2006 BUDGET REPORT	**FINANCIAL INFORMATION COLLECTION DATE:**				09/30/2006
FY PLANNED GROSS BUDGET:	$119,271		**FISCAL YEAR NET AVAIL BAL:**		$121,778
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	Carry forward balance applies to Tasks 1, 2 and 3 and will be expended toward the completion of the research under this agreement in FY2007.		**FISCAL YEAR EXPENDITURES:**		$57,400
			FISCAL YEAR OBLIGATIONS:		$00
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$64,378**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/02/2007

PROJECT B.12 ONGOING PROVISIONAL MONITORING – STATUS AND TRENDS OF THE FISH COMMUNITY FROM BELOW DIAMOND CREEK

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC - Grand Canyon Monitoring & Research Station
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, B.12 (GCMRC No. BNE8H)
(3.) PROJECT TITLE:	Ongoing Provisional Monitoring – Status and Trends of the Fish Community From Below Diamond Creek

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Matthew E. Andersen / Lew Coggins, USGS Sponholtz, USFWS Persons, AZGFD Lauretta, SWCA	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	lcoggins@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7379	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	The downstream fish community is an assemblage of native and nonnative fish that occur in the Colorado River ecosystem. This assemblage is exclusive of the trout fishery that is managed in Glen Canyon by the Arizona Game and Fish Department. The constituents include four native fish and introduced competitors/predators like rainbow trout, brown trout, channel catfish, carp, and other nonnative forms. The status and trends of the fishery are regulated by biotic and abiotic mechanisms that may in turn be affected by the operations of Glen Canyon Dam. Monitoring basic population statistics including abundance and distribution of native and nonnative fishes provide the fundamental information necessary to assess the status of these resources and the attainment of program goals and objectives.
(6.) OBJECTIVES:	Provide a baseline of fish abundance indices that can be used for long-term, species and community-based change detection.
(7.) RELATIONSHIP TO MRP:	Related to Goal 2
(8.) METHODOLOGY:	Sampling in the mainstem Colorado River is conducted using electrofishing, trammel netting, hoopnetting, and seining. Data are utilized to compute abundance indices and presence/absence by species and geomorphic reach.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	One sampling trip occurred in 2006. Data were collected on fish species, length, and abundance in the mainstem Colorado River below Diamond Creek and selected tributaries.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	All sampling trips occurred as scheduled and data have been incorporated into the GCMRC long-term fish monitoring database. Preliminary results suggest an increased abundance for flannelmouth sucker, common carp, channel catfish, and striped bass relative to previous years.
(11.) REPORTS/PRODUCTS COMPLETED:	The 2006 trip report was submitted to GCMRC.

(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)					
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	A draft of the 2006 annual report has been submitted and will be reviewed by GCMRC staff in early 2007.				
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	In 2007, fish sampling from Diamond Creek to Lake Mead will occur in late summer as opposed to spring in previous years. This change in sampling protocol is being enacted to improve ability to detect warm-water adapted nonnative fish.				
(14.) FY2006 BUDGET REPORT	**FINANCIAL INFORMATION COLLECTION DATE:**				09/30/2006
FY PLANNED GROSS BUDGET:	$81,000		**FISCAL YEAR NET AVAIL BAL:**		$64,570
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$61,363
			FISCAL YEAR OBLIGATIONS:		$3,207
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Matthew E. Andersen	**TITLE:**	Biology Program Manager	**DATE:**	02/02/2007

PROJECT C.1 ONGOING PROVISIONAL MONITORING OF INTEGRATED ARCHAEOLOGICAL SITES

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC- Grand Canyon Monitoring & Research Center
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, C.1 (GCMRC No. BNE3K)
(3.) PROJECT TITLE:	Ongoing Provisional Monitoring of Integrated Archaeological Sites

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Helen Fairley	Mailing Address:	2255 N. Gemini Drive, Flagstaff		
E-mail:	hfairley@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	928-556-7285	Delivery Address:	Same as above		
FAX:	928-556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Glen Canyon Dam and the manner in which it is operated have altered the hydrological regime, sediment budget, and sediment flux of the Colorado River downstream in Grand Canyon. Because these factors directly and indirectly influence terrestrial geomorphological processes, including rates of landscape erosion, there are ongoing concerns about the effects of these processes on the physical condition of archaeological sites embedded within the river corridor landscape. To effectively evaluate and address these concerns requires a robust, ecosystem-based monitoring program to track and evaluate the potential effects of dam operations and other factors, such as climate and visitor use, that in combination have the potential to affect the long-term integrity of cultural resources in the river corridor. The ability to quantify various impacts and use these monitoring data in future models to make well-founded predictions about which sites are most likely to be impacted by ongoing modification of the riverine landscape under different dam operating scenarios, as well as effects of changing human use levels and varying climatic conditions, will assist the Glen Canyon Dam Adaptive Management Program and the National Park Service to objectively evaluate and manage the effects of dam operations on cultural sites in the Colorado River corridor.
(6.) OBJECTIVES:	Develop, test and evaluate methods for objectively monitoring and quantifying factors contributing to archaeological site stability and/or degradation and establish a suite of formal monitoring protocols that can be implemented through a future pilot monitoring project.
(7.) RELATIONSHIP TO MRP:	See MRP discussion under Goal 11
(8.) METHODOLOGY:	Over a 2-year period, conduct research on appropriate approaches and techniques for monitoring and quantifying impacts to cultural sites using a variety of methods, including archival research, direct observation, and documentation of

	relevant site attributes, and field testing of various methods for tracking and quantifying physical changes at archaeological sites.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Tasks: - Assess archaeological site values and geomorphic attributes that are relevant to determining and quantifying changes in site condition - Test a variety of methods for tracking and quantifying rates of erosion, weather parameters, and human use impacts at archaeological sites in the river corridor - Evaluate past methods used to monitor archaeological sites in Grand Canyon and elsewhere in the Southwestern US and evaluate utility of existing monitoring data for quantifying rates of impacts. - Establish and apply criteria for including or excluding sites within the monitoring population and devise sampling strategies, as appropriate, to select appropriate sites for future monitoring.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	FY06 was the first year of a multi-year research and development project for core monitoring of archaeological resources. Implementation of the first year's work was delayed several months due to disagreement among a subset of AMP stakeholders about how to proceed with project implementation. The project finally got under way in March, 2006 with the first of three geo-archaeological assessment research river trips in FY06. This work was conducted concurrently with treatment planning efforts sponsored by BOR. In addition to conducting geo-archaeological assessments (as the first step towards grouping sites for future monitoring), testing and evaluating total station vs. LiDAR surveys to quantify rates of erosion was conducted at a sample of sites during these trips. A draft report on the first phase of archaeological assessment work (151 sites) was completed by NPS in January, 2007; a separate report on the geomorphic characterization of these same sites is due to be completed by USU cooperators in spring, 2007. Both reports will undergo review in spring, 2007. Processing of the total station and LiDAR survey data has been completed, and an interim report on the first year of work is in preparation. Preliminary analysis of the existing site data in relation to modeled river stage (flow lines) has been completed and was presented to the CRAHG in July, 2006; additional analyses of existing monitoring data are planned for FY07.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems,*	- Draft report on archaeological assessment of 151 sites (prepared by NPS; currently in review) - GIS analysis of site data in relation to projected flows (PowerPoint presented to CRAHG, July 2006) - Progress report on comparison of survey techniques - USGS fact sheet summarizing utility of LiDAR for ecological and archaeological monitoring in Grand Canyon and elsewhere in the western US

newsletters, etc.)					
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	- Report on geomorphic assessment of 151 sites (draft report to be completed in spring, 2007) - Final report on comparison of total station vs. LiDAR for monitoring archaeological site erosion				
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Continue R&D project as planned (ongoing in FY07)				
(14.) FY2007 BUDGET REPORT	**FINANCIAL INFORMATION COLLECTION DATE:**				09/30/2006
FY PLANNED GROSS BUDGET:	$374,201		**FISCAL YEAR NET AVAIL BAL:**		$321,463
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	Trip logistics for this project were combined with the treatment planning project; resulting savings were applied to a new coop agreement with USU to complete geomorphic site assessment work in FY06 and FY07.		**FISCAL YEAR EXPENDITURES:**		$54,712
			FISCAL YEAR OBLIGATIONS:		$266,751
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Helen Fairley	**TITLE:**	Sociocultural Program Manager	**DATE:**	02/06/2007

PROJECT C.2 SYNTHESIZE TRIBAL MONITORING PROGRAMS RESULTS (1995 – 2005)

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	SUBMISSION DATE:	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, C.2 (GCMRC No. BNE3L)
(3.) PROJECT TITLE:	Synthesize Tribal Monitoring Programs Results (1995 – 2005)

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Helen Fairley	Mailing Address:	2255 N. Gemini Drive, Flagstaff		
E-mail:	hfairley@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	928-556-7285	Delivery Address:	Same as above		
FAX:	928-556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Glen Canyon Dam and the manner in which it is operated have altered the hydrological regime, sediment budget, sediment flux, vegetation patterns and associated terrestrial habitats of the Colorado River downstream in Grand Canyon. There are ongoing concerns about the effects of these ecosystem changes on resources important to the Native American tribes who have long-standing traditional cultural ties to the Grand Canyon. To effectively evaluate and address these concerns requires development of a robust monitoring program to track and evaluate changes in aspects of the terrestrial ecosystem important to the tribes. This project was developed to provide the tribes participating in the GCDAMP with supplementary funds to design tribally-appropriate resource monitoring protocols; the budget also included funding for a part time student employee to assist GCMRC with managing the project. When AMWG approved the project, they requested that BOR handle the individual contracts with the tribes in FY06; funding allocated for the program assistant remains with GCMRC. The project described below explains how the funds originally programmed for the project assistant were used by GCMRC to support the long-term goals of future (but as yet undefined) tribal monitoring projects.
(6.) OBJECTIVES:	Support goals of future tribal monitoring programs.
(7.) RELATIONSHIP TO MRP:	Related to Goals 11 and 12
(8.) METHODOLOGY:	N/A
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	The GCMRC portion of the funding originally allocated for this project was used to fund a part of the salary for one USU cooperator to develop GIS layers that will be useful for future tribal monitoring programs, specifically vegetation coverage, archaeological site polygons, and projected river flow lines.
(10.) PROGRESS STATEMENT:	

(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)	Preliminary results of GIS analysis of archaeological site distributions in relation to projected flow lines were presented to the CRAHG in July, 2006; processing of recently acquired vegetation data (from 2005 overflight mission) is underway and ongoing.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Preliminary results of GIS analysis of archaeological site distributions in relation to projected flow lines was completed and presented in a PowerPoint format to the CRAHG in July, 2006.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	The funding covered only a portion of the cooperator's salary and was used to support the work described above. No additional products or reports are planned at this time.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	The tribes did not receive FY06 funding until late in FY06; consequently, they are still in the process of developing proposal for future monitoring approaches. It is anticipated that these projects will entail additional support requirements from GCMRC in the form of GIS data requests, as well as data archiving and peer review. Additional funding may be required to support these programs, but until such time as the projects have been fully defined and accepted by TWG, accurate predictions about additional costs can not be accurately projected.

(14.) FY2007 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:		$29,250	**FISCAL YEAR NET AVAIL BAL:**		$25,133
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$3,437
			FISCAL YEAR OBLIGATIONS:		$21,696
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Helen Fairley	**TITLE:**	Sociocultural Program Manager	**DATE:**	02/06/2007

PROJECT C.3 INTEGRATED CAMPSITE MONITORING AND RESEARCH (PILOT STUDY)

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007
(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center	
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, C.3 (GCMRC No. BNE3M)	
(3.) PROJECT TITLE:	Integrated Campsite Monitoring and Research (Pilot Study)	

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Helen Fairley / Rod Parnell, NAU	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	hfairley@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	928-556-7285	Delivery Address:	Same as above		
FAX:	928-556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Glen Canyon Dam and the manner in which it is operated have altered the hydrological regime, sediment budget, and sediment flux of the Colorado River downstream in Grand Canyon. Because these factors directly and indirectly influence terrestrial and aquatic geomorphological processes, including rates of sandbar deposition and erosion, there are ongoing concerns about the effects of these processes on the physical condition and size of sand bars and associated camping areas within the river corridor. The size and distribution of campable sand bars in turn affects visitor management issues that are important to the National Park Service, such as visitor carrying capacity, camp site competition, and crowding along the Colorado River. To effectively evaluate and address these concerns requires a robust monitoring program to track and evaluate changes in sand bars and campable area. The project described below continues and integrates of two monitoring projects that have been in place for many years: surveying sand bar volume and area (since 1991) and measuring changes in campable area (since 1998.)
(6.) OBJECTIVES:	Quantify changes in sand bar area and volume and in associated campable area through repeat total station surveys at a sample of long-term sand bar sites in the Colorado River corridor.
(7.) RELATIONSHIP TO MRP:	Repeat intensive total station surveys at a sample of sand bar sites. See Kaplinski and others 2005 for details.
(8.) METHODOLOGY:	Repeat intensive total station surveys at a sample of sand bar sites.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Tasks: - Conduct total station surveys to quantify area and volume changes at 45 sand bars between Lees Ferry and Diamond Creek - Complete total station surveys of campable area at 37 of these same sand bar sites (not all surveyed sand bars are campsites)

	- Process survey data and compare with results from previous years - Prepare annual report
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	FY06 monitoring field work was conducted and completed in October, 2006, at 45 sand bar sites; most of the data have been processed and preparation of a report is currently (January, 2007) underway.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	- Report preparation is In progress.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Annual report on monitoring results is anticipated in March, 2007.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	No changes in monitoring protocols are recommended at this time. We recommend continued tracking of changes in sand bar area, volume and campable area using established protocols in FY07 and FY08, or until such time as alternative sediment storage monitoring protocols are developed. Note: the FY06 budget included costs for collecting sand bar survey data in addition to campable area measurements, but not for processing or analysis of the sand bar survey data, pending final outcome and recommendations of the FY06 sediment PEP. Subsequently, at the request of the Physical Science program manager, these data were processed and analyzed for inclusion in the 2004 Experimental summary and final Fine-grained Sediment Team (FIST) report. Additional funding to cover the discrepancy between planned and actual FY06 data analysis costs is therefore needed.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:		$86,287	**FISCAL YEAR NET AVAIL BAL:**		$77,657
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$2,288
			FISCAL YEAR OBLIGATIONS:		$75,369
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Helen Fairley	**TITLE:**	Sociocultural Program Manager	**DATE:**	02/06/2007

PROJECT D.1 ONGOING COORDINATION AND SUPPORT PROGRAM-LOGISTICS OPERATIONS

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM				SUBMISSION DATE:	*02/20/2007
(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center				
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, D.1 (GCMRC No. BNE6A)				
(3.) PROJECT TITLE:	Ongoing Coordination and Support Program-Logistics Operations				
(4.) PRINCIPAL INVESTIGATOR INFORMATION:					
GCMRC Program Manager / Principal Investigator:	Carol Fritzinger	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	cfritz@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7207	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001
(5.) STATEMENT OF PROBLEM:	Implementation of the GCMRC mission to provide credible, objective scientific information to the GCD-AMP begins with effective coordination of all technical and logistical support of research activities. The Research Coordination and Support Program staff functions as a team to facilitate collaboration with the Integrated Science and Cultural Programs through effective communication with program managers, principal investigators (PI) and the Technical Support Services.				
(6.) OBJECTIVES:	To provide comprehensive logistical support to the GCMRC research and monitoring activities in the Grand Canyon.				
(7.) RELATIONSHIP TO MRP:	Goal 12				
(8.) METHODOLOGY:	The GCMRC provided complete logistical support for approximately 30 research, monitoring, and administrative river trips through the Grand Canyon. These trips range in length from 7 to 21 days and from 4 to 36 people in size. Trips are comprised of a variety of motor and oar powered boats operated by contracted boat operators. Projects operating in the Glen Canyon reach of the Colorado River (Glen Canyon Dam to Lees Ferry) were supported by a variety of motor powered boats operated by GCMRC researchers and contracted boat operators. Additionally, research activities on the Little Colorado River and at other locations outside of the Grand Canyon National Park boundaries were supported by helicopter services contracted with the Bureau of Reclamation. Ground based support for other research activities outside of the river corridor were also coordinated with the use of GCMRC leased vehicles. This logistical approach has evolved since the GCES phase to allow a detailed overview of trip particulars that most influence cost, efficiency, and safety ultimately giving the GCMRC control over trip costs and productivity. Effective communication with PIs and sensitivity to and awareness of the challenges they face in implementing their studies enable the GCMRC to offer more customized (and therefore more cost-effective and productive) logistical support than other support strategies utilized previously. Retaining control over the process of supporting trips also facilitates compliance with NPS regulations and allows greater control over issues sensitive to the general public and the				

	"recreational river community.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	See above
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	The GCMRC provided complete logistical support for approximately 30 research and monitoring river trips through the Grand Canyon in FY06. These trips range in length from 7 to 21 days and from 4 to 36 people in size. Trips were comprised of a variety of motor and oar powered boats operated by contracted boat operators. Projects operating in the Glen Canyon reach of the Colorado River (Glen Canyon Dam to Lees Ferry) were supported by a variety of motor powered boats operated by GCMRC researchers and contracted boat operators. Additionally, research activities on the Little Colorado River and at other locations outside of the Grand Canyon National Park boundaries were supported by helicopter services contracted with the Bureau of Reclamation. Ground based support for other research activities outside of the river corridor were also coordinated with the use of GCMRC leased vehicles.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	N/A
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	N/A
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Continue providing logistics support for field activities.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**	09/30/2006
FY PLANNED GROSS BUDGET:	$ 122,616	**FISCAL YEAR NET AVAIL BAL:**	$ 197,946
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	This portion represents ***only*** the Logistics base costs. See the following budget report for the breakout of the project logistics costs.	**FISCAL YEAR EXPENDITURES:**	$ 156,281
		FISCAL YEAR OBLIGATIONS:	$ 41,665
		END OF FISCAL YEAR AVAILABLE BALANCE:	**$ 00**
FY PLANNED GROSS BUDGET:	$ 983,970 (est. need gross)	**FISCAL YEAR NET AVAIL BAL:**	$ 845,179

COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	This portion includes ***only*** the GCDAMP support projects that were dispersed throughout the budget and not included in the Logistics base costs.		**FISCAL YEAR EXPENDITURES:**		$ 833,719
			FISCAL YEAR OBLIGATIONS:		$ 11,460
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PM/PI.)	/S/ Carol Fritzinger	**TITLE:**	Logistics Operations Specialist	**DATE:**	01/31/2007

PROJECT D.2 ONGOING SURVEY OPERATIONS

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	SUBMISSION DATE:	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC - Grand Canyon Monitoring & Research Station
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, D.2 (GCMRC No. BNE6B)
(3.) PROJECT TITLE:	Ongoing Survey Operations

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Carol Fritzinger / Kristin Brown	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	cfritz@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7207	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Ensure accurate positioning of the spatial data required by GCMRC programs that allow accurate change detection computations including volumetric and surface area computations, and facilitate direct integration into a GIS.
(6.) OBJECTIVES:	GCMRC's survey department supports the research needs of the scientists and includes acquiring topographic data, positioning remotely sensed data, evaluating innovative mapping techniques towards achieving research goals, validating accuracy of topographic and spatial data, compiling historical data, as well as, updating positions for historical topographic and spatial data for inclusion into the GIS database.
(7.) RELATIONSHIP TO MRP:	The trained GCMRC survey staff supports monitoring and research activities by collecting survey data following standard protocols and by delivering data in the formats consistent with data standards.
(8.) METHODOLOGY:	The survey department advises researchers on the appropriate methods of collecting topographic or spatial data to meet the requirements of a scientific study as well as evaluates advanced mapping techniques to accomplish project objectives. The survey department is also responsible for obtaining, maintaining, and upgrading all survey equipment required to meet project goals. Applies survey knowledge to address complexities of integration of historical survey data into a GIS.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	• Supply GCMRC principal investigators (PI) with the necessary equipment, supplies, and survey knowledge to perform the spatial data collection required by their research. • Publish updated control point coordinates, superseded coordinates, and associated error estimates for all network control. This will be done through the development of the

	GCMRC control point database and made available to Grand Canyon National Park and all CRE researchers. • Publish control point maps and make them available for all CRE field survey activities • Publish and populate the descriptions in the Control Point Database. • Continue translating and rotating historical survey data sets to updated network control coordinates • Integrate the prioritized historical survey datasets into the CRE database • Educate principal investigators and researchers regarding the limits of various mapping techniques. • Evaluate innovative mapping techniques supporting research goals
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	• Completed – Equipment, survey support, or establishing control were provided to the following projects: IASM, KAS, Campsite, NAU/FIST, Sediment Modeling, Control Network, Fish (rangefinder), and foodbase (rod and level). • Completed – Provide control point information or establish control in support of data collection for cultural project (Pederson, NPS/MNA Arch Excavation) and for the sediment modeling project (Bright Angel Creek). • Completed – Survey Department houses two control point atlases available for check out. Additional control point maps were mad for IASM/NPS Archaeology, KAS, Control Point Database (GCY), foodbase, and Sediment Modeling. • Collection of photos and descriptions to populate the control point database is nearly complete. From a total of approximately 850 control points, 299 points concentrated between Lees Ferry and Phantom Ranch need site descriptions (less than 10 points need site descriptions between Phantom and Diamond Creek). • Progress toward updating historical data for inclusion into a GIS database continues. Updated control point coordinates supplied to NPS facilitated the NPS-funded project to update most of the legacy archaeology survey data. NPS shared a copy of the dataset with GCMRC. The updated data requires verification. • The procedure for updating FIST historical data was established. • Several historical datasets are ready for analysis in a GIS platform, but a formal structure for a survey database has yet to be defined. • Task is ongoing - survey expertise is provided to PIs for georeferencing collected project data, as well as best/appropriate technique for collecting survey data to best

	meet research goals and project objectives. • Complete and Ongoing – Evaluation of ground-based LiDAR as a less intrusive mapping technology for monitoring cultural sites is in progress; this includes a comparison between survey techniques and ground-base LiDAR techniques as well as, evaluation of ground based LiDAR as a monitoring tool. • Evaluation of Oblique Photogrammetry is in the preliminary stages.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Products Completed: - Report by Brian Collins evaluating ground-based LiDAR during the 2004 HFT - Datasets from above field work (10.1) have been delivered to researchers for analysis. - Maps and Data provided to NPS - Archeology survey data from NPS Completed Training - RTK Surveying - GIS Fundamentals I - GIS Lab - GIS Principles: Exploring Spatial Data Instruction of Motorboat Operator Certification Course to GCMRC employees and contractors.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Planned Products: - Comparison of Survey and Ground-base LiDAR report - Oblique photogrammetry/ground-based LiDAR/survey comparison (2004 HFT)
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Continue providing survey support as described above. Explore the use, effectiveness, costliness of the following mapping techniques: ground-based LiDAR, oblique photogrammetry, and improved GPS systems. Continue historical data integration to updated coordinates. Define structure of a survey database.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:		$118,572	**FISCAL YEAR NET AVAIL BAL:**		$106,326
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$65,377
			FISCAL YEAR OBLIGATIONS:		$40,949
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Carol Fritzinger	**TITLE:**	Logistics Operations Specialist	**DATE:**	01/31/2007

PROJECT D.3 ONGOING DEVELOPMENT OF GEODETIC CONTROL NETWORK

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007
(1.) SUBMITTING AGENCY:	USGS – SBSC – Grand Canyon Monitoring & Research Center	
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, D.3 (GCMRC No. BNE6C)	
(3.) PROJECT TITLE:	Ongoing Development of Geodetic Control Network	

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	Carol Fritzinger / Keith Kohl	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	cfritz@usgs.gov	State:	Arizona	Zip Code:	86001
Telephone:	(928) 556-7207	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	The geodetic control network serves as the foundation for all spatial measurements necessary for long term monitoring. The referencing of spatial data must be consistent in order to perform accurate change detection. As such, the positional accuracy must be well defined *locally* (at a specific site or along a short river reach) and *regionally* (throughout the length of the CRE). In addition, the data must be correctly and consistently referenced to the National Spatial Reference System (NSRS) for reliable use in Geographical Information Systems (GIS). Defining all levels of this hierarchy is particularly critical since diverse methods are used to determine positions, (e.g. remotely sensed LiDAR and photogrammetry, conventional ground-based optical methods, the Global Positioning System (GPS), and hydrographic surveys). Combining the results of these various methods to derive a consistent set of coordinates requires a detailed knowledge of how these coordinates are derived, as well as the accuracy of the derivation. It is important to note that the efforts described here are required by the Federal Geographic Data Committee (FGDC).
(6.) OBJECTIVES:	The objectives of this project are to implement recommendations made by the GCMRC Survey Protocol Evaluation Program (PEP), to create and fully document a survey control network, and to ensure spatial data products are compliant with FGDC regulations. The PEP recommendations include rigorously tying the control network to the NSRS (both horizontally and vertically) and meeting FGDC requirements for data validation, accuracy assessment, and documentation. The overarching goal is to develop a sound process for establishing, maintaining, and verifying survey control in support of long-term monitoring within the CRE. Toward this end, GCMRC requires a control network and survey procedures that will yield reliable and consistent results now, while allowing for advances in theory and technology in the future. Importantly, the procedures must withstand changes in personnel that will inevitably occur over the life of the CRE monitoring programs.

(7.) RELATIONSHIP TO MRP:	Goals 6, 7, 8, 11, and 12, MOs 6.4, 7.3, 8.1, 8.2, 8.3, 8.4, 8.5, 9.3, 11.1, 12.2, 12.3, and 12.9.
(8.) METHODOLOGY:	The primary control surveys are performed using GPS equipment and adhere to guidelines in *NOAA Technical Memorandum NOS NGS-58*, (1997) and *NOAA Technical Memorandum NOS NGS-59* (2005, currently in draft form) and are tied to at least three NGS Continuously Operating Reference Stations. Within the primary network, survey marks are occupied with conventional survey equipment or GPS receivers and antennas, set on collapsible, stable survey tripods. All measurements, GPS data, field records, and documentation are examined to verify compliance with the specifications for the intended accuracy of the survey. Results of the minimally constrained, least squares adjustment of the survey measurements are examined to ensure correct weighting of the observations and freedom from blunders. Local and network accuracy measures computed by random error propagation determine the provisional accuracy. In contrast to a constrained adjustment where coordinates are obtained by holding fixed the datum values of the existing control network, accuracy measures are computed by weighting datum values in accordance with the network accuracies of the existing network control. The survey accuracy is checked by comparing minimally constrained adjustment results against established control. The result must be at the 95% confidence interval.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	We continue to focus on adding vectors to the tertiary level of the network. These optical measurements (totaling over 1,000 records including occupied point, back sight point, foresight point, slope distance, height of instrument, height of target, horizontal angle, and zenith angle) are compiled in field notes collected in survey books from 1990 to present. These notes will be digitally recorded, adjusted for curvature and refraction, fixed to GPS results and entered into a least-squares adjustment for coordinate calculations and accuracy assessments.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	As of December, 2006, the GPS network within Grand Canyon has been expanded to include 159 traverse points referencing 39 GPS stations. Additionally, 217 Photo-identifiable hard points have been referenced throughout 18 sites from RM0 to RM225. These stations, combined with the 20 rim control stations, 25 primary river stations, and 170 secondary river stations now total 374 survey monuments and 217 photo-identifiable stations that are referenced to the National Spatial Reference System.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those*	The results continue to be very promising. We have shown that accurate geodetic positions can be achieved in the hostile GPS environment within the steep confines of Grand Canyon. Primary rim, primary river and secondary river network adjustment are

deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)	complete. The primary rim network includes 153 completely independent vectors. The primary river network includes the adjustment of 224 independent vectors. The secondary network adjustment includes 1,633 vectors. Adjustment of more than 1,000 optical measurements taken from 1990 to present are currently being added to the tertiary level of the network.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	1. A network of survey control points established in specific research areas and throughout the CRE, referenced to the primary control network established by the GCMRC and the National Geodetic Survey. 2. Coordinates and realistic positional and height accuracy estimates for all network control stations will be available to the NPS, the GCMRC, and all cooperating agencies. 3. Creation of a database for georeferencing of past datasets and assessing accuracy of remotely sensed data. 4. A peer reviewed publication reporting collection and processing methodologies, analysis and discussion of results, accuracy validation per FGDC requirements, and recommendations for future positioning needs.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	The final deliverable (2008) will be a comprehensive geodetic control network report for the CRE. The report will include use and analysis of many costly data sets collected between 1990 and 2006 that directly aid modeling and ecosystem change detection capabilities. One major outcome of the report will be the determination of realistic and achievable accuracies for supporting GCDAMP scientific investigations.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:		$138,270	**FISCAL YEAR NET AVAIL BAL:**		$117,528
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$77,528
			FISCAL YEAR OBLIGATIONS:		$40,000
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ Carol Fritzinger	**TITLE:**	Logistics Operations Specialist	**DATE:**	01/31/2007

PROJECT E.1 INFORMATION TECHNOLOGY SUPPORT

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	SUBMISSION DATE:	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC - Grand Canyon Monitoring & Research Station
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, E.1 (GCMRC No. BNE5A)
(3.) PROJECT TITLE:	GCMRC Component of SBSC Systems Administration Support

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	John F. Hamill / Mike Liszewski	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	jhamill@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7094	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Provide computer, network, security, and website support for GCMRC staff relative to its mission of supporting the science goals of the AMP.
(6.) OBJECTIVES:	• Provide necessary computer hardware and software required by the GCMRC • Provide computer networking infrastructure • Meet DOI/USGS security requirements • Maintain and troubleshoot computer systems as necessary • Provide website support
(7.) RELATIONSHIP TO MRP:	All goals
(8.) METHODOLOGY:	Utilizing IT helpdesk model
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	The annual state of work is a continuation of the statement of problem above.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	There were no significant deviations from the AWP. Support was provided in the following areas: • Provided necessary computer hardware and software required by the GCMRC • Provide computer networking infrastructure • Met DOI/USGS security requirements • Maintained computer systems as necessary • Provide website support
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Required computer hardware and software, networking infrastructure, security, and website support was provided and all computer maintenance and troubleshooting was completed.

(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Updated computer hardware and software, networking infrastructure, security, and website support will be provided as necessary. Maintenance and troubleshooting will be provided as needed.				
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	None				
(14.) FY2006 BUDGET REPORT	**FINANCIAL INFORMATION COLLECTION DATE:**				09/30/2006
FY PLANNED GROSS BUDGET:	$354,510		**FISCAL YEAR NET AVAIL BAL:**		$309,606
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$258,256
			FISCAL YEAR OBLIGATIONS:		$51,350
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ John F. Hamill	**TITLE:**	Chief, GCMRC	**DATE:**	02/02/2007

PROJECT F.1 ADMINISTRATIVE OPERATIONS

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM						SUBMISSION DATE:	*02/20/2007
(1.) SUBMITTING AGENCY:	USGS – SBSC - Grand Canyon Monitoring & Research Station						
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, F.1 (GCMRC No. BNE7A)						
(3.) PROJECT TITLE:	Administrative Operations						
(4.) PRINCIPAL INVESTIGATOR INFORMATION:							
GCMRC Program Manager / Principal Investigator:	John F. Hamill	Mailing Address:	2255 North Gemini Drive, Flagstaff				
E-mail:	jhamill@usgs.gov	State:	AZ	Zip Code:	86001		
Telephone:	(928) 556-7364	Delivery Address:	Same as above				
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001		
(5.) STATEMENT OF PROBLEM:	Effective management of the GCMRC program and the ability of its scientists and technicians to successfully fulfill their research obligations rely on their ability to effectively and efficiently perform their duties.						
(6.) OBJECTIVES:	It is necessary to have smooth running, transparent administrative operations that ensure the scientist's focus can remain on their research rather than on the administrative details involved with the payment of rent and utilities, timekeeping concerns, filing, and various other administrative topics.						
(7.) RELATIONSHIP TO MRP:	All goals						
(8.) METHODOLOGY:	General methods include standard accounting procedures and regulatory and legal standards as required by the USGS and other Federal agencies with legal oversight. The GCMRC will follow USGS guidelines as assigned for personnel, travel, and other processes. Administrative personnel will focus on how to accomplish requests within Federal laws and regulations. The Administrative Officer for SBSC and the Budget Analyst for GCMRC will report annually to the AMWG/TWG on year-end projections and on the actual expenditures for the previous fiscal year.						
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Effective management of the GCMRC program and the ability of its scientists and technicians to successfully fulfill their research obligations rely on their ability to effectively and efficiently perform their duties. It is necessary to have smooth running, transparent administrative operations that ensure the scientist's focus can remain on their research rather than on the administrative details involved with the payment of rent and utilities, timekeeping concerns, filing, and various other administrative topics. Administrative operations activities provide the oversight and management of facilities, burden, and overhead; personnel issues; expenditure tracking; processing of and financial management of cooperative and interagency agreements; processing of contracts; timekeeping; bank card tracking and reconciliation; travel plans and voucher processing; and liaison activities between the USGS administrative groups (Western Region Budget and Fiscal Services and Contracting Offices, Headquarters in Reston, and the Biological Headquarters). In addition, this project is innately involved with the USGS nationwide budget tracking and reporting						

	system known as BASIS+, that is used by the USGS Headquarters and Regional offices to make their annual reports to Congress as well as to respond to Congressional inquiries with turnaround times as short as 12 hours. (As part of the Glen Canyon Dam Adaptive Management Program, GCMRC administrators have been called upon to provide information of this type from the system on many occasions.)
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	There were no significant deviations from the AWP. Administrative activities involved oversight and management of facilities, burden and overhead; addressing personnel needs/issues; expenditure tracking; processing of and financial management of cooperative and interagency agreements; processing of contracts; timekeeping; bank card tracking and reconciliation; travel plan and voucher processing; and liaison activities between the USGS administrative groups.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Budgetary and other financial information provided to Program Managers upon request. SCORE Report was published using administrative funds; refer to AMWG/TWG Requests Project Progress Report.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	The Administrative Officer for SBSC and the Budget Analyst for GCMRC will present a report in actual expenditures for the previous fiscal year that will normally be presented at the Spring/Summer AMWG meeting.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	GCMRC administrative personnel have met with BOR personnel in FY 2007 and will be providing detailed billing information for agreements. In addition, GCMRC and BOR worked together to determine a perceived discrepancy of $1.7 million dollars under the closed agreement (No. 01-AA-40-4640). When the books were compared, the difference in the books came to approximately $400 over the course of the 5-year agreement and $36,296,000. GCMRC and BOR administrative personnel agreed to meet on a consistent basis to maintain an open working relationship and discuss and resolve issues before they become problems.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:	$772,545		**FISCAL YEAR NET AVAIL BAL:**		$743,899
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	See Recommendations.		**FISCAL YEAR EXPENDITURES:**		$737,899
			FISCAL YEAR OBLIGATIONS:		$6,000
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ John F. Hamill	**TITLE:**	Chief, GCMRC	**DATE:**	02/13/2007

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	SUBMISSION DATE:	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC - Grand Canyon Monitoring & Research Station
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, F.2 (GCMRC No. BNE7B)
(3.) PROJECT TITLE:	Program Planning and Management

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	John F. Hamill	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	jhamill@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7364	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Successful scientific research and reporting can be enhanced by strong and effective leadership that provides close working relationships between managers and employees. Good managers can apply knowledge as management actions that can enhance scientific research and imagination. In GCMRC, in addition to their program management responsibilities, the Program Managers are also subject area experts in their respective fields. It is important that GCMRC Program Managers and scientific staff maintain this expertise so they can provide high quality technical assistance in the form of expert analysis, opinion, and advice to the Chief, TWG, and AMWG, as requested.
(6.) OBJECTIVES:	The GCMRC's goal is to deliver a comprehensive ecosystem science program that is effective in responding to management needs articulated through the GCDAMP and by DOI. Productive, well-qualified personnel are critical to achieving this goal.
(7.) RELATIONSHIP TO MRP:	All goals.
(8.) METHODOLOGY:	In order to provide strong leadership that provides a quality science program that is responsive to the needs of the GCDAMP, GCMRC will be administered by a core program management staff that includes the following key positions: **Center Chief** Establishes Center science policies and strategic direction and provides accountability for the GCMRC budget. Interfaces with USGS management, Secretary's GCDAMP Designee, and GCDAMP managers to assure that quality science is provided in a timely manner on priority issues identified by the GCDAMP leadership. **Program Managers** Responsible for the timely execution of the science program within their program area; interaction with other program areas to ensure integrated ecosystem approaches, quality control of products and contractors/ cooperators; contract/agreement management; management of budget within their program area, and providing reports to GCDAMP work groups as needed. In FY 2006,

	GCMRC activities were organized into four major program areas: 1. ***The Physical Science and Modeling Program*** conducts research and monitoring activities on physical elements of the Colorado River ecosystem including studies of sediment storage and transport in the regulated river, integrated downstream water quality monitoring and research. The program has been responsible for conducting several experimental high flow releases from Glen Canyon Dam (GCD) to conserve sediment resources for building beaches and improving habitat for native aquatic species in the Colorado River. 2. ***The Biological Program*** provides scientific information that supports the conservation of native species in the Grand Canyon and the Lees Ferry trout fishery. Elements of the program include the assessing the effects of GCD on fishery resources, characterizing the aquatic food base, evaluating terrestrial contributions to the aquatic food base, improving fish community monitoring, developing and testing of techniques to control nonnative fishes, evaluating terrestrial vegetation changes as a result of dam operations, and water quality monitoring and modeling in Lake Powell and the Colorado River below GCD. 3. ***The Cultural and Socioeconomic Program*** focuses on culturally significant sites and artifacts and recreation activities based in the Grand Canyon. The current focus is on development of comprehensive monitoring programs to assess the condition of the culturally significant sites affected by the operation of GCD. 4. ***The Logistics Program*** supports up to 40 river trips per year and coordinates research permit management for the Grand Canyon Monitoring and Research Center. The Logistics Program also provides survey support to various program and activities.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Beginning in FY06, in an effort to simplify distribution of program planning and management salaries and travel, the Program Manager salaries were assigned to this category exclusively. In addition to the five program managers, 50% of the salary for the Southwest Biological Science Center's Information Technologies Director is also included in this line item to support the GCMRC's ongoing information and technology needs. Travel expenses in support of the program, but separate from TWG and AMWG participation, are also included. Salaries and travel costs for Program Managers, the Chief, and Deputy Chief are included in program planning and management budget.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	GCMRC program managers actively participated in and provided staff support to AMWG, TWG, SPG, and CRAHG activities. Program managers also coordinated/facilitated implementation of FY06 projects and supervised GCMRC staff. All key GCMRC program manager positions were filled in FY06 including a Chief and Biology Program Manager. A Deputy Chief position was established to oversee internal operations and facilitate integrated multidisciplinary science.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that*	Refer to individual projects.

have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)					
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Refer to the Glen Canyon Dam Adaptive Management Program Fiscal Year 2006 Budget & Work Plan as Recommended by the Adaptive Management Work Group. http://www.usbr.gov/uc/rm/amp/amwg/mtgs/05aug30/documents/Attach_012.pdf				
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Fill the recently vacated Physical Program Manager position.				
(14.) FY2006 BUDGET REPORT	**FINANCIAL INFORMATION COLLECTION DATE:**				09/30/2006
FY PLANNED GROSS BUDGET:	$566,444		**FISCAL YEAR NET AVAIL BAL:**		$486,175
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$486,175
			FISCAL YEAR OBLIGATIONS:		$00
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ John F. Hamill	**TITLE:**	Chief, GCMRC	**DATE:**	02/13/2007

PROJECT F.3 AMWG/TWG PARTICIPATION

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	SUBMISSION DATE:	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC - Grand Canyon Monitoring & Research Station
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, F.3 (GCMRC No. BNE7C)
(3.) PROJECT TITLE:	AMWG/TWG Participation

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	John F. Hamill	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	jhamill@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7364	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	This project is an account to hold funds for travel expenses only of USGS employees who are involved in or travel to AMWG and TWG meetings.
(6.) OBJECTIVES:	To fund travel costs for AMWG/TWG meetings.
(7.) RELATIONSHIP TO MRP:	Goal 12
(8.) METHODOLOGY:	Methods used are standard USGS travel authorizations and vouchers.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Fund all travel costs for GCMRC employees to travel to and from AMWG and TWG meetings while project related travel is budgeted within projects.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	GCMRC managers and appropriate staff attended all AMWG and TWG meetings in FY06.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Project progress report.
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Actual expenditure report for the previous fiscal year that will normally be presented at the Spring/Summer AMWG meeting.

(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Recommend renaming this project to represent its actual purpose which is to fund travel costs only to/from TWG/AMWG meetings for USGS employees.				
(14.) FY2006 BUDGET REPORT	**FINANCIAL INFORMATION COLLECTION DATE:**				09/30/2006
FY PLANNED GROSS BUDGET:	$17,550		**FISCAL YEAR NET AVAIL BAL:**		$14,543
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$14,543
			FISCAL YEAR OBLIGATIONS:		$00
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ John F. Hamill	**TITLE:**	Chief, GCMRC	**DATE:**	02/13/2007

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	SUBMISSION DATE:	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC - Grand Canyon Monitoring & Research Station
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, F.4 (GCMRC No. BNE7D)
(3.) PROJECT TITLE:	Independent Review Panels

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	John F. Hamill	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	jhamill@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7364	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	Independent external review is at the heart of GCMRC's approach to program management and implementation. Together with the competitive process, independent external peer review ensures the quality and objectivity of GCMRC's programs. Independent review panels are utilized to evaluate GCMRC's plans and activities. All proposals, reports, programs, etc., are subject to independent peer review according to GCMRC's peer-review protocols.
(6.) OBJECTIVES:	To increase the efficiency and quality of the science being developed by GCMRC and used by the AMWG and the Secretary, GCMRC will establish a peer-review process to ensure that all unsolicited, solicited, or in-house proposals and all draft reports received by GCMRC undergo independent, external peer review. Additionally, the Science Advisors Board will provide independent scientific oversight and technical advice to ensure that GCMRC science programs are efficient, unbiased, objective, and scientifically sound.
(7.) RELATIONSHIP TO MRP:	All goals
(8.) METHODOLOGY:	**Peer Review** All of GCMRC's scientific activities undergo an independent, external peer review including all unsolicited, solicited, or in-house proposals. Similarly, all draft reports received by GCMRC undergo independent, external peer review. The peer-review protocols developed by GCMRC meet or exceed the standards articulated by the Secretary of the Interior for the Department of the Interior. Peer review for proposals received by GCMRC in response to an RFP is conducted through a panel process, while peer review for unsolicited and in-house proposals, as well as project reports is conducted through the mail. In all cases, the reviewers are offered anonymity and the individual and panel reviews, where applicable, are provided to the PIs along with comments from GCMRC. In addition, GCMRC conducts PEPs to review and assess GCMRC's projects and methodologies. To date, PEPs have been held for remote sensing, physical, survey control, terrestrial and aquatic, cultural resources and the water quality program. The GCMRC review process is handled by a report review coordinator to ensure that the peer-review process is conducted one-

	step removed from the GCMRC Program Managers to guard against any conflicts of interest – real or perceived. Strict conflict-of-interest guidelines are adhered to. GCMRC annually recruits new individuals to join the ranks of its peer reviewers and maintains a database of almost 500 potential reviewers, organized by area of expertise. GCMRC peer reviewers come from academia, Federal, State and Tribal government, non-governmental organizations, and the private sector. Reviewers are selected on the basis of their record of scientific accomplishment and expertise. **Science Advisors** The GCMRC works with a group of Science Advisors (SAs) as one of its independent review panels. The SAs are advisory and not a decision making body. It is an interdisciplinary group composed of scientists who are qualified, based on their record of publication in the peer-reviewed literature, or other demonstrable scientific achievements. An Executive Secretary leads the SAs and serves as the liaison officer to the AMWG and the GCMRC. The SAs, together and individually, will be expected in FY06 to review and comment to the AMWG and GCMRC on: (1) GCMRC's annual work plan and budget proposal, (2) GCMRC's long-term monitoring and research plan (MRP), (3) the results of GCMRC's completed monitoring and research activities, (4) the results of any synthesis and assessment activities initiated by the GCMRC, and (5) any other activities (i.e., developing a monitoring plan, enhancing opportunities for integrated science, and other program specific scientific advice) it is asked to address by the GCMRC Chief or the AMWG.
(9.) ANNUAL STATEMENT OF WORK: **(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)**	The GCMRC librarian coordinates review activities for Protocol Evaluation Panels (PEPs) and research proposals and reports funded by the Center. In FY2006 this included 1 PEP, 4 research proposals, and 26 research reports. The Scientific Advisors individually will be expected upon request, among other things, to review and comment on: 1. Results of ongoing and completed monitoring and research program activities, as well as any synthesis and assessment activities initiated by GCMRC 2. The appropriateness of GCMRC's RFPs, especially their responsiveness to management objectives 3. The protocols used in GCMRC sponsored scientific activities, including a 5-year review of GCMRC monitoring and research protocols 4. GCMRC's long-term monitoring plan 5. GCMRC's annual monitoring and research plans 6. GCMRC's annual budget proposals, to ensure that the science program is efficiently and effectively responding

	to AMWG goals (i.e., management objectives) 7. Any other program specific scientific and technical advice it is asked to address by the AMWG, the GCMRC, or the Secretary
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	Two Science Advisors positions were open from 2005, and three SAs resigned in 2006 at the end of their appointment period. A proposal by GCMRC to AMWG to reduce the Science Advisor group from 10 to 8 was accepted, and three of the five open positions were refilled. Dr. Harold Tyus, fish/aquatic ecologist from UC Boulder; Dr. Don Fowler, anthropologist from UN Reno, and Dr. Ellen Wohl, geomorphologist from CSU, were appointed by the GCMRC Chief as Science Advisor replacements. All three specialists are currently working with existing SAs on review projects. Continuing SA Appointments are: Jill Baron, Plant Ecologist, USGS/CSU Virginia Dale, Systems Specialist, TVA Lance Gunderson, Adaptive Management Specialist, Emory College Jim Kitchell, Fish Ecologist, Univ of Wisconsin Dale Robertson, Limnologist, USGS The SAs produced the following reviews of documents in 2006: • Knowledge Assessment Report (KAR) • Section of SCORE Report • Draft HBCC • Strategic Science Plan (2) • Monitoring and Research Plan (2) • FY 2007 Annual Work Plan and Budget • Hydropower Economic Statement of Work Review • Biophysical/Socio-Cultural Statement of Work Review Science Advisory Services of SAs: The SAs, and specifically the SA Executive Secretary, agreed to significantly increased contributions of advisory services to the AMP in 2006 to ensure support to planning process needs in science and management. This has involved contributions in the following areas. • A Science Planning Group to develop AMP science plans; i.e., SSP, MRP, AWP and Budget • SPG to develop experimental options • Review and advisory service to TWG and GCMRC • Advisory service to Task Team for Experimental Options Assessment Resource Requirements
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support*	Refer to the Annual Report: FY 2006 Science Advisor Accomplishments and Proposed FY 2007/2008 Science Advisor Review and Advisory Service Program prepared by L.D. Garrett, SA Executive Secretary, for Dr. Kurt Dongoske, TWG Chair, on October 24, 2006. http://www.usbr.gov/uc/rm/amp/amwg/mtgs/06dec05/index.html http://www.usbr.gov/uc/rm/amp/amwg/mtgs/06dec05/AIF_SAsRpt.pdf

systems, newsletters, etc.)	
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Refer to the report links, above.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Selected recommendations of the Science Advisors from various reviews are as follows: • Incorporate ecosystem paradigm into more elements of research, monitoring, and management actions • Focus on most critical management resource concerns • Implement aggressive HBC program of research, monitoring, and management actions • Redirect aquatic food base program • Focus new food base program toward key higher trophic resources • Direct science program with strategic and operational science questions • Determine how to integrate management actions into ongoing science/monitoring programs • The FY 2007 and FY 2008 budget for Science Advisor programs should be reduced to previous levels of between $170,000 and $190,000.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:		$380,250	**FISCAL YEAR NET AVAIL BAL:**		$326,810
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$181,284
			FISCAL YEAR OBLIGATIONS:		$145,526
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ John F. Hamill	**TITLE:**	Chief, GCMRC	**DATE:**	02/13/2007

PROJECT F.5 SUPPORT FOR STRATEGIC SCIENCE IMPLEMENTATION PLANNING

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007
(1.) SUBMITTING AGENCY:	USGS – SBSC - Grand Canyon Monitoring & Research Station	
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, F.5 (GCMRC No. BNE7E)	
(3.) PROJECT TITLE:	Support for Strategic Science Implementation Planning	

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	John F. Hamill	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	jhamill@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7364	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	The Science Planning Group (SPG) was authorized by the AMP Secretary's Designee and AMWG in 2005 at the request of GCMRC and TWG. A 12-month focused effort of AMP managers and scientists was approved.
(6.) OBJECTIVES:	To develop the AMP 5-year experimental plans and associated science programs plan.
(7.) RELATIONSHIP TO MRP:	All goals.
(8.) METHODOLOGY:	The Science Advisors group was appointed to direct and facilitate the process. The SPG, led by GCMRC and TWG members, was an experimental adaptive management task group developed specifically to assure involvement of all AMP programs and groups in the planning process.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	No specific Statement of Work developed.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	The SPG has documented their process and performance in "A Report on Activities and on Accomplishments of the GCD AMP Science Planning Group: 2005-2006." In brief, the SPG: • Developed and followed a 12-month plan of specific objectives, and proposed schedules, costs, and outcomes. • Utilized an open process of all AMP parties' involvement in multiple workshop meetings to develop all plans. • Produced and evaluated in 12 months and within budget: ♦ Three 5-year experimental plan alternatives ♦ A 5-year Strategic Science Plan (SSP) ♦ A 5-year Monitoring and Research Plan (MRP) ♦ A 2007 Annual Work Plan and Budget (AWP) In conducting its activities, the SPG found the lack of full development in several aspects of the GCD AMP structure and processes that created weaknesses in the science planning process, and will likely affect other future management and science activities in a similar nature. These findings prompted a set of

	recommendations from the SPG.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	The SPG has documented their process and performance in "A Report on Activities and Accomplishments of the GCD AMP Science Planning Group: 2005 – 2006."
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	Strategic Science Plan to Support Glen Canyon Dam Adaptive Management Program, Fiscal Years 2007–11, Draft for AMWG Review, October 27, 2006; Prepared by the Grand Canyon Monitoring and Research Center Developed in cooperation with the Glen Canyon Dam Adaptive Management Program http://www.usbr.gov/uc/rm/amp/amwg/mtgs/06dec05/index.html http://www.usbr.gov/uc/rm/amp/amwg/mtgs/06dec05/AIF_Science_Plans.pdf
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	The SPG felt its size, composition, and task orientation contributed strongly to its performance. However, it also determined that its performance and the performance of future task groups could be greatly improved if resolve could be gained in several critical aspects of the structure and processes of the AMP. The SPG identified 10 issues for continued efforts in FY 2007 and 2008. To this end, the SPG recommends that the SPG be followed in 2007 by another similar task group that is charged in the 12-month period to provide resolve to one or more of five critical issues. • Develop improved methods and/or procedures for managers to establish and articulate priorities for specific 3-5 year time intervals. • Develop improved methods for managers and scientists that permit more effective tradeoff assessments. • Develop more effective scientist/managers collaborative working procedures. • Implement methods to monitor and improve the adaptive management process. • Implement methods to define future conditions (DFCS) for the Colorado River Ecosystem resources of concern.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:		$29,250	**FISCAL YEAR NET AVAIL BAL:**		$24,596
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$24,596
			FISCAL YEAR OBLIGATIONS:		$00
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by	/S/ John F. Hamill	**TITLE:**	Chief, GCMRC	**DATE:**	02/13/2007

PI.)					

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	SUBMISSION DATE:	*02/20/2007

(1.) SUBMITTING AGENCY:	USGS – SBSC - Grand Canyon Monitoring & Research Station
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, F.6 (GCMRC No. BNE7I)
(3.) PROJECT TITLE:	GCMRC's FY 2006 Biennial Science Symposium

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	John F. Hamill	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	jhamill@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7364	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	The symposium represents an exciting opportunity to learn and to share recent activities. The symposium also coincides both with the tenth anniversary of the environmental impact statement (EIS) that set the stage for the Glen Canyon Dam Adaptive Management summary on the impacts of the operation of Glen Canyon Dam on downstream natural, cultural, and recreational resources within Glen Canyon National Recreation Area and Grand Canyon National Park.
(6.) OBJECTIVES:	To facilitate critical information transfer and promote science and management discussions as new information is derived from the science and GCD-AMP efforts. In addition, the symposium should engender discussion on how best to use scientific results from research conducted in the Colorado River ecosystem to advance the future monitoring and research efforts.
(7.) RELATIONSHIP TO MRP:	All goals.
(8.) METHODOLOGY:	To hold a symposium in a centrally located city where researchers can share their findings with others.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	The report, The State of Colorado River Ecosystem in Grand Canyon, SCORE, serves as a focal point for the first day of the symposium. It is a significant milestone in the use of adaptive ecosystem management (AEM) to support the Grand Canyon Protection Act of 1992 (GCPA). Importantly, its analysis and results can be a catalyst for education and interaction among the scientific community. The second day offers a preliminary update of the results of the November 2004 Experimental High Flow and efforts to mechanically remove nonnative fishes in the Colorado River within Grand Canyon. During the afternoon of the second day, monitoring and research activities in the realms of aquatic biology, economics, planning and experimentation are highlighted. The third day explores other important components of the monitoring and research program, including spatial and remotely sensed data, water quality, physical science, and primary productivity. The symposium concludes with recent findings related to the endangered humpback chub (Gila cypha) population in

	Grand Canyon.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	Symposium completed; SCORE Report written and published; see the following link for abstracts, etc. http://www.gcmrc.gov/news_info/outreach/symposiums/2005/sym_2005.htm
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	Symposium completed; see the following link for abstracts, etc. http://www.gcmrc.gov/news_info/outreach/symposiums/2005/sym_2005.htm and the following link for the complete SCORE report: http://www.gcmrc.gov/products/score/2005/score.htm
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	See links, above.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	Conduct the next science symposium in FY08 in coordination with the Upper Basin Recovery Implementation Program and the Lower Basin Multi-species Conservation Plan.

(14.) FY2006 BUDGET REPORT		**FINANCIAL INFORMATION COLLECTION DATE:**			09/30/2006
FY PLANNED GROSS BUDGET:		$29,250	**FISCAL YEAR NET AVAIL BAL:**		$24,596
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		**FISCAL YEAR EXPENDITURES:**		$24,596
			FISCAL YEAR OBLIGATIONS:		$00
			END OF FISCAL YEAR AVAILABLE BALANCE:		**$ 00**
SIGNATURE: (Must be signed or submitted by PI.)	/S/ John F. Hamill	**TITLE:**	Chief, GCMRC	**DATE:**	02/13/2007

PROJECT F.8 AMWG, TWG REQUESTS DURING FY 2006

FISCAL YEAR 2006 PROJECT REPORT FOR THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM	**SUBMISSION DATE:**	*02/20/2007
(1.) SUBMITTING AGENCY:	USGS – SBSC - Grand Canyon Monitoring & Research Station	
(2.) GCDAMP/GCMRC AWP ID/OTHER NO.:	Glen Canyon Dam Adaptive Management Program, Fiscal Year 2006 Budget & Work Plan, F.8 (GCMRC No. BNE7F)	
(3.) PROJECT TITLE:	AMWG, TWG Requests During FY 2006	

(4.) PRINCIPAL INVESTIGATOR INFORMATION:

GCMRC Program Manager / Principal Investigator:	John F. Hamill	Mailing Address:	2255 North Gemini Drive, Flagstaff		
E-mail:	jhamill@usgs.gov	State:	AZ	Zip Code:	86001
Telephone:	(928) 556-7364	Delivery Address:	Same as above		
FAX:	(928) 556-7092	State:	AZ	Zip Code:	86001

(5.) STATEMENT OF PROBLEM:	This funding is recommended as a placeholder in the event that additional needs are identified during the course of FY2006.
(6.) OBJECTIVES:	To fund unexpected projects or expenditures that may arise during the course of the fiscal year.
(7.) RELATIONSHIP TO MRP:	Dependent on need.
(8.) METHODOLOGY:	Dependent on need.
(9.) ANNUAL STATEMENT OF WORK: *(Briefly summarize the annual SOW to the extent that the project is identifiable. Include specific tasks where appropriate and helpful.)*	Dependent on need.
(10.) PROGRESS STATEMENT: *(Describe how each task identified in the AWP was/was not met and summarize initial findings and final results. Include a description of any significant deviation from the AWP Scope of Work.)*	Minimal funds were used to help with the costs of publishing the SCORE report.
(11.) REPORTS/PRODUCTS COMPLETED: *(Include all deliverables identified in the AWP that have been completed and report on all products beyond those deliverables identified. Include reports, presentations, poster sessions, exhibits, databases, workshops, maps, website contributions, decision support systems, newsletters, etc.)*	The State of the Colorado River Ecosystem (SCORE) Report publishing costs were partially funded from this account. See the link, below, for the full report. http://www.gcmrc.gov/products/score/score_reports.htm
(12.) REPORTS/PRODUCTS PLANNED: *(See above, but report those items that are in progress and include expected delivery dates.)*	None.
(13.) RECOMMENDATIONS: *(Describe recommendations for continuation or modification of project, other studies, or activities resulting from findings of this project; recommendations for MRP changes or future program guidance, etc.)*	None at this time.

(14.) FY2006 BUDGET REPORT			FINANCIAL INFORMATION COLLECTION DATE:		09/30/2006
FY PLANNED GROSS BUDGET:	$87,750		FISCAL YEAR NET AVAIL BAL:		$80,408
COMMENTS: *(Discuss anomalies in the budget; expected changes; anticipated carryover; etc.)*	None at this time.		FISCAL YEAR EXPENDITURES:		$23,103
			FISCAL YEAR OBLIGATIONS:		$00
			END OF FISCAL YEAR AVAILABLE BALANCE:		$57,305
SIGNATURE: (Must be signed or submitted by PI.)	/S/ John F. Hamill	TITLE:	Chief, GCMRC	DATE:	02/13/2007

----------END OF REPORT----------