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Date: 11/20/99 3:50PM
Subject: GCMRC FY2001 M&R Plan Response to Comments

Attached in .pdf format is GCMRC's Response to Comments document which addresses TWG comments and questions regarding the FY2001 Work Plan draft dated 10/22/99.

This document was scheduled to be distributed to the TWG on 11/19/99 for discussion at the December 7-8 TWG meeting. There are three tables/attachments which are being finalized today and will be e-mailed on Monday, Nov. 22. Also on Monday, a hard copy of the complete document will be sent via Federal Express to official TWG members. We will request the deliveries to be made Tuesday morning.

The document is entitled, "TWG Comments on October 22, 1999, Draft FY2001 Monitoring and Research Plan (dated 11/19/99) - Response to Comments." It is also available in MS Word format at: http://130.118.161.89/amwg_new - on the home page under the category "Announcements & Recent Web Site Postings," under "Response to Comments." Please note that this document is available only in Word and Adobe Acrobat formats.

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GCMR-700
PRJ 5.10

November 22, 1999

MEMORANDUM

To: Technical Work Group

From: Barry Gold, Acting Chief

Subject: Documents for review at the December 7, 1999, TWG Meeting

Attached to this memo please find the following documents:

1. "Response to Comments" table.
2. Attachment 1 - Revised Current Knowledge for Biological Resources
3. Attachment 2 - Revised Summary Budget from page 117 of the FY 2001 Work Plan
4. Revised Table 2.1
5. Revised Table 2.2
6. New Figure 2.1 showing the schedule of PEPs in FY 2000 and FY 2001

These documents have been prepared to respond to the comments that you provided GCMRC on the DRAFT (10/22/99) GCMRC FY 2001 Monitoring and Research Work Plan. We are scheduled to review these documents at the TWG meeting on December 7, 1999, beginning at 2:30 p.m.

We plan to go through the "Response to Comments" table one comment at a time focusing on those comments where one or more TWG members still have questions after reading the response. We will refer to the associated documents (items 2 - 6 above) as needed during this discussion. Once we have reviewed the responses, GCMRC will modify the DRAFT FY 2001 Work Plan for mailing to the AMWG.

We appreciate your comments and your help in improving the clarity and substance of the Work Plan.

TWG Comments on October 22, 1999 DRAFT FY2001 Monitoring and Research Plan
(November 19, 1999)

GENERAL PLAN - RESPONSE TO COMMENTS

Line # or Page #	Comments and/or Recommended Action	GCMRC Response
	US BUREAU OF RECLAMATION (10/31/99): In general, the study plan is a great improvement from a resource integration perspective and we appreciate GCMRC's efforts. Coordination between the broad tables and the specific project descriptions could be improved. The specificity of cultural resource proposals within the context of broader projects should be increased to allow the reader to understand exactly what is proposed but we understand the time constraints under which the plan was modified and that it is a work in progress.	No response required.
	GC TRUST (11/8/99): Congratulations to you and your staff on the new integrated format. I like the format very much, and I have several suggestions that I think will help strengthen the document. **(CONCLUSION)** The format of this plan is on the right track. I suggest that the GCMRC staff and the TWG stakeholders work together between now and the FY2002 plan to agree on format and content on future work plans. We should continue to strive to make this a professional product that reflects positively on the AMP, and is of maximum utility to the Center and the stakeholders.	No response required. GCMRC would welcome the opportunity to work with the GC Trust and the rest of the TWG to strengthen the format and the content of the Annual Work Plan between now and the time we begin developing the FY 2002 Work Plan.

	THE HOPI TRIBE (11/15/99): The Hopi Tribe has reviewed the FY2001 Monitoring and Research Work Plan and has the following comments. The Hopi Tribe appreciates the Grand Canyon Monitoring and Research Center's efforts toward integrating the various resource programs into a more holistic monitoring and research strategy. However, a truly holistic ecosystem monitoring and research strategy is not yet reflected in this draft work plan. The basis for the lack of this integration is probably two fold. One, we have not yet achieved the level of scientific understanding of the interconnectedness of resources that comprise the Colorado River ecosystem to design an integrated and holistic monitoring and research program; and, two, there has not been sufficient effort, by both the GCMRC and the participating tribes, to identify the various resources of traditional cultural concern and integrate these resource concerns across resource categories within the design of a integrated monitoring and research program.	Efforts have been initiated to review GCMRC projects using integrated perspectives. These efforts will be continued and expanded. GCMRC has begun meeting with the tribes on a regular basis. It is hoped that these meetings will provide the opportunity to incorporate broader tribal perspectives throughout GCMRC programs.
	CREDA (11/5/99): REQUEST FOR ADDITIONAL MONITORING For your information, CREDA will request AMWG to recommend to the Secretary that the GCMRC be directed to reprogram funds in 2000 and 2001 to initiate the monitoring of flows a short distance downstream from the dam. This is critical to getting resolution to the question of how much effect putting the plant on AGC during downramp hours has on flow patterns in the Glen Canyon reach. There are funds programmed in both years for unsolicited proposals and TWG/AMWG requests sufficient to begin this critical monitoring program. It would appear that the MO and IN discussion on stream flow monitoring on pg. 29 of the FY2001 plan would support this request.	Issues of impacts to resources related to ramping rates were studied and discussed rather extensively during the EIS period. The results of those studies formed the basis for the preferred alternative that eventually was adopted as the Record-of-Decision by the Secretary of the Interior. Additional studies on effects of ramping rates on resources specifically located in the tailwaters reach may be needed for issues not studied during the EIS. Before initiating new studies, an analysis of existing and historical data should be conducted, to see if it sheds any light on the concerns being raised. This analysis of historical data is also important to designing an appropriate monitoring program.

	CREDA (cont'd)	The first step in meeting new information needs related to ramping rates is to design and implement a monitoring program that is sufficiently robust to detect impacts of changing hourly operations. Beyond monitoring, specific research can only be designed, whether by proposers or the GCMRC, when hypotheses are clearly articulated relative to perceived impacts of ramping rates related to the ROD, or those that depart from the ROD. With respect to initiating a monitoring program, the Glen Canyon gage can be brought back into operation in a short time for a cost of about $27,000 in FY 2000. The study design for addressing the impacts of ramping rates needs to be carefully thought out by GCMRC and its cooperators; e.g. w.r.t the food base, recreation, native fishes, etc. The TWG needs to clearly state what the questions are that need to be addressed, as well as the process and schedule for decision making once the research results are available.
	WAPA (11/8/99): GENERAL Dam releases intended to comply with the 1500 cfs down ramp restriction, including system-dependent fluctuations around the 1500 cfs ramping rate target, have been a contentious issue for some stakeholders in the AMP. Minor exceedences of the down ramp restriction have been reported. System fluctuations around the target are, also, reported as exceedences. As a result, automatic generation control operations are sometimes removed from Glen Canyon Dam during down ramp periods. However, the effects of such minor variances downstream have not been investigated. The need for scientific study is presented to determine the impacts of system-generated fluctuations on downstream resources (biological, physical, and cultural). Western in collaboration with concerned stakeholders will propose a study plan to address this issue. The proposal will address MO 1 and IN 1.1, either as an unsolicited proposal or in response to the proposed project guidance titled Long-term Monitoring of Streamflow and Fine-sediment Transport in the Main Channel Colorado, Paria, and Little Colorado Rivers (page 77 of the draft Workplan). It may be beneficial to initiate this proposal (unsolicited) as part of the FY2000 Workplan.	See response to comment by CREDA above. GCMRC believes that a better way to proceed than for "Western in collaboration with concerned stakeholders to propose a study plan," would be for Western in collaboration with concerned stakeholders to clearly articulate the questions they would like to see addressed through a study, to present this to the TWG, and gain the support of the TWG for such a study to be a priority item. With that guidance, GCMRC would work to develop a study plan and/or RFP to address the identified questions.

CHAPTER 1	GEOGRAPHIC AND INSTITUTIONAL SCOPE RESPONSE TO COMMENTS	
Pg. 4 Line 68	**WAPA 11/5/99** I clearly understand that the PA uses 256,000 cfs as the flow impact limit on which to base subsequent monitoring and research activities. I also understand this is [illegible] factor under GCMRC's control. I will make the point anyway. 256,000 cfs does not make sense for current day or future operation philosophy for the dam. It is conceivable that in future years the AMP may address regulatory clearance to intentionally release flows up to 100,000 cfs. It is not conceivable that by intentional human decision we would ever release flow even approaching 256,000 cfs for the purposes of this program. Any flow through dam facilities much above 100,000 cfs would only occur as human reaction to an act of nature (e.g. mid-1980s flood). The burden imposed on the AMP by this unrealistic flow impact limit should be revised to reflect current-day operation philosophy.	Consistent with guidance received from the TWG/AMWG, GCMRC has used the definition of Geographic and Institutional Scope contained in the FY 1997 - 2002 Strategic Plan which currently governs GCMRC activities under the AMP.
Pg. 4 Line 70	**CREDA 11/5/99**: What is basis for 100,000 cfs level? According to the sentence, this is the level of inundation impacts to physical, biological, recreational and other resources.	Consistent with guidance received from the TWG/AMWG, GCMRC has used the definition of Geographic and Institutional Scope contained in the FY 1997 - 2002 Strategic Plan which currently governs GCMRC activities under the AMP.
Pg. 4 Lines 75-84	**CREDA 11/5/99**: CREDA supports this statement of constraints on the GCMRC program.	To make this statement consistent with lines 72-74, GCMRC proposes to add the word "primarily" on line 83 after the statement "... the effects of the Secretary's actions..."

Chapter 1 (cont'd)	*CURRENT KNOWLEDGE – RESPONSE TO COMMENTS*	
Pgs. 5-20	**GC TRUST (11/8/99): CURRENT KNOWLEDGE** I think this section should eventually be a synthesis of our understanding of ecosystem function. As such it will be of tremendous utility to the stakeholders. This section should paint the big picture of the relationships between ecosystem patterns (abundance and distribution) and ecosystem processes (physical and biological drivers of ecosystem patterns), and demonstrate the "ecosystem science approach" called for in the Center's mission statement (line 95). In addition, this section should discuss how each of the current research and/or monitoring projects has either validated or refuted the current paradigm. Perhaps it should also discuss how our understanding of pattern and process is similar or dissimilar with other river ecosystems. The use of visuals such as causal loop diagrams[1] would be helpful, as would a rigorous citing of pertinent references. I understand that this is a significant challenge and beyond our reach this year, but we should strive to achieve it in the upcoming FY2002 plan. The format of the Current Knowledge sections should be consistent. I would like the Biological and Cultural Resources sections in the FY2001 plan be revised so that they follow the format of the Physical Resources section. A clearer explanation of how the ITP activities relate to each other and contribute to a whole is also needed.	The state of knowledge for biological resources is expanded. It contains information associated with specific contracts currently funded. A copy of the amended state of knowledge is attached to this document. ITP relationships are described in the introduction of the technical support section starting at line 447 and are also shown in figure 3.2. Additional information on the IT program can be found in the draft FY2000 2004 strategic plan. The Socio-cultural resources sections have been re-formatted into Previous and On-going Investigations sections to reflect the format used in the Physical Resources section. Line 286: Previous Investigations: Line 295: Ongoing Investigations: Line 328: Previous Investigations: Line 335: Ongoing Investigations:

[1] See Ford, A. 1999. Modeling the environment: an introduction to system dynamics models of environmental systems. Island Press, Washington, D.C. *(GC Trust footnote)*

Pg. 5	**AGFD (11/3/99):** The section on Sediment and Water Resources is good and provides a clear overview of the state of knowledge and current (FY99) projects. The Biological Resources section would benefit from additional information regarding ongoing contracts. Several projects were excluded from this section (aquatic foodbase [phyto-benthic community], Lees Ferry trout fishery, and riparian vegetation) and should be summarized as was done for the sediment and water resources section. Throughout the Current Knowledge section I found few references to other program areas to indicate integration across resource programs.	The state of knowledge for biological resources is expanded. It contains information associated with specific contracts currently funded. A copy of the amended state of knowledge is attached to this document.
Pg. 8 **Lines 185 & 222**	**US BUREAU OF RECLAMATION 10/31/99: BIOLOGICAL RESOURCES** With respect to the lower threshold of main channel sediment storage accumulation, lines 185 and 222 should be consistent.	The text in these two sentences has been revised to achieve consistency, and the flow level referred to in each is actually estimated to be about 8,000 cfs on the basis of preliminary research.
Pg. 9, 10 **Beginning with line 230** **Line 232** **Line 258**	**US BUREAU OF RECLAMATION 10/31/99: BIOLOGICAL RESOURCES** The biological status of canyon resources should be expanded to give the reader a sense of the current state of these resources. This section is limited to endangered species issues and is very brief compared to the physical, cultural and IT resource areas. Topics such as the status of the trout fishery, food base, water quality, and vegetation should be covered. Replace "impending" with "potential". Replace "operations" with "NEPA analysis".	The state of knowledge for biological resources is expanded. It contains information associated with specific contracts currently funded. A copy of the amended state of knowledge is attached to this document The recommended changes no longer apply to the content of the revised current knowledge. This is addressed in the previous comment.
Pg. 10 **Line 263-264**	**GC TRUST (11/8/99): BIOLOGICAL RESOURCES** Change sentence to something like "Brood parasitism may also affect fledgling success" and cite appropriate reference(s).	The intent of the phrasing was to note that other factors may be playing a role in fledgling success besides cowbirds. It has been rewritten as "While parasitism on flycatcher nests by cowbirds does affect willow flycatcher success, other factors may also be affecting fledgling success."

Pg. 10 **Line 264**	**US FISH & WILDLIFE SERVICE 11/12/99: BIOLOGICAL RESOURCES** Not sure why the sentence reads : Parasitism on flycatcher eggs may also affect fledgling success. Cowbird parasitism on flycatchers in Grand Canyon has been well documented.	The intent of the phrasing was to note that other factors may be playing a role in fledgling success besides cowbirds. It will be rewritten as "While parasitism on flycatcher nests by cowbirds does affect willow flycatcher success, other factors may also be affecting fledgling success."
Pg. 11 **Lines 275-277** **Lines 297-300**	**GC TRUST (11/8/99): SOCIO-CULTURAL** Is this goal internally consistent? What does it mean for such a dynamic ecosystem to protect plants and animals *in situ*? Because erosion is a "natural process," does the use of "natural processes" in this sentence mean natural processes operating within the range of natural/historic variability? This needs to be clarified here and throughout the cultural resources section.	This goal refers primarily to cultural resources that have fixed locations such as archaeological sites and traditional resources such as plant locations, springs, physical landforms etc. Line 297 -300 has been clarified to read: "While some surface erosion is due to natural processes that are unrelated to dam operations, sediment loss from erosional processes believed to be related to dam operations and mainstem water levels, and head cutting arroyos appear to impact archaeological sites at specific locations."
Pg. 12 **Lines 308-310**	**US BUREAU OF RECLAMATION 10/31/99: SOCIO-CULTURAL** The sentence at lines 308 - 310 should be expanded to include pre-dam processes to understand how the frequency and magnitude of pre-dam floods preserved cultural sites.	Line # 310 has been clarified to read: "...dam operations. These data can then be used to analyze available information on pre-dam processes that affected cultural site preservation."
Pg. 13 **Lines 325-327**	**GC TRUST (11/8/99): SOCIO-CULTURAL - Recreational Resources** Clarify whether "mainstem base levels" refers to a geomorphic surface, or to base flow.	Mainstem base levels refer to base flow

Pg. 13 **Line 325-342**	**WAPA COMMENTS 11/5/99: SOCIO-CULTURAL** Constant, heavy recreational use of campable beaches must also be a significant erosion factor. I have yet to see a proposed project to evaluate this aspect of beach erosion, yet this is one erosive element we can control. Pre-dam recreational impacts to beaches were insignificant compared to the current level of use. Temporary increases in campsite number and size resulting from flood flows may be the only operational mitigation for maintaining sediment deposits above normal fluctuations, but regulating beach use could extend that temporary benefit.	With regard to the first WAPA comment here, I agree that this is one aspect of the program that has been absent; the others include the role of aeolian reworking of sand bars versus dam operations and recreational camping, as well as the impacts of motorized boat wakes and their possible erosional impacts on pre-dam terraces in the Glen Canyon reach. Line #340 on: Data on beach use frequency is currently being collected by an NPS study and will be available in FY 2001 for use in future studies investigating human impacts to beach sites.
Pg. 16 **Line 423**	**US BUREAU OF RECLAMATION 10/31/99: INFORMATION TECHNOLOGIES** Justification should be given for purchasing a multi-beam system rather than contracting for the channel map of the entire study area.	A hydrographic multibeam contractor generally uses equipment and methodology designed for a specific purpose such as oceanic and open water applications. GCMRC has worked to develop this application for a swift-water system (dealing with white water boat design, environmentally sealed equipment, and software development). In-house capability provides the flexibility to conduct change detection associated with monitoring or event driven episodes like BHBFs that have short lead times. Our investigations to date of available contracting capability indicate that there would be development time required and substantial associated costs (ca. $425,000) for mapping the channel through a private contractor. In addition, this would not provide the capability for the type of change detection monitoring noted above. GCMRC will re-evaluate the cost effectiveness of in-house vs. contracting for obtaining one time full channel bathymetry.

Pg. 18 **Line 488**	**WAPA COMMENTS 11/8/99** Whatever is done for the remote sensing project, cultural needs to be involved to ensure the remote sensing data that is acquired will be useful and not duplicative [See Page 51, Line 986].	Line # 488 notes past recommendations of a PEP. Line # 986 applies these recommendations to a proposed cultural project. The cultural resource program manager will oversee this project to ensure that it will be useful and there is no duplication.
Pgs. 18-19 **Lines 475,476, 521-525**	**CREDA 11/5/99: INFORMATION TECHNOLOGIES PROGRAM** Given the slow start, will the entire $400,000 be required in FY2000 or 2001?	The remote sensing initiative is programmed to start in FY2000. We are in the process of contracting for a remote sensing coordinator. The full $400K will be required to complete all RS activities proposed in the FY2001plan. Similarly, we expect the full $400K will be required to complete the RS activities proposed for FY2001. These funds are needed to implement the strategic plan that guides the remote sensing initiative. The remote-sensing initiative is on track given that several field studies have been initiated. Examples include: LIDAR, HYDICE, NGS and Emerge overflights, as well as evaluations of digital photogrammetry, use of oblique stereo-photogrammetry, and development and field testing of multi-beam, and swath bathymetry.
Pg. 20 **Map**	**US BUREAU OF RECLAMATION 10/31/99: Fig 1.2 - GIS Sites Map** The map is too small to be of value. Either delete or print landscape and enlarged to allow the reader to understand the GIS sites.	The map will be printed landscape or a new map will be provided that is more legible.

Chapter 1 (cont'd)	*PROGRAM INTEGRATION - RESPONSE TO COMMENTS*	
Pgs. 21, 22 and Figure 1.3.	**GC TRUST (11/8/99):** I would like to see some discussion on the strategy for addressing the multitude of INs that have been identified. Which ones are the highest priorities and why? How do you bundle several INs into an RFP? What is an ideal sequence of research projects? For me, Figure 1.3 does not add clarity to the text.	The prioritization process for the existing MOs and INs has been described in detail as an appendix to the strategic plan. As has been stated at previous TWG meetings, our strategy consists of designing monitoring programs that yields data which can subsequently be analyzed to address more than one information need and to develop specific research activities for this information needs that can only be addressed through a specific research activity. In working with the prioritized INs, GCMRC would concur that it does not appear that the current prioritization always represents a logical sequence of what needs to be known first and looks forward to working with the TWG in developing such a framework as we revise the MOs and INs.
Chapter 1 (cont'd)	*MANAGEMENT OBJECTIVES AND INFORMATION NEEDS - RESPONSE TO COMMENTS*	
Pg. 21 Lines 543-544	**CREDA 11/5/99:** See 632-634 [Schedule and Budget]. According to the Loveless Guidance Document, the AMWG makes recommendations regarding MOs and INs and dollars made available to GCMRC to achieve the M0s etc. and does not make decisions.	This is true. The AMWG can only make recommendations to the Secretary. The line 543 has been rewritten to read:"...intended to address the management objectives and prioritized information needs recommended by the AMWG to the Secretary and approved by the Secretary for use in developing priorities for monitoring and research activities for the Colorado River ecosystem."

Chapter 1 (cont'd)	***PROTOCOL EVALUATION PROGRAM - RESPONSE TO COMMENTS***	
Pgs. 21-23	**GC TRUST (11/8/99):** It would be useful to use a table or timeline to show which PEPs have been completed, and when upcoming ones are planned. Use associated text to define the process and justify the timetable.	A figure showing the schedule of PEPs has been added to chapter 2 and is included as an attachment with this table (Fig 2.1).
Chapter 1 (cont'd)	***CONTINGENCY PLANNING - RESPONSE TO COMMENTS***	
Pg. 23 Line 590 Line 592	**WAPA COMMENTS 11/5/99** Correct "Authority" to "Administration." When the BHBF contingency is addressed for FY2001, contingency planning activities should include time to address compliance activities.	Corrected to read "Western Area Power Administration" Compliance activities are not addressed as part of the contingency planning because the current process calls for having compliance completed in January of the given year so that a BHBF can occur anytime between January - July of that year, assuming the hydrologic triggering and resource criteria are met.
Chapter 1 (cont'd)	***FUTURE CHALLENGES - RESPONSE TO COMMENTS***	
Pg. 24 Line 605	**US FISH & WILDLIFE SERVICE (11/12/99):** Under the topic of the temperature control device, it states that the structure will not be in operation until 2002, which means that all of the pre-operational testing and surveys should be conducted during the implementation of this 2001 plan. Yet, later in the document beginning on line 1518 under New Research Associated with Experimental Flows for Fish and Temperature Control Device, only preliminary projects are identified. Since the TCD workshop has not taken place, I suspect that both of these sections will need to be re-written to adequately prepare us for testing the TCD in 2001.	The final draft for a science plan associated with the TCD will be completed by March 2000 and revised studies associated with the TCD will be discussed with the TWG and incorporated into the FY2001 plan at this time, as appropriate. There is a typographical error on line 620, it should read January 2001 not January 2000 as this plan is for

Pg. 24 Beginning on Line 616	US FWS (cont'd): It states that we assume that a decision for implementing SASF will be made in January 2000 for implementing in FY 2001. Please clarify whether the SWCA contract which addresses this issue will have a report available in January to help make this decision. If the report is not available for deliberations in this decision making, how will the document be used? Deferring the decision making on whether to conduct SASF until 2001 may not meet Reclamation's obligations under the ESA. Reclamation is committed to conducting experimental low flows during the first 8.23 maf year. If 2001 is a low water year, Reclamation will be forced to make a decision about flows for native fish. Also, what are the odds for 2000 being a 8.23 year. If the odds are similar to the odds of a BHBF, planning for the two events should be treated the same.	FY 2001. The SWCA final report on endangered fish research flows should be available in the Spring of 2000. If this occurs, GCMRC will do its best to expedite completion of the SWCA report and make it available to the TWG for their use in making recommendations concerning the implementation of a SASF. Since this plan is for FY2001, we assume the odds you are talking about are for 2001. Randy Petersen has stated that, "The odds of 2001 being an 8.23 MAF year are approximately 25% and the odds of a BHBF occurring in 2001 are approximately 33%."
Pg. 24, Line 607 **Line 608** **Line 609 and following**	**US BUREAU OF RECLAMATION (10/31/99):** Revise "the construction" to "potentially both the construction". Delete "possible". The term SASF was tied to a specific GCDEIS alternative, while one of the Biological Opinion RPA's called for a test of low steady summer flows. As currently understood, the research addresses the latter and the terms should be replaced throughout the FY 2001 study plan.	Line 607 has been revised as proposed. "possible" has been deleted from line 608 the phrase "endangered fish research flows" has been deleted from line 609

Chapter 1 (cont'd)	*SCHEDULE AND BUDGET - RESPONSE TO COMMENTS*	
Pgs. 24-25 **Lines 616-629**	**CREDA (11/5/99):** CREDA supports use of Sec. 8 funds for this program.	No response needed.
Pg. 25 **Line 622 and following**	**US BUREAU OF RECLAMATION (10/31/99):** The funding of research of low steady summer flows does not come from Section 8 appropriated funds. As part of the 1956 Colorado River Storage Project Act, Section 8 funds are tied specifically to the construction of facilities to benefit recreation and fish and wildlife, such as the TCD. As was previously discussed in a TWG meeting, this research would be contingency funded as would BHBF research. Line 2779 and the budget table on page 117 correctly list the use of Section 8 funds. This should be corrected throughout the study plan, including page 37 of table 2.1.	Line 626 will be revised to read: Again, we would expect to support this additional work from contingency funds. Table 2.1 (Attached) has also been corrected. While the flows may be triggered by hydrology, the need for preliminary data associated with a particular flow cannot be overlooked. If the flow is a treatment and therefore an experiment, then data needs to be collected prior to, during and after the treatment to determine the effect of the treatment. Many of the questions associated with either a TCD or steady flows are similar because both treatments have similar objectives. Contingency funding may be used during a steady flow event, but other funds are needed to address pre-treatment data collection efforts.
Pg. 25 **Lines 638-639**	**CREDA (11/5/99):** What is the source of the $1416mil mentioned here? Where does it appear in the Table on pg. 117? Should it be the $1068mil discussed at last AMWG meeting?	The $1,416 million figure supports the above the line activities. These include Bureau Administration of the AMWG, TWG and SAB, Bureau Administration of the AMP, and support of the PA.

CHAPTER 2	SCIENTIFIC ACTIVITIES - RESPONSE TO COMMENTS	
	AGFD (11/3/99): GENERAL I appreciate the efforts of the Grand Canyon Monitoring and Research Center (GCMRC) to integrate projects across resource categories and realize that it is a difficult task and a major challenge for GCMRC. While the structure of Table 2.1 suggests that there will be integration across resource areas, it is unclear both in the table and in the text of the Plan how that integration will be accomplished. In several sections of the Plan there are phrases such as "community change data associated with food or habitat resources will be extracted from phyto-benthic and sediment monitoring data". However, it is not clear how the extraction will be done, or who will be responsible for the integration. The sections on integration need more detail. I expect the Center to take the lead in ensuring that both the sharing and analysis of data take place. That has been a problem in the past that I know you are working to resolve. There needs to be integration of projects during the design phase so that data are collected concurrently (spatially and temporally) for valid integration to take place. I saw no mention of ensuring integration during the project design, only after the data were collected. This has not worked well in the past, and unless procedures are changed to integrate during the design of monitoring projects, integration likely will not take place.	GCMRC has intiated a number of activities aimed at developing an integrated approach and program for monitoring the Colorado River ecosystem. These begin with the conceptual modeling activities intiated in FY1998 to develop an overall framework for understanding the Colorado River ecosystem. Model development is ongoing as are synthesis activities in each resource area. Protocol evaluation activities have been initiated with the specific goal of developing long-term monitoring programs that are integrated across resources. A primary role of GCMRC's program managers is to insure that monitoring is conducting in a linked fashion and the resulting data are integrated across resources. The projects described in the FY2001 initiate this integration and necessitate multiple IN's being included in a single project. Information technology activities like the development of a database will further this effort. Monitoring and research RFPs will be written in ways that allow and promote proposers opportunities to design highly integrated studies where one of the main goals is to understand the ecological linkages of the Colorado river ecosystem. The science plan developed for the FY99 BHBF was designed to promote integration in both data collection and analysis.

	GLEN CANYON NATIONAL RECREATION AREA (11/15/99):	
	1. Multiple MO/INs for single projects - In most cases more than one IN is specified under a single project title (see Table 2.1). In fact, in one instance, 12 INs are specified for a single general project title. It is unclear how such broad project objectives can translate into monitoring/research programs that will answer specific IN questions. Granted, the projects as described will likely provide general trend information but IN requirements are much more specific then that.	1. Monitoring and research programs are designed to collect data which can then be analyzed to address multiple INs.
	2. Unclear project titles - In many cases project titles are an amalgam of several MO/INs. In certain cases the titles are so general that it is impossible for the reader to understand what information will actually be gathered.	2. The project titles in the tables and text have been revised and made consistent. In addition, the INs addressed by each project have been clarified See revised Table 2.1 (Attached).
	3. Specifying methodology inappropriate - It is unclear why the plan specifies project methodologies when RFP bidders should specify them. Since scientific review panels will evaluate the credibility of each project methodology offered, why is GCMRC specifying methodologies before proposals are received.	3. Specific methodologies associated with monitoring are appropriate if the intent is to establish consistent measurement and data collection. This is different from research projects that are open to more creativity.
	4. IN selection process not specified - The priorities specified in the plan do not seem consistent with those set by the TWG/AMWG. The reasons for this apparent change in priorities should be explained. For example, under Native Fish MO 8, IN 8.2 and 8.3 are selected but have low priority while higher priority INs are ignored (IN 8.1, 8.5, 8.6). Under trout MO 2, IN 2.3 is selected while other higher priority INs are not included.	4. See revised Table 2.1
	5. Unclear relationship between project title and MO/INs - Certain projects lack clear relevance between their title and the MO/INs specified. For example, under the project entitled "Streamflow and fine sediment transport" are MOs related to water quality. This MO and related INs would be more appropriately placed in the IWQP project area.	5. See revised Table 2.1
	6. Incomplete project information in Table 2.1 - Certain projects in table 2.1 lack relevant MO/IN information as well as any description of methodology.	6. See revised Table 2.1

	GCNRA (cont'd)	
	7. Table 2.2 incomplete - Table 2.2 has numerous missing entries, i.e., TBD. It would seem appropriate that a final draft of a plan should be complete before TWG is asked to review it.	7. We stated at the TWG meeting when the plan was handed out that Table 2.2 was incomplete. The reason for this was the change in project budgeting and accounting resulting from this effort to integrate scientific activities across projects. The revised Table 2.2 is now complete.
	8. Projects not in Table 2.1 - Certain cultural projects (pages 49 and 52) are described in the text but not listed in Table 2.1.	8. See revised Table 2.1
	9. Basic research questions - There are several basic research questions that should be answered through the FY-2001 plan related to the following: - Native fish use of and need for backwater habitat. We keep discussing flows that will establish such habitat but do not know the relationship or need with native fish. - Determine the primary food source of native fish. Are native fish now dependent on the river primary productivity for food (autochthonous) or are they opportunistic and use what ever is available? - Relative importance of marsh habitat in the river corridor. The first two questions are basic but control and justify our need for such management actions as BHBFs. It would seem in order to justify continued use of such management actions that the research be there to back them up.	9. Habitat relationships are supposed to be addressed through current contracts with FWS and the backwater thesis being conducted by AGFD and Larry Stevens. Once these reports are received, we will consider next steps. Food source relationships are being examined through the stable isotope analyses being conducted by NAU, once this report is received, we will consider next steps. Relative importance of marsh habitat will be addressed through the vegetation synthesis work and the trophic relationships work contracted for in FY 2000 will begin to address this issue.

	WAPA (11/5/99): FORMAT For each "ongoing" project presented it would be informative to include in the project description a synopsis of current status. What has been accomplished in the previous year(s) of study. The reader then has a better idea of where the continued study is headed and if it is headed in the right direction. This is included to some degree in the Current Knowledge section on page 5, but would be more helpful if addressed within the specific project description.	These formatting suggestions have been incorporated into tables 2.1 and 2.2, and has resulted in improved clarity for tracking the linkages between tables 2.1 and 2.2, the project descriptions and the budget summary in Chapter 3.
	The organization of Table 2.1 is not clear. Category titles (e.g. "Terrestrial Ecosystem Projects" or "Physical Resources Program") for the listed proposed projects would help. Also the titles of the projects presented should be consistent with those in the narrative section and presented in the same order for the convenience of the reader.	Additional categories for "Surveying" and "GIS" have been added to Table 2.1, in addition to the IT column This was done to show what projects require GIS and surveying support from GCMRC. The budget totals for each row reflect only the costs of contracting and logistics. The totals for each column reflect only the contracted program costs. Once GCMRC reaches agreement with the AMWG Budget Format Ad hoc group, on the final budget formatting, inclusion of other costs, as appropriate, will be added to the table.
	See the general comment for Line 670-1674, regarding the level of information provided to the reader for each project.	Additional activities listed in the chapter 3 summary budget under Cultural Resources, such as outreach, will be added to Table 2.2.
	The budget information presented for each project and for program areas needs a direct, trackable connection to the budget summary page on page 117.	The titles in the tables have been revised to match the project description, and they have been reordered to follow the order of the text. The project titles and their order now correspond in both table 2.1 and 2.2 and in the text portion of chapter 2.

Pg. 26 **Lines 657-661**	**AGFD (11/3/99):** The text in this section indicates that there will be a five-year strategy of protocol evaluation, remote-sensing technology development and ongoing program development intended to produce an integrated long-term monitoring and research program. Were unclear in describing which programs were "ongoing", "integrated" and "new" projects. Can you clarify that section? Does "ongoing" mean transition monitoring (moving from the present data collection program to a long-term monitoring program) or does it mean that a long-term monitoring program will be in place?	This refers to the strategy described in the strategic plan, the PEP prospectus and the Strategy for Evaluating Remote Sensing. The text on lines 657-661 has been revised to read: "Each of these projects are classified as either: 1) Ongoing – meaning a continuation of efforts supported during FY's 1998-2000 without modification until PEP is completed; 2) Ongoing with Modification – meaning that efforts supported in FY's 1998-2000 will continue, but with some modification in methods or focus based on PEP or other review recommendations or information needs; and 3) New meaning that the project is a new research effort, or a component of the draft long-term monitoring plan using current or new alternative methods and sampling designs. Because the existing science program is still in a transitional phase and is evolving toward a fully integrated design, some of the FY 2001 science activities will remain "ongoing," or "ongoing with modification," until such time that PEP activities are completed program-wide. In the case that formerly used methods and designs are found to fully meet information needs, scientific standards and cost efficiency, ongoing efforts will be continued as part of long-term monitoring. New projects described under the "integrated terrestrial and aquatic" heading in the text and in Table 2.1, represent initial steps toward implementing the draft long-term monitoring program. For example in the FY 2001 Workplan, most of these contain elements formerly described as components of the "Physical Resource" research and monitoring under the GCES and FY's 1997-2000, GCMRC annual plans, but are often complimented by new "alternative" or modified sampling methods and designs that were identified through the PEP/CEDS review process completed in fall 1999."

Chapter 2 (cont'd)	*TABLE 2.1 SUMMARY TABLE OF FY2001 PROJECT TITLES & ASSOCIATED MO'S & IN'S*	
Pg. 27	**AGFD (11/3/99):** I had some difficult understanding this table and might offer a few general suggestions. In the "how accomplished" column it would be nice to see a reference to a specific project as was done in the State of Knowledge section on physical resources section. That way the reader can tell who is doing the work, if it is part of an ongoing project or is a new project. Perhaps the project title column should indicate who the PI is for ongoing work? **Fine grained sediment storage** – Should include MO's for "phyto-benthic community". The I.N. on "availability and quality of spawning substrate in Glen Canyon reach..." could also be included in the "coarse sediment inputs" project if you consider gravel to be coarse sediment. **Monitoring status and trends of Lees Ferry trout fishery** – Will "how accomplished" depend on the results of the PEP? Suggest replace "SCUBA" with "SCUBA, snorkel or other methods depending on results of the FY2000 PEP".	An excellent suggestion. The revised tables will reflect these suggestions, along with other changes that are being planned to improve their information content. Table 2.1 is a synopsis of the project descriptions that follow. In an effort to economize and maximize communication we use table 2.1 to link project titles to MO's and IN's. Specific P.I information has been added under the project title: column 1. We will add the MO's for the phyto-benthic community to this table. The wording will reflect this suggested change. The "how accomplished" column which was intended to provide a brief summary of what is contained in the project description has been deleted from Table 2.1 to avoid confusion and misunderstanding. This information can be found in the project descriptions.
Pg. 27	**US BUREAU OF RECLAMATION (10/31/99):** On table 2.1, the order of the studies should correspond in order to those more detailed descriptions that follow. Titles of specific projects should correspond in both places.	Tables 2.1 and 2.2 have been revised to reflect this comment.

Pg. 27 **Line 669**	**WAPA (11/5/99):** • The Table is incomplete for several projects on pages 29. 30. And 39. • In reading the project proposals it appears that MO 2 (trout) and IN2.4 (trout) under Fine-grained sediment storage might be more appropriately addressed under the Course-sediment inputs, storage, and impacts project. • Population genetics of HBC should include literature review under "How" to ensure the genetic work of the upper basin projects and those genetic relationships are considered. **WAPA (11/8/99):** For Fine-grained sediment storage, cultural could also benefit from studies on sediments helping reduce erosion on sites.	Bullet #1, Table 2.1 has been revised to provide completed information. Bullet #2, We believe they should likely be included in both, since fine sediment can diminish spawning habitat. These monitoring programs compliment each other. Coverage of coarse-sediment substrates by dynamic inputs and transport of fine sediment is the idea for monitoring here. By conducting long-term monitoring or sand coverage of the bed (in this case, gravels) some indication of the changing physical condition of spawning habitats will be gained. This MO and IN couplet is also included as part of monitoring and research of coarse-sediment inputs hence, it shows up in more than one project summary. See revised Table 2.1. The population genetics RFP that was released requested that the population relationships include outgroups which would mean including upper basin projects. The report should include all pertinent literature including upper basin literature. The genetics question was specific to the relationship of the LCR individuals to the mainstem. We have included cultural resources in this project. The project will be designed to address INs associated with Cultural MO1 and several IN's. Please review the revised table 2.1.
Pg. 27 **Line 669**		Regarding the last WAPA comment in this box: See Table 2.1.

Pgs. 27-37 **Line 669**	**CREDA (11/5/99):** Table 2.1. Comparing proposed project titles (MOs and INs) to Appendix 2 and the priority assigned to INs, we see a lot of differences. Some explanation is needed as to why certain needs were identified as very high priority for work by the TWG yet fail to show up on the FY 2001 Work Plan Table 2.1 Summary (e.g., IN 14.6 KAS monitoring, IN 6.2 HBC 2nd population study, etc.). Also, other work was identified as being of very low priority but is now listed for work in FY 2001 (e.g., IN 2.3 tracking changes in camping beaches, IN 3.1 determining powercraft navigability, etc.). A quick comparison of high (>10 votes), medium (10-8), low (4-7) and other (<4 votes) priority Information Needs in Appendix 2 with Table 2.1 shows FY2001 work includes two high priority needs, 15 medium priority needs, 23 low priority and 12 other priorities. We should be fulfilling all the high priority needs and most of the medium priority needs. As for low and other needs, these could be postponed without jeopardizing resources.	INs were prioritized within and across resource areas resulting in different prioritizations for a given IN. In addition, as we have initiated monitoring and research activities it has become clear that certain INs need to be addressed before others. The INs in table 2.1 reflect our effort to address these conflicting prioritizations.
Line 669	We remain concerned that the baseline data needed to determine effects of dam operations under the present operating criteria appear to not be the highest priority. Baseline data are needed to establish cause and effects of the present flow regime established under the ROD. The work plan could resolve this by cross-referencing all those INs that provide baseline data under a heading "Baseline Monitoring Efforts." This would be especially useful in seeing where data gaps exist and what other monitoring and research is being proposed. Without these baseline data, experiments to change the flow regime have no justification.	IN 11.1 Define and specify ecology of native faunal components, especially threatened and endangered species; including evolutionary and environmental changes, natural range of variation, linkages, interdependencies, and requirements. Is ranked as 9 which is primarily related to the monitoring and research that is being proposed in this plan. We have reviewed table 2.1 to ensure that INs are appropriately referenced. The notion that baseline data are not a high priority is a falacy. Each of the projects has INs that are specific to monitoring. Examples of this are MOs regarding Humpback chub that require data collection around life history requirements and sustainable populations. This is a monitoring information need that is a component of fish monitoring. Similarly, the population estimates for Humpback chub based on the work of Biowest and Douglas for the period 1991- 1995 represent baseline data, as does the CPUE indexes being developed by AGFD for the period they have monitored Hnmpback chub and the work of Walters et al. to evaluate trends in the status of Humpback chub populations. Similar baseline data is being compiled in other areas. The results of the contracts let by GCMRC in FY 1998 are only now being submitted to GCMRC and will contribute to the establishment of baseline data.

Pgs. 27-39	**GC TRUST (11/8/99):** I did not review this section because it is incomplete.	No response needed.
Chapter 2 (cont'd)	***TERRESTRIAL ECOSYSTEM ACTIVITIES***	
Pg. 40 **Line 664**	**The Hopi Tribe (11/15/99): Title: Monitoring Avifauna** For example, the Monitoring of Avifauna program gives minimal recognition of the cultural importance of birds to Native American tribes, but demonstrates a significant lack of specific understanding of which birds are of cultural importance to which tribes. The Hopi Tribe has specific concerns about the abundance and vitality of raptors, specifically Golden Eagles, hawks, and falcons, within the Grand Canyon, but the recognition of this fact and its integration into this monitoring program is not presented in the narrative. Moreover, the Hopi Tribe would suggest that Ruth Lambert be identified as a key GCMRC personnel that is involved with the administration of this project.	Line 698 is revised to read : distribution of waterfowl, nesting avifauna, raptors, and other culturally important birdswithin the main channel resulting from Line 709: Related to species abundance and distribution for waterfowl, breeding birds, raptors and other culturally important birds Line: 739: Personnel - Ralston, Lambert
Pgs. 40-99	**GC TRUST (11/8/99): SCIENTIFIC ACTIVITIES** To me, these project descriptions are extremely important and should demonstrate a thoughtful, strategic approach to research and monitoring. The descriptions should clarify how we think the system functions, what is being measured (explanatory and response variables), why we choose those metrics, how the data will be analyzed, and what the results might tell us about whether or not we're achieving our goals. The text needs to be much more succinct, clear, thoughtful, and consistent. Perfunctory statements such as the lead sentence in many of the "Integration" sections ("To achieve ecosystem-level understandings....") do not contribute to the document. The statements on MOs and INs should have some purpose other than referring the reader to Table 2.1.	These project's are developed from MOs and INs that are a part of the strategic plan. The guidance received from the TWG following our discussions of the FY2000 workplan were to make the overall plan concise. Some details may not be included in this plan in our effort to respond to the request for a concise document. Consistent with our response to your earlier comment, we suggest that we collaborate on a sample project description to arrive at the appropriate level of detail acceptable to all TWG members. We can then use this as a template for additional project descriptions.
Pg. 41 **Line 670**	**US FISH & WILDLIFE SERVICE (11/12/99): Title: Monitoring Avifauna** This is more of a general comment, but possibly most pertinent to avifauna monitoring, endan[illegible] species permits are required f[illegible] vorking in and around endangered species habitat. Occasionally research plans are modified [illegible]o minimize negative impacts to breeding birds or habitat.	Long-term monitoring of avifauna, as a whole will not preclude specific monitoring protocols associated with endangered species.

Pg. 41 Line 670-1634	**WAPA (11/5/99): [General comments about the entire section first]** Generally, the descriptions and detail provided in the "Terrestrial Ecosystem" and "Aquatic Ecosystem" Activities sections are not as comprehensive as those provided for "Integrated Terrestrial and Aquatic Ecosystem Activities." Reader understanding of project purpose, need, and method is enhanced in the "Integrated" section. Projects in the first two sections would benefit from revisions in this regard. Also, all multi-year projects should have an annual progress reporting requirement in addition to the final project report. In this way GCMRC and TWG can track the progress and usefulness of individual projects. Some projects do include this requirement, some don't.	The detail in integrated activities reflect the efforts of protocol review. The terrestrial and aquatic protocol reviews are in process now and subsequent descriptions after review is completed should reflect these efforts. Providing more detail is possible once the level of detail that the reader want is identified. See response to comment from GC Trust above regarding our proposal to develop a "model" project description to serve as a template for future project descriptions. Yes, all projects have at least annual reporting requirements, and some if not all are required to submit quarterly and trip reports as has occurred in many FY 1998-2000 projects. It is the intent that all of these projects will have annual reports. Research as well as monitoring reports require progress or annual updates as a part of contracting. All contracts have a deliverable schedule.
Pg. 41 Lines 708-712	**CREDA (11/5/99): Title: Monitoring Avifauna - *Project Goals and Objectives*** 708-712. The 1998 prioritization effort placed this work in the low priority category. Annual monitoring of diet needs, encroachment of vegetation, etc. likely to change on less frequent time scales serves little purpose for this program. Vegetation in the new high water zone changes little year to year and for purposes of this program reducing monitoring frequency would not unduly impinge on our ability to make management decisions. We suggest a monitoring frequency of every 2-3 years.	The frequency of monitoring is a consideration that will be included in developing a long-term monitoring program. Vegetation monitoring is undergoing protocol review and the frequency and extent will be determined prior to releasing the RFP. Monitoring of vegetation associated with campable area may be at a level that is different than structural concerns for wildlife. These may require different levels of monitoring, and will be evaluated prior to release of the RFP.

Pg. 41 **Lines 711 & 717**	**WAPA (11/5/99): Title: Monitoring Avifauna - *Project Goals and Objectives*** Is the evaluation of campable area in this project a duplication of effort with that proposed in Fine-grained sediment monitoring (page 75 line 1707)? Can some savings be found in placing this objective one place or the other?	Line 711 references vegetation encroachment to campable area and the potential implications for avifauna. Line 1707 refers to depositional quality of campable areas. However, as per Line 726 available and appropriate data will be extracted from campsite monitoring data.
Pg. 42 **Line 746**	**WAPA (11/8/99): Title: Monitoring Terrestrial Habitat & Evaluating its Quality for Utilization** There needs to be a more developed discussion of how ethnobotanical resources will be monitored and evaluated. Native American involvement would appear to be critical in order to get a true evaluation. Also, consultation is certainly necessary to ensure monitoring does not occur in areas the tribes have identified for no visitation. For Modeling of reach-averaged sandbar evolution, there needs to be a justification for cultural participation in this project.	Methodology for ethnobotanical resource assessments will be developed with Native American project participants as well as the project specifics. Consultation will occur during project phases with Native American stakeholders. Line 806: be scheduled to coincide with nesting avifaunal monitoring (April, May). Project specifics and methodologies will be developed with Native American participants. The contribution from the Cultural resources budget is intended to support additional sand bar modeling information related to conditions of arroyo formation and mitigation through sand bar building flows in reaches such as Glen Canyon and in the vicinity of Granite Park. These simulations would be similar to those contracted by the GCMRC in FY 1998-2000 in the Furnace Flats reach by USGS. There is also a very important recreational simulation component to the modeling that [illegible]pported under the Socio- portion of the Socio-Cultural program budget.

Page 42 **Line 846**	**THE HOPI TRIBE (11/15/99): Title: Monitoring Terrestrial Habitat & Evaluating its Quality for Utilization** Another example of the lack of specific integration of resource concerns is the Monitoring Terrestrial Habitat and Evaluating Its Quality for Utilization program. Here again, the importance of the terrestrial habitat as a traditional cultural resource to tribes is identified in a very general sense, but no specific information about which plant resources are of importance to which tribal groups is presented, or how this information will be integrated into this monitoring program.	See above comment.
Pg. 44 **Lines 789-793**	**CREDA COMMENTS 11/5/99: Title: Monitoring Terrestrial Habitat & Evaluating its Quality for Utilization - *Project Goals and Objectives*** The 1998 prioritization effort placed this work in the low priority category. Annual monitoring of terrestrial habitats for composition and structure, encroachment, etc. likely to change on less frequent time scales serves little purpose for this program. Vegetation in the new high water zone changes little year to year and for purposes of this program reducing monitoring frequency would not unduly impinge on our ability to make management decisions. We suggest a monitoring frequency of every 2-3 years.	Lines 789-93 relate to MO 11, IN 11.1 which is ranked at a 9, very high on the priority ranking. Native components include birds other than willow flycatcher, and inter-relationships include vegetation structure and composition. Regarding the monitoring frequency, the frequency is dependent on the related resource needs because vegetation, like sediment are habitat components and cultural resources.
Pg. 44 **Line 791**	**WAPA (11/5/99): Title: Monitoring Terrestrial Habitat & Evaluating its Quality for Utilization - *Project Goals and Objectives*** It is not clear how campable area considerations fit into this project. See comment above. There is nothing in the MOs or INs listed for this project that would indicate need to include campable area evaluation.	Including campable area responds to recreation needs associated with a beach for camping. The growth of habitat for wildlife and the measurement of loss of camping beaches are likely not separate efforts, but recognize that these resources are linked and the monitoring is integrated. Line 791 refers to the proximity of important ethnobotanical resources to camping and recreational areas and the potential impacts to the botanical resources. Line 791: Relates to the proximity of sensitive ethnobotanical resources to camping and recreation areas.

Page 45 **Line 828**	**THE HOPI TRIBE (11/15/99): Title: Monitoring Kanab Ambersnail Habitat at Vaseys Paradise** Vaseys Paradise is an important traditional cultural place for the Hopi people and their association with Vaseys Paradise transcends three hundred (300) years. The Monitoring Kanab Ambersnail and Habitat At Vaseys Paradise project does not recognize the importance of this place to the Hopi Tribe, nor does it assess the impact of the proposed activities on those characteristics that make this place culturally important for the Hopi people in the integration section of this project's description. Moreover, the Hopi Tribe recommends that Ruth Lambert be identified as part of the GCMRC personnel involvement in this project.	Line 833: unique ecosystem determined to be of concern by stakeholders. T[illegible] is also a traditional cultural resources to all Native American stakeholders. Line 852: recreational value. In addition, the location is a sensitive cultural resource to Native American stakeholders. Line 875: including pre-dam river vegetated habitat. Project consultation will be conducted with Native American stakeholders. Line 885: Personnel - Ralston, Lambert, Gonzales, and Kohl
Pg. 46 **Lines 864-865**	**CREDA (11/5/99): Title: Monitoring Kanab Ambersnail Habitat at Vaseys Paradise - *Project Goals and Objectives*** Why must we monitor on-site if significant flow changes (e g., >25k) are not expected (especially if abundance and distribution in the lower elevations area are a function of flows >25K)? There appear to be sufficient data to establish this relationship and we could avoid species and habitat disturbance.	On site monitoring is required because we currently have a hydrologic and resource criteria process in place for Beach Habitat Building Flows. The amount of KAS habitat below 45K cfs dictates the flow volumes above 25K. Abundance of snails follow a seasonal pattern, but are also dependent on primary habitat that increases over the growing season (i.e., the % of habitat susceptible to take varies by month). GCMRC is exploring the use of remote measurements to determine area change. This would not eliminate the need to physically census snail populations, however, which is required by compliance.
Pg. 46 **Line 866**	**WAPA (11/5/99): Title: Monitoring Kanab Ambersnail Habitat at Vaseys Paradise - *Project Goals and Objectives*** It appears this project should have a habitat monitoring objective. Suggestion: • Related to habitat composition, recovery (from flooding), and use by KAS (directed at habitat requirements).	This is intended as a monitoring project that includes habitat monitoring as indicated by the title of the project

Pg. 47 **Line 875**	**WAPA (11/5/99): Title: Monitoring Kanab Ambersnail Habitat at Vaseys Paradise - *Recommended Approach/Methods*** It is not clear what is meant by or the benefit of including "pre-dam river vegetated habitat."	Vegetation and snails inhabit areas above the old high water zone. These areas are still included in habitat estimates for KAS monitoring.
Pg. 47 **Line 892** **Lines 895, 902, 910, 923**	**CREDA (11/5/99): Title: Ongoing Research on Terrestrial Trophic Linkages** The title of this project implies that it is research. It is also labeled as research in Tables 2.1 and 2.2. The wording indicate[s] that it is basically a monitoring effort. If this is true it would help if you titled it as a monitoring program.	This is a research project that was initiated in FY 2000. The purpose of this research is to provide information for the monitoring of avifauna populations. The description will be written to reflect that it is a research project aimed at assisting monitoring efforts.
Pg. 49 **Line 943**	**NPS (11/16/99): Title: Evaluation of Cultural Resource Monitoring and Mitigation Strategies** This will directly improve upon the preservation treatments that have been implemented (focusing on checkdam construction). Coincidentally, in the FY99 annual report we have recommended quantifying the effectiveness of checkdams by measuring volumetric change. I would hope that we would be working rather closely with this project. At least supplying some detailed information on checkdam construction, elapsed time since original construction, maps, comments, etc. Should this be noted in the plan somewhere.	See comment below relative to Recommended Approach.
Pgs. 49 & 50 **Lines 943 & 972**	**CREDA (11/5/99):): Title: Evaluation of Cultural Resource Monitoring and Mitigation Strategies** Where is this project found in Tables 2.1 and 2.2? Is it geomorphic investigations on pg. 39?	See revised Tables 2.1 and 2.2.

Pg. 49 **Line 943**	**WAPA (11/8/99): <u>Title: Evaluation of Cultural Resource Monitoring and Mitigation Strategies</u>** The section on (line 943) is a misnomer. The focus is actually on applying remote sensing technologies to evaluate geomorphic processes. This section has been rewritten to read: General Project Description: Identification of geomorphic processes affecting cultural resources and evaluation of the significance of these processes to cultural monitoring and mitigation strategies at selected locations (can we include examples here?) along the Colorado River corridor through the use of remote sensing technologies.	The General Project Description has been clarified to read as follows. Lines 946-948: General Project Description: Evaluate the effectiveness of cultural resource monitoring and mitigation strategies at selected locations along the Colorado River corridor using remote sensing technologies. Locations will be selected in consultation with the NPS prior to project implementation.
	(WAPA cont'd) Rationale/Problem Statement: (1st paragraph stays the same) The evaluation of the processes that may affect the utility of monitoring and mitigation strategies of cultural resources provides data needed by managers to: as sess the status of the preservation of cultural resources, including biological and physical traditional resources that are of management concern; 2) determine the effects of controlled floods believed to preserve and sustain cultural resources through the deposition of fine sediment along channel margins; and 30 allow identification and interpretation of linkages between dam operations and changes in socio-cultural, physical, and biological resources. The use of remote sensing technologies can provide resource assessment methods that are cost-effective, less intrusive than traditional field methods, and may provide expanded spatial coverage than that gathered by field-based efforts. These areas of information support science-based evaluations of large-scale flow experiments (e.g. Secretary's actions), and associated decision responses required for adaptive management to succeed.	The Rationale/Problem Statement is clarified to read as follows: Line 955: The evaluation of the utility of monitoring and mitigation Line 961: cultural, physical, and biological ecosystem resources. The use of remote sensing
	(WAPA cont'd) Integration: Cultural resource locations along the main channel include physical, biological, and recreational resources. Information on the processes that affect the utility of monitoring and mitigation strategies to preserve cultural resources must be measured in ways that can be related to dam operations.	The Integration statement is clarified to read: Line 968: biological, and recreational ecosystem resources. Information effectiveness Line 969: of monitoring and mitigation strategies to preserve cultural resources must be

	(WAPA cont'd) MO's and IN's to be Addressed: This project shall provide data related to management objectives and information needs as indicated in Table 2.1. The investigations shall provide information on the effectiveness of monitoring and mitigation techniques used to preserve cultural resources and on the processes that may influence the effectiveness of these strategies.	This section is clarified to read: Line 971: Mos and Ins to be Addressed: This project provides data related to Line 972: management objectives and information needs as indicated in Table 2.1. The investigations
	(WAPA cont'd) Project Goals and Objectives: The primary goal is to use appropriate remote sensing technologies to investigate geomorphic processes that affect cultural resources, including traditional resources within the realms of physical and biological resources. Secondary goals relate to the application of remote sensing techniques to detect changes in cultural resources as a means of evaluating the effectiveness of monitoring and mitigation strategies. These data provide information needed to interpret changes in cultural resources relative to annual operations of Glen Canyon Dam. Specific objectives of the project include: - Using existing and on-going studies, without doing additional geomorphic studies, identify geomorphic processes that operate in specific resource locations that influence resource preservation. - Monitor these processes using remote sensing technologies - As appropriate, use remotely sensed data to evaluate PEP recommendations.	This section is clarified to read: Line 976-977: Project goals and Objectives: The primary goal is to evaluate the effectiveness of monitoring and mitigation strategies for cultural resources, … Line 980-981: Secondary goals relate to the identification of the factors that may influence the effectiveness of monitoring and mitigation strategies at cultural resource locations. Line 984: Using existing and on-going studies, identify geomorphic and other processes that operate in specific
	(WAPA cont'd) Expected Results: (stays the same)	This section is clarified to read: Line: 989: Expected Products: A project report with associated data bases providing 1) an evaluation of the effectiveness of the existing monitoring and mitigation efforts for cultural resources at project locations and; 2) information on the processes affecting cultural resources.

	(WAPA cont'd) Recommended Approach/Methods: Geomorphic processes will be identified, quantified and documented at selected cultural resource locations that exemplify settings dominated by particular geomorphic processes. These investigations will be used to refine, clarify, and field test the predictive model generated by current studies evaluating the hypothesis that dam operations, through lowered mainstem base levels, fosters erosion in river-marginal deposits containing cultural materials. These processes will be investigated using remote sensing applications (but how? This has been said 5 times, but never explained how. What type of remote sensing data? If you are using the aerial photos from the pre beach-building flow, you should state this. Then, it is clear what the baseline data is and what needs to be replicated. Otherwise, they would be creating a baseline in FY2000 which would require replication on a regular basis.) that will evaluate the effectiveness of the monitoring and mitigation strategies utilized to preserve cultural resources within specific geomorphic settings. Strategies to be evaluated include on-site monitoring and mapping and construction of check dams within arroyos and gullies. (The only thing you can really look at here is the upstream migration of head cuts. It is extremely unlikely you could look at depth of arroyos, only length and width.) Remotely sensed data will be verified by field visits (how will this be done? clarify this. I don't believe you can evaluate on-site monitoring and mapping except to say that if the monitoring form states that erosion is increasing, the remote data could confirm this. I don't think this is valuable information for future work. Remote sensing could be used to identify areas where erosion is increasing to prioritize sites for mitigation. This evaluation would be unrelated to monitoring, mapping or past mitigation). Remotely sensed data may also be used to evaluate the PEP recommendations for collecting monitoring data for cultural resources.	This section is clarified to read: Line 993-1003: Recommended Aproach/Methods: Selected resource locations will be targeted for evaluation. Locations will include sites where monitoring and mitigation activities have occurred or where resources appear to be at high risk. Examples of strategies to be evaluated include on-site monitoring and mapping and construction of check dams within arroyos and gullies. Project data will be coordinated with existing NPS data. These locations will be assessed using remote sensing technologies such as photogrammetric applications to aerial photography and other technologies currently being evaluated through the GCMRC remote sensing initiative. Geomorphic processes that may affect the utility of treatment efforts will be identified, quantified and documented at selected cultural resource locations that exemplify settings dominated by particular geomorphic processes. These investigations will be used to refine, clarify, and field test the predictive model generated by current studies that are evaluating the hypothesis that dam operations, through lowered mainstem base levels, fosters erosion in river-marginal deposits containing cultural materials. Remote sensing will help to identify areas where erosion is increasing to prioritize sites for mitigation. Remotely sensed data may also be used to evaluate the PEP recommendations for collecting monitoring data for cultural resources.
	(WAPA cont'd) Schedule: (stays the same)	
	(WAPA cont'd) Cost Range: I don't believe $65,000 is enough for this. Provide a justification for cost.	Cost figure is derived by programming funds from geomorphic model applications and the investigation of Isolated Occurrences to this project.

	(WAPA cont'd) Another geomorphic study that would be more effective, involves comparison of existing data to identify "critical zones" within sites where erosion is most likely to 1) occur and 2) be destructive. Having those zones delineated, you can prioritize areas for mitigation. As examples, armor the banks with stones or brush to reduce lateral erosion or develop a data recovery strategy. This project would be done using the total station mapping data from sites. This could use both remote sensing data and total station mapping to compare and contrast the techniques to see which is most effective. For TSM, it is possible to get precise quantifiable data. The TSM data could also provide data for evaluating the effect of dam operations on sites. Another study would be to determine how much precipitation it takes to cause water to run through the arroyos/gullies which cross sites. What are the consequences of given discharges on arroyo/gully characteristics (how much does it erode laterally or vertically). What was the previous condition of arroyos/gullies e g. just prior to run-off, presence of check dams, presence of aeolian sand?	It is anticipated that these elements will be part of this project, once the detailed methodology is developed using data that will soon be available from the ongoing studies.
Pg. 50 **Line 986**	**WAPA (11/8/99): Title: Evaluation of Cultural Resource Monitoring and Mitigation Strategies - *Project Goals & Objectives*** I believe all the remote sensing technologies should be shared by each of the program areas, or totally covered by remote sensing. Splitting them out makes no sense. Line 488 [Page 18 of Plan]., whatever is done for the remote sensing project, cultural needs to be involved to ensure the remote sensing data that is acquired will be useful and not duplicative. Western recommends combining the tribal and unsolicited proposals to ensure that the right blend of science is being done. All these projects should be considered on an equal level.	Remote sensing evaluation is described on Line 488 and following. The application of appropriate remote sensing technologies are incorporated within proposed projects. A portion of the funds for tribal proposals ($50,000 have been reprogrammed into unsolicited proposals. The remainder to of the funds ($ 75,000) have been directed into the monitoring of terrestrial habitat project. This is to ensure that ethnobotanical resources are integrated with other resources.
Pg. 51 **Lines 993-994**	**CREDA (11/5/99): Title: Evaluation of Cultural Resource Monitoring and Mitigation Strategies - *Recommended Approach & Methods*** Looks like this is a description for the Geomorphic Investigations on pg. 29. Suggest you pick one name for this work and use it on pg. 943 and tables 2.1 and 2.2.	See the revised Tables 2.1 and 2.2.

Pg. 52 **Line 1021**	**NPS (11/16/99): Title: Development of Historic Contexts to Evaluate the Significance of Cultural Resource Data** Again, this is a great project, should have been completed right after or during the survey. Anyway, historic contexts will definitely provide information to aid in prioritizing sites for treatment. However, in addition to historic contexts, the geomorphological setting should be the other factor in prioritization of sites for treatment. Our office goal is to have a list of archaeological factors and geomorphological factors to prioritize a site for treatment. A concern is how closely will this project be incorporate. d with the development of the HPP, This was brought out in the meeting (11-15-99) briefly, but it should be a noteworthy concern. As I see it, this project should work in conjunction with the appropriate sections of the HPP (whoever is doing that) and the PEP review- Once again, I would hope that PA involvement plays a big role in supplying the relevant data to complete the project. Should this be acknowledged in the plan?	Prioritization of geomorphological settings and the cultural resource site locations that are at risk will be accomplished as a result of the current study. Funds programmed for FY 2000 will be used, in part, for this purpose. This study will follow the development of the HPP and provide additional information that will assist in prioritizing cultural resource assessments and treatments. The PA participants will be involved in project development. Line 1063: Utilizing these data in consultation with PA participants, evaluate and prioritize cultural resources for appropriate treatment measures.
Pg. 52 **Line 1021**	**WAPA (11/8/99): Title: Development of Historic Contexts to Evaluate the Significance of Cultural Resource Data** This project may come too late to provide input in the HPP. Rationale/Problem Statement: this section should also mention that historic contexts help determine what type of data recovery efforts are appropriate for each site type. Project Goals and Objectives: this may not be possible, but it is not feasible to understand human occupation of the Colorado River corridor without some examination of the human occupation of the rim area. Some coordination with data from the rim or side canyons would be invaluable. Expected Product: for 2), it should be done based on site type. Recommended Approach/Methods: the SHPO RP3 contexts should be checked for applicability.	Given current schedules, this project will be useful in the implementation of the HPP. Appropriate treatment measures will be specified by site types when the Historic context is developed. Coordination of data from the greater area of Grand National Park emphasizes the role the NPS and the PA participants will play in this project.
Pg. 52 **Line 1021-1051**	**CREDA (11/5/99): Title: Development of Historic Contexts to Evaluate the Significance of Cultural Resource Data** Where is this project found on Table 2.1?	See revised Table 2.1.

Chapter 2 (cont'd)	*AQUATIC ECOSYSTEM ACTIVITIES*	
Pg. 55 Line 1106	**AGFD (11/3/99): Title: Ongoing Monitoring Phyto-Benthic Community and Evaluating its Quality for Utilization** "The occupation and use or quality of these habitats by all organisms is dependent on their quality or availability". Unclear. Suggested change: "The occupation and use of these habitats is dependent on their quality, distribution, and availability".	The line will read "the occupation and use of these habitats or resources by all organism is dependent on their quality, distribution and availability." This reflects cultural and biological perspectives.
Page 56 Line 1143	**AGFD (11/3/99): Title: Ongoing Monitoring Phyto-Benthic Community and Evaluating its Quality for Utilization - *Expected Products*** Would like expected products to include an integrated project design as well as delivery and exchange of data for integration with fish monitoring and research projects. This includes the Lees Ferry trout fishery. Linkage between the benthic community and the fish community can be expanded beyond stable isotope analyses, especially in the Glen Canyon reach using trout where collecting diet information is feasible. **However, to be effective, coordination of project designs is critical, not just data sharing after the fact.**	Making linkages across aquatic resources is the intent of integrated monitoring. Recall that both benthic community and mainstem fish monitoring will undergo protocol review and development of Long-term monitoring programs in FY2001.
Pg. 57 Line 1164	**AGFD (11/3/99): Title: Ongoing Monitoring Phyto-Benthic Community and Evaluating its Quality for Utilization - *Cost Range*** "Continuing agreement awarded through competitive RFP to Northern Arizona University". Sounds like pre-selection to me. Please clarify. It also appears that the annual cost of the phyto-benthic community work has gone from $166,000 to $230,000 while most other projects have remained fairly stable (5% increases). Has the scope of work expanded?	The continuing agreement is no more like pre-selection than the current continuing agreement that exists with the Lees Ferry Trout contract in FY2000 or the avifaunal work also extended for FY2000. As explained last year and approved by the TWG, the increase is associated with moving money from the fish contract that was funding the stable isotope work directly to the group doing the work to save overhead costs. The continuing agreement is a recognition that the new Long-term monitoring protocol will not be initiated until FY2002. Continuing contracts while PEP was occurring is the approach that was taken with AGFD with regard to the Lees Ferry Trout contract that was extended through FY 2000. The native fish contract would have been extended in a similar manner if the P.I. had continued.

Pg. 57 **Line 1170**	**WAPA (11/5/99): Title: Ongoing Monitoring Phyto-Benthic Community and Evaluating its Quality for Utilization - *GCMRC Involvement*** It is not clear why Lambert is listed here.	This was a typographic error. It should read Ralston and Yard.
Pg. 58 **Line 1217**	**CREDA (11/5/99): Title: Ongoing Monitoring of the Status and Trends of Downstream Fish Community - *Project Goals and Objectives*** Even after several million dollars of study of a population relatively confined in distribution and relatively easy to capture and tag, we still have doubts as to the actual abundance of humpback chub in the LCR. We think it unrealistic to attempt to determine the actual abundance of native/nonnative fish in the Colorado River ecosystem. However, relative abundance between species may be sufficiently depicted for our purposes with a good sampling protocol.	The word "abundance" will be modified by the word "relative"
Pg. 58 **Line 1220**	**AGFD (11/3/99): Title: Ongoing Monitoring of the Status and Trends of Downstream Fish Community - *Project Goals and Objectives*** Suggest that you include a project objective to assess fish health and parasites, related to the management objectives to "achieve healthy self-sustaining populations of native fish" (MO8).	If fish health assessment is implicit in any of the IN's associated with MO8, then we appreciate the recommendation. Project objectives are tied to IN's. Many of the IN's appear to be specific to life history traits, specifically reproductive requirements of native fish.
Pg. 60 **Line 1259**	**CREDA (11/5/99): Title: Monitoring of the Status and Trends of the Lees Ferry Trout Fishery - *Rationale/Problem Statement*** The problem statement ignores the large role of fishery managers (regulations, hatcheries, etc.) in creating the present trout population status. We will forever fall short of accurately depicting the relative influences on the population if we do not include Arizona Game and Fish Department actions in addition to dam operations.	If by fishery managers, you mean stocking practices in Glen Canyon, then this is not an issue presently. The AGFD currently is running a natural spawning fishery in Glen Canyon. The issue of take is a good point and GCMRC would like to hear ideas of how to address this issue as part of a long-term monitoring program.

Page 60 **Line 1263**	**AGFD (11/3/99): Title: Monitoring of the Status and Trends of the Lees Ferry Trout Fishery - *Rationale/Problem Statement*** Suggest delete catfish (a quick search of our monitoring database revealed 0.01% of catch was catfish [3 catfish/25,443 total fish]).	We can delete this reference, but doesn't its presence still indicate that it represents a competitor, if not with trout then with FMS which is part of the L.F. ecosystem?
Pg. 61 **Line 1301**	**AGFD (11/3/99): Title: Monitoring of the Status and Trends of the Lees Ferry Trout Fishery - *Expected Products*** Perhaps a way to tackle the integration issues is to make one of the products an integrated long-term monitoring design. Simple delivery of data and exchange will likely not lead to comprehensive integration. See my earlier comments on integration.	We are intending this to be a Long-term monitoring contract that has a long-term monitoring design inherent in it. This is indicated in the schedule. It is intended that the data are integrated upon delivery, and that other components are synthesized by the GCMRC staff. The design is developed by the GCMRC and the methods very well detailed by the GCMRC with input from the PEP.
Pg. 62 **Line 1329**	**GCNRA (11/15/99): Title: Integrated Water Quality Monitoring** 1. Relationship to MO/INs - Unclear how the "monitoring program" will address specific INs. For example, how will the proposed program answer specific questions related to side channel influence?	As stated previously, monitoring programs are designed to provide data that can be analyzed to address multiple INs. INs that can not be addressed through this approach are addressed through specific research activities. The IWQP provides $50,000 ($30,000 from O&M and $20,000 AMP) which can be used in FY 2001 to address such needs.
	GCNRA (cont'd) 2. Lake Powell conceptual model - Completion of the Lake Powell conceptual model should be included within the FY-2001 plan. Further, the integration of higher trophic level linkages should be discussed and alternative funding sources specified. It would seem essential that the conceptual model be completed in order to understand the impact of the TCD and climatic variability on the downstream water quality.	The IWQP Plan (6/24/99) identifies plans for conceptual modeling in FY 2001 to allow for linkages with the existing conceptual modeling activities for the Colorado River ecosystem.

	GCNRA (cont'd) 3. Program description - The IWQP is relatively unique within GCMRC in that internal staff will conduct it almost entirely. Because of this, additional specificity is needed on individual program elements. Specifically, I would like to see more detail on the types of analyses to be made with the monitoring data to answer the specified INs. In particular, I would like to see lower trophic level biology discussed. Since such data has been conducted for several years now, I would expect that a statement about the completion of analysis should be made.	The program is described in the IWQP Plan (6/24/99). We would be happy to work with you to address the additional detail you've requested if that is not adequately addressed in Chapter 4 and the Appendices of the IWQP Plan.
	GCNRA (cont'd) 4. Project goals and objectives - Monitoring objectives "related" to various parameters are very mushy and do not provide solid information regarding the questions to be answered with the data collected through the monitoring effort. I suggest that if the monitoring data is not sufficient to answer specific questions that the program should be modified to ensure that high priority specific questions can be answered.	We believe high priority questions are being addressed. Based on this comment and your earlier comments, perhaps it would be more productive to work with you in drafting a plan that will address your specific concerns.
	GCNRA (cont'd) 5. Expected products - Since the IWQP is unique among GCMRC programs, it would seem appropriate that additional information be provided on the specific products to be produced during the work year. Specifically, I would like to see what types of analyses will be conducted to answer the specific INs identified in Table 2.1.	Please see the IWQP Plan (6/24/99).
	GCNRA (cont'd) 6. It is unclear why the long-term monitoring program will not become officially instituted until FY-2002.	The long-term monitoring program will not be implemented until after the PEP which is scheduled for Nov. 2000.
	GCNRA (cont'd) 7. Cost range - Why is there such a wide range in cost for this project? It would seem that the investigators should, by now, have a solid understanding of what is needed and how much it costs to get it. By showing such a wide cost range, it suggests that they do not have a good understanding of the proposed program specifics. Further, since the program will be run in-house, a detailed budget should be provided to justify the expenditures.	As stated in the FY 2001 IWQP Plan the costs for this project includes salaries, field logistics, and contract costs for laboratory analyses of Lake Powell and tailwater samples as well as collection and analysis of water quality samples in the mainstem performed by the USGS.

Pg. 62 **Line 1329**	**CREDA (11/5/99): Title: Integrated Water Quality Monitoring** There should be a breakdown of the sources of funding for this work along the black/gray/white lines approved by AMWG. As now depicted, all $350k is listed as earmarked for reservoir work. Where are the dollars and effort depicted for tailwater and downstream areas? Table 2.1 Integrated Water Quality Program is all Lake Powell. Where in this table is the listing of routine work being done to collect water quality downstream? How much effort is this going to take? MO 2 under Water and IN 2.1 was rated as a high priority yet we see nothing in Table 2.1 specific to this effort.	The money is earmarked for the Integrated Water Quality Plan that includes downstream monitoring. This includes the efforts supporting USGS' gage station work and their water quality collection at Diamond Creek and Lees Ferry.
Pg. 64 **Lines 1367-1370**	**WAPA (11/5/99): Title: Integrated Water Quality Monitoring - *Project Goals & Objectives*** It is not clear how cultural resources (or recreational for that matter) could be affected by the chemical constituents being considered. Neither cultural nor recreational resources are listed in the MOs or INs for this project.	Cultural resources, such as ethnobotanical, faunal, mineral resources may be affected by chemical constituents. For example, water quality may affect plant abundance and the food base for culturally important birds and animals. Water quality may affect recreational opportunities for fishing, swimming, and rafting. Temperature (recreation) and water quality elements that affect public health are a concern. Likewise, water quality constituents do influence associated cultural resources like plants, and aquatic animals. We have added the MOs and INs that pertain to this work.
Pg. 65 **Line 1396**	**WAPA (11/5/99): Title: Integrated Water Quality Monitoring - *Cost Range*** There should be specific explanation for the extreme range given here.	To make the budget for this project consistent with the other projects presented here, the budgeted amounts have been revised to represent the project costs and the logistics costs, minus salaries. The new figures for the monitoring project are: Project costs: $105,000 Logistics: $28,0000 NPS contract: $10,000

Pg. 65 Line 1396	**US BUREAU OF RECLAMATION (10/31/99): Title: Integrated Water Quality Monitoring - *Cost Range*** The cost range cited here seems to indicate a difference in costs whether the work is conducted in-house or by contract. In reality the costs are likely similar or the same and a singular figure should be shown.	See Table 4 on the page 36 of the IWQP Plan (6/24/99) and the above comment.
Pg. 65 Lines 1416-1417	**CREDA (11/5/99): Title: Ongoing Research Associated with Population Genetics of Humpback Chub in Colorado River Ecosystem - *Rationale/Problem Statement*** The goal of the EIS/ROD and Biological Opinion is to remove jeopardy and this is far different than recovery.	This sentence will be rewritten to say "Plans are either in place or are being developed to address elements of the Biological Opinion."
Pg. 66 Lines 1434-1448	**WAPA (11/5/99): Title: Ongoing Research Associated with Population Genetics of Humpback Chub in Colorado River Ecosystem** Population genetics of HBC should include literature review under "How" to ensure the genetic work of the upper basin projects and those genetic relationships are considered.	Line 1434 will read as follows "Understanding the inter-population relationships are integral to management actions associated with endangered fish"
Pg. 67 Line 1471	**AGFD (11/3/99): Title: New Research Associated Interactions Between Native and Non-native Fish Species - *Rationale/Problem Statement*** Statement that "non-native fish... exist in great enough numbers in the mainstem to pose a problem to native fish recruitment" seems like a conclusion that has not been verified yet. To my knowledge we do not have population estimates or predation rate estimates for brown trout, rainbow trout, or channel catfish. Suggest you change to "may exist in great enough numbers" until this question is answered.	Monitoring data indicate that rainbow trout are the most abundant fish in the mainstem. Both rainbow and brown trout are known to consume native fish (see SWCA integration report, page 127-132). These pages include a table for estimates of predation on native fish. As was brought out in the TCD symposium, the degree to which predators or temperature affects recruitment levels is at issue and needs to be resolved.

Page 68 **Line 1501**	**AGFD (11/3/99): Title: New Research Associated Interactions Between Native and Non-native Fish Species - *Recommended Approach/Methods*** I don't think your suggested approach to use available published life history information on predators and prey to determine time when feeding and movement is greatest will yield useful results. Suggest a preliminary effort to use synthesized and compiled baseline data from Grand Canyon on species composition and distribution, species association indices, diet and habitat overlap, or another approach to tackle this issue first. There is also a need to estimate both population sizes of predators and rates of predation to assess the potential severity of this problem. Your FY2000 Plan (page 39) stated that "*Research is needed to address historic data associated with native and non-native interactions and baseline information for fish. GCMRC will initiate an effort to consolidate data and to provide procedures for sharing data among researchers. Funds associated with this effort are estimated at $30,000*". What is the status of this project?	The literature is a source for beginning to develop a laboratory design. It would be great to use GC data, but as of this draft, that information is not synthesized There are simple projects that may look at temperature and feeding, or turbidity and feeding that do not need to have total population estimates for predators. I think the historic data indicate that trout are predators on native fish, otherwise this would not be a project that GCMRC would consider funding. The laboratory effort is meant to provide a focus for efforts in the field to test their applicability and predictions. There is not a lot of money available for any research, but the thought is that contained experimentation that is moved into a field situation will at least provide more information than a strictly observational effort in Grand Canyon with multiple parameters.
Page 68 **Line 1501**	**US FISH & WILDLIFE SERVICE (11/12/99): Title: New Research Associated Interactions Between Native and Non-native Fish Species - *Recommended Approach/Methods*** Under the discussion for native and non-native fish species I thought there would be some experimental trapping of non-natives in the field. Has this been removed or has a decision not yet been made on this issue?	Experimental trapping of fish in the field has not been presented as a proposal to GCMRC.
Pg. 68 **Line 1509**	**WAPA (11/5/99): Title: New Research Associated Interactions Between Native and Non-native Fish Species - *Cost Range*** Is this total $ for two years of study?	Line 1509. This is a budget plan for FY2001 and the schedule for this work is two years. Therefore the range is 30-90K/year. We will amend the line to include a "/year".

Pg. 68 **Line 1509**	**AGFD (11/3/99): Title: New Research Associated Interactions Between Native and Non-native Fish Species - *Cost Range*** From my experience doing lab studies, the money for this Project is inadequate if the suggested approach is taken.	Facilities exist at Willow Beach that are being used for movement studies. This project is scheduled as a two year effort. The funding is for this FY2001 funding. Subsequent years are dependent on available funds. Estimated cost range over two years is $60,000 to $180,000. Perhaps funding at this level will be adequate, or externally funding or cost sharing will need to be developed for this project. The figure of 30-90 was a per year funding level
Pg. 69 **Line 1518**	**CREDA (11/5/99): New Research Associated with Experimental Flows for Fish and Temperature Control Device - *General Project Description*** What is the cost and source of funding for this program? Is it black, white, or gray? Also, a workshop to discuss the merit of such work is planned for next week. If the workshop concludes such work as has been identified here is not needed (e.g., studying whirling disease) we assume this would free money for fulfilling other information needs.	The source of funding is section 8 funding from the Bureau of Reclamation. These are not AMP funds that support TCD research. Experimental Flows work is funded by contingency funding. The intent of the workshop was to identify data collection efforts associated with the TCD.
Pg. 69 **Line 1534**	**CREDA (11/5/99): New Research Associated with Experimental Flows for Fish and Temperature Control Device - *General Project Description*** Why do we need to do basic research on whirling disease here when so much has been/is being done on this disease elsewhere especially as it relates to such a fundamental question as temperature effects on the disease? This is highly questionable.	The projects that are listed in this plan were there to provide a range of issues and possible projects that may be explored following the workshop.

Pg. 69 **Line 1536**	**CREDA (11/5/99): New Research Associated with Experimental Flows for Fish and Temperature Control Device - *General Project Description*** Why do we need to do basic research on the effect of temperature on primary and secondary productivity in order to make a decision regarding the temperature control device? If models can tell us what temperatures to expect, then biologists experienced in primary and secondary productivity should be able to tell us what to expect from the anticipated new temperature regimen for our purposes without experimentation. This is a waste of time.	The question aquatic biologists have is if the functional groups that exist would be maintained under temperature changes. Changing species is recognized and somewhat predictable, but the question is if the food quality would be similar or decline. Its easy to be a critic. A more constructive comment would be to provide some alternative ideas associated with the TCD rather than just indicate what is a waste of time or what is questionable. Help us out here if you've got ideas.
Pg. 71 **Line 1579**	**US BUREAU OF RECLAMATION (10/31/99): New Research Associated with Water Quality in Lake Powell** The collection of wind and solar radiation data should be directly tied to specific Lake Powell modeling requirements. It is unclear whether this work will be contracted, but if it is expected to use existing GCMRC staff, then the $50,000 figure seems high and there would be concerns about a lack of integration with existing Lake Powell water quality data collection trips to reduce these new data collection costs.	The work will likely be contracted out given the work load of the current GCMRC staff, however, Susan Hueftle will likely be involved in some capacity in this effort, beyond contract oversight.
Pg. 71 **Line 1579**	**CREDA (11/5/99): New Research Associated with Water Quality in Lake Powell** Is this program funded from Sec.8 ?	Yes, that is our proposal.
Pg. 71 **Line 1592**	**WAPA (11/5/99): New Research Associated with Water Quality in Lake Powell - *Rationale/Problem Stmt*** Add "and rate of regeneration" after "quantity."	We will add the suggested change.

Pg. 71 **Line 1596**	**CREDA (11/5/99): New Research Associated with Water Quality in Lake Powell - *Rationale/Problem Stmt*** We question the need for new research on Lake Powell heat budget at $50k per year. Existing models should be good enough for purposes of determining impacts and heat availability and for making a decision to go or not to go on with the temperature control device.	The research is a component of the IWQP that was approved by the TWG and AMWG in July. The plan sets aside $50k for research efforts associated with water quality. The current models for the heat budget are based on data from the Page airport and a weather station in Utah. The TCD workshop suggested that additional wind and solar radiation data on the lake would be helpful in developing the heat budget model.
Chapter 2	***INTEGRATED TERRESTRIAL AND AQUATIC ECOSYSTEM ACTIVITIES RESPONSE TO COMMENTS***	
Pg. 77 **Line 1768**	**WAPA COMMENTS (11/5/99): Title: Long-term Monitoring of Streamflow and Fine-Sediment Transport in the Main Channel Colorado, Paria and Little Colorado Rivers** Could the streamflow component of this project also be used to track/verify compliance with discharge criteria for dam releases in the Lees Ferry Reach? Page 6, line 132 indicates data on discharges is available in 15-minute unit values.	Yes, the detailed description of the main channel monitoring network for streamflow lists the Glen Canyon streamgage, and is intended specifically to fulfill MO 1 and IN 1.1 under Water and Sediment.
Pgs. 78-79 **Lines 1779, 1808, 1816-1818**	**WAPA COMMENTS (11/5/99): Title: Long-term Monitoring of Streamflow and Fine-Sediment Transport in the Main Channel Colorado, Paria and Little Colorado Rivers** Is the water quality component of this project duplicating IWQP efforts or can some efficiency be gained from incorporating the water quality needs of this project into the IWQP?	This is a component of the IWQP. This project is intended to provide some of the downstream water quality data described in the IWQP using funds from the Biological budget, as is the case in FY 2000.
Pg. 83 **Line 1922**	**WAPA (11/5/99): Title: Long-term Monitoring of Coarse-grained Sediment Inputs, Storage and Impacts to Physical Habitats - *Rationale/Problem Statement*** In reading the project proposals it appears that MO 2 (trout) and IN2.4 (trout) under Fine-grained sediment storage might be more appropriately addressed under the Course-sediment inputs, storage, and impacts project.	The MO and IN referred to with respect to trout is now included in Table 2.1 under the research and monitoring projects related to coarse-sediment inputs.

Pg. 92 **Line 2193**	**WAPA (11/5/99): Development of a One-Dimensional Fine Sediment-Routing Model Along the Main Channel - *GCMRC Involvement*** Can the river trips for this project and the Reach-averaged Modeling trip be combined into one at a savings of up to $18k?	It is possible that they could if the decision were based simply of field logistics and not on data collection needs. Certainly, if the projects were both awarded to one research team, then there would be a higher likelihood that the field activities could become highly coordinated. Basically, the two projects are anticipated to have completely different field data needs, so it is probably not very likely that savings will be realized by combining field trips. As per GCMRC policy, we look for every opportunity to consolidate field logistics, as appropriate.
Pg. 95 **Line 2279**	**WAPA (11/5/99): Title: Advanced Conceptual Modeling of Coarse-grained Sediment Inputs Related to Evolving Physical Habitats and Aquatic Processes - *GCMRC Involvement*** Is "Lambert" an intentional inclusion here?	Yes, Lambert is intentionally included as part of the oversight team for this project, but from the standpoint of geomorphic impacts of coarse-grained sediment inputs on evolution of campsites, rather than impacts on cultural resources.

Chapter 2 (cont'd)	*PROTOCOL EVALUATION ACTIVITIES*	
Pg. 95 **Line 2283**	**CREDA (11/5/99): Biological Resources and IWQP PEP** We assume the costs of PEP activities are included in the cost estimates of the individual science activities in Chapter 2. Is this correct or is the funding on lines 2790 and 2794?	
Pg. 96 **Line 2306**	**AGFD (11/3/99): Biological Resources and IWQP PEP** "The timeframe currently set for long-term monitoring precludes testing of new protocols prior to releasing of RFPs for long-term monitoring". This statement is troubling. What is the purpose of PEPs if they will have no effect on the long-term monitoring program? If the PEPs for fish and the phyto-benthic community monitoring suggests that the current sampling strategies are inadequate to address integration and Management Objectives, will you still award a five-year contract that uses those methods? Integration of a long-term monitoring program needs to take place in the design stage of projects. It seems to me that if PEP's are not conducted concurrently, we are unlikely to achieve integrated monitoring designs and therefore unlikely to be able to integrate data across resources once the data are collected. See my earlier comments on integration.	PEPs are being conducted this summer for the aquatic ecosystem. This provides an additional year, or half a year to evaluate protocols. Long-term monitoring for the aquatic resources except the Lees Ferry trout is not anticipated until FY2002 with RFPs released in Spring of 2001.
Pg. 96 **Line 2320**	**NPS (11/16/99): Socio-Cultural Resources PEP** What does the sentence mean? Haven't we been conducting long term monitoring since 1992? Instead of begin, maybe continue? Confusing. It is also very vague regarding the allocation of funds. I realize it is dependent on the review, however, shouldn't there be at least a minimum of $5,000 per PA tribe and NPS, or something like that to compensate for follow up recommendations given by the PEP?	Line 2320: Recommendations derived from the PEP will be incorporated into long-term monitoring that is anticipated to begin in FY 2001/2002. The funds refer to monies that are programmed by the GCMRC. Additional funding may be supplied by Reclamation, if appropriate and needed.

Chapter 2	*TABLE 2.2 - SUMMARY BUDGET FOR SCIENTIFIC ACTIVITIES*	
	US BUREAU OF RECLAMATION (10/31/99): Table 2.2. Summary Table of Projected FY2001 Budget for Projects and by GCMRC Program Allocations	
Pgs. 100-103 Lines 2399-2402	With respect to table 2.2, there are inconsistencies between this table and the individual descriptions preceding the table. Examples of the descriptions vs. table 2.2 include: fine grained sediment monitoring $320,000 vs $340,000 Lees Ferry trout monitoring $120,000 vs $130,000 Terrestrial habitats $90,000 vs. $165,000 Evaluation of cult. Res. monitoring $40,000 vs $65,000 Perhaps as a result of these discrepancies, the program total for Biological Resources does not match that of the table on page 117. On table 2.2, the $400,000 evaluation of remote sensing technologies should be listed under the column "Remote Sensing" rather than "Information Technology".	The figures for Table 2.2 were correct and the text associated with the project descriptions will revised to reflect these corrections as follows Fine grained sediment monitoring: $340,000 Lees Ferry Monitoring $120,000 Terrestrial habitat $165,000 Evaluation of cultural resources $65,000 The values in the column labeled "Biological Resources," add up to the line item total for the same category in the budget table on p.117. The $165K value includes money contributed from Cultural resources beyond the 90K funding levels from biology. Yes, this has been corrected and the IT is now divided into Survey and GIS columns also.
Pgs. 100-103	**GC TRUST (11/8/99): Table 2.2. Summary Table of Projected FY2001 Budget for Projects and by GCMRC Program Allocations** This table is very useful. Two minor comments are to delete "N/A" throughout for increased readability (maybe use a dash instead), and use a title instead of a surname for personnel.	See revised Table 2.2

CHAPTER 3	MANAGEMENT AND BUDGET	
Chapter 3	*UNSOLICITED PROPOSALS - RESPONSE TO COMMENTS*	
Pg. 104 **Lines 2417-2425**	**WAPA (11/5/99): Tribal Proposals** It is an important point that all unsolicited proposals compete equally for unsolicited $. In any given year it should be acceptable to find zero unsolicited projects that qualify for funding if the projects proposed do not contribute to the year specific goals of the AMP. Hopefully, the $ could be carried forward to fund qualifying projects in the next budget cycle.	Equal consideration for all proposals assumes unsolicited proposals are received and evaluated at one time. The nature of the existing process for unsolicited proposals is that they are submitted and evaluated throughout the year. This means that unsolicited proposals received earlier in the year may have a slight advantage based on availability of funds. Following the protocols developed with the Transition Working Group and included in the FY 1997-2002 strategic plan, ALL research proposals, responses to RFPs, unsolicited, and in-house, to undergo an independent external peer-review with the recommendation from the peer-reviewers falling into one of the following categories: Fund As Is, Fund With Modification, Do Not Fund.

Chapter 3	*IN-HOUSE RESEARCH - RESPONSE TO COMMENTS*	
Pg. 104 **Lines 2428-2435**	**WAPA (11/5/99):** How are the competitive and peer review processes applied to these proposals?	Following the protocols developed with the Transition Working Group and included in the FY 1997 - 2002 strategic plan, In-house research is not solicited competitively but it does undergo the same independent external peer review as ALL proposals and the recommendation from the peer-reviewers can fall into one of the following categories: Fund As Is, Fund With Modification, Do Not Fund.. To ensure objectivity of the peer review, it is managed at one level removed from that of the individual submitting an in-house research proposal. The majority of the GCMRC science program is generally considered at this time to consist of "competitive, out-house" activities.
Pgs. 104-105	**GC TRUST (11/8/99):** I strongly support in-house research. I presume that the decision to award a project in-house depends mainly on whether the project: 1) clearly helps a program manager stay current in their field; 2) is directed to achieve a priority management objective or other AMP need; 3) is a priority given other program tasks; and 4) can be conducted in-house in a cost-effective manner.	This is the rationale for in-house research as described in the strategic plan.

Chapter 3	*AMWG & TWG SUPPORT - RESPONSE TO COMMENTS*	
Pg. 105 Line2443	**US BUREAU OF RECLAMATION (10/31/99):** The carrying over of funds from year to year is appropriate, but there should be a limit on how much of this carryover money is allocated for AMWG/TWG requests, otherwise this fund could grow to a very large pot of money that could/should be used for other science areas.	We agree that these funds should not be carried over from year to year to such an extent that this pot of money grows very large. A few years of operation should give us an estimate on the appropriate size for this pool of funds. It is anticipated that once that is determined, if there are excess funds proposed for carry-over from one year to the next, they would either be reprogrammed to another need or the GCMRC budget request would be reduced by that amount in the subsequent year.
Chapter 3	*TSS - INFORMATION TECHNOLOGY PROGRAM - RESPONSE TO COMMENTS*	
Pg. 106	**US BUREAU OF RECLAMATION (10/31/99): Introduction** Regarding WWW publishing, GCMRC should focus its publishing efforts on science products, since Reclamation SLC will be posting all AMP management-related documents. If possible, GCMRC should make available on the WWW all historic science documents and reports.	The focus of the GCMRC WWW publishing is on scientific content. All new reports are required to be delivered in electronic format to facilitate publishing on the Web. GCMRC agrees that it is desirable to make historic science documents available on the Web. There is currently not sufficient manpower available to address this need in a formal manner. However, it is GCMRC's intent to make additional scientific information available on the WWW on a time available basis.
Pg. 106	**US BUREAU OF RECLAMATION (10/31/99): Data Base Management System** GCMRC should carefully investigate existing data bases (e.g. HDB, STORET) and their structure before creating their own in an effort to increase ease of access using established computer programs.	An evaluation of existing environmental and ecological data bases is scheduled for FY2000. It is anticipated that this objective will be completed before FY2001.

Pg. 106 Line 2491	**WAPA COMMENTS (11/5/99): Data Base Management System** Do these procedures include data compatibility requirements for format, data transfer media, etc. If not, where will these requirements be applied?	Data format, transfer, etc. requirements have already been defined and incorporated into GCMRC contracts under the subheading for "Data Standards". These requirements will be refined and updated as needed.
Pg. 107	**US BUREAU OF RECLAMATION (10/31/99): Geographic Information System** Considering the difficulty of establishing, training, and retaining significant GIS expertise, GCMRC should strongly consider contracting for specific GIS products and computer program interface development. Our Salt Lake office has taken this approach for similar reasons. Also, these products should be targeting specific MO's and IN's in order to ensure that this potentially expensive technology is cost effective.	Specific, well defined, GIS projects will be considered for contracted services. GCMRC believes that the most cost effective manner to develop GIS infrastructure, organize legacy spatial data, and ensure consistency in GIS products delivered by contractors is to have an in-house GIS expert.
Pg. 109 Line 2558	**GCNRA (11/15/99): Remotely Sensed Data Collection** Integration of remote sensing - The use of remote sensing technologies is good but the evaluation and use of the technology within this program area seems far removed from the specific resource MO/INs. The use of the technology is dependent on various factors related to needed spatial resolution, detection level, cost etc. All of which are related to resource objectives. Therefore, if the program sets as an objective the evaluation of plant community change throughout the system a system-wide analysis using remote sensing technology would likely be appropriate. Such a system should be suggested by the RFP bidder answering specific IN questions posed. I believe that the Information Technologies program should evaluate suggested remote sensing proposals for validity but should not specify technology unless GCMRC is conducting such analyses in-house.	The first step in strategic plan the governs the remote sensing initiative is to have the program managers specify their monitoring needs in terms of scale and accuracy for each resource based on the current MOs and INs. These are then used to identify potentially feasible remote sensing technologies. The next step calls for field testing and evaluation of the products produced, prior to a final PEP and recommendations for the incorporation of remote sensing as part of the GCMRC long-term monitoring protocols.

Chapter 3	***PUBLIC OUTREACH - RESPONSE TO COMMENTS***	
Pg. 113 **Line 2663**	**NPS (11/16/99):** This is a good idea. I hope the tribes take advantage of this.	
Chapter 3	***ADMINISTRATION AND PERSONNEL - RESPONSE TO COMMENTS***	
Pg. 115 **Line 2720**	**THE HOPI TRIBE (11/15/99): A Cultural Resources Task Group** The Hopi Tribe believes that the Cultural Resources Task Group should not only operate to facilitate the articulation between the socio-cultural resource program and the programmatic agreement program, but this group should also assist the GCMRC in the development of a more holistic and integrated program.	A Cultural Resources task Group operates to facilitate the incorporation of cultural concerns within all GCMRC program areas to assists the GCMRC in the development of a more integrated program that incorporates Native American perspectives. The Task Group consists of the GCMRC Socio-cultural Program Manager and cultural representatives from the stakeholders.
Pg. 117 **Lines 2790-2791**	**CREDA COMMENTS (11/5/99): Program Schedule** Where are these found in tables 2.1 and 2.2 ? Where is an explanation of "public outreach"? Is this really an appropriate AMP/GCMRC program?	Public outreach is described on lines 2664-2678. As discussed in that section the needs for these activities was brought to the attention of the AMWG by the Deputy Secretary of the Interior and the AMWG has established an Ad hoc group to develop activities in this area. The specific funds budgeted in this area for FY 2001 are in support of tribal activities. Tables 2.1 and 2.2, have been revised to include all of the individual activities supported under the "Cultural Resources" budget line.
Line 2794	Does this include the costs of SAB ?	The cost of the SAB is included on line 2794 as one of the Independent Review Panels. This is described on lines 2619-2661.

Attachment 1

Current Knowledge - Biological Resources

Terrestrial Biological Resources - Since 1998 work associated with terrestrial biological resources have represented data collection efforts in support of eventual long-term monitoring programs. As with sediment resources, the emphasis for biological projects was in moving toward long-term monitoring while transitioning from EIS related efforts associated with these resources. This transition has included attempts to maintain continuity among data sets that were collected prior to 1996. Little emphasis has been put on research associated with terrestrial biological resources. Current contracts are separated into vegetation (Kearsley, NAU), avifauna (Spence, GCRA), and Kanab ambersnail (Meretsky, SWCA). The following is information provided from these monitoring projects.

Monitoring vegetation change along the Colorado River mainstem - Dr. Michael Kearsley of Northern Arizona University has been involved in measuring vegetation change along the Colorado River corridor since 1993. Data collection efforts have changed from a focus on detailed compositional change that takes place on microhabitat scale (Stevens and Ayers 1996) to characterizing change at the community or plant associated level. His work over the last two years has been to evaluate and incorporate structural components of vegetation, in addition to identifying changes in the species composition of plant communities. These structural components provide an index of vertical complexity, a variable that effects bird distribution and abundance. Measurements have also been done along shorelines to determine the relative availability of vegetated shoreline, a shoreline habitat utilized by young fish (Converse et al. 1998). Preliminary results of this research have identified factors affecting availabilty of shoreline habitat to include discharge, magnitude of fluctuations, and time of year. Other results of this monitoring effort indicate that some community constituents have changed very little (e.g., tamarisk) in their representation and extent, while others are increasing in abundance (arrowweed).

These trends suggest that growth rates of arroweed may have implications associated with campable area over the long-term.

Monitoring avifauna abundance and distribution along the Colorado River mainstem – Dr. John Spence of the Glen Canyon National Recreation Area has been in charge of overseeing a project to monitor bird distribution and abundance along the Colorado River corridor. Included in this project is the monitoring of the endangered southwestern willow flycatcher. The project has determined that abundance and diversity changes in the avifaunal community along the Colorado River corridor is associated with vegetation densities and distance from the dam. Structurally complex vegetation patches like those found from river mile 42 to Cardenas and in the western Grand Canyon support more birds and more species of birds. Glen Canyon is also an area of waterfowl diversity, likely associated with the relatively rich benthic community and lower velocity waters found in this reach. The next year will be spent synthesizing the bird data and evaluating it to provide recommendations for long-term monitoring that can be integrated with habitat data.

Monitoring of Kanab ambersnail populations and habitat at Vaseys Paradise – Dr. Vicky Meretsky through SWCA Inc., has been the lead biologist involved with developing population estimates for the Kanab ambersnail (KAS) located at Vaseys Paradise in Grand Canyon. Both available habitat and snail numbers are determined for each trip throughout the year. Trips are conducted on a quarterly basis that coincide with the life history of the snail. Monitoring of the habitat indicate that primary habitat composed of Nasturtium is highly variable in terms of area covered. This plant species is an annual and its area cover is influenced by local climate effects. A warm winter may result in greater growth earlier in the season, while a summer storm event may result in scour of local patches. The variability in habitat is less likely to be observed with Mimulus (monkey flower) the other major plant species associated with KAS. This plant is a perennial species and the variability in area cover should be less than that of Nasturtium. Population estimates for KAS between years has not been shown to be significantly

different. However, the confidence intervals around these estimates are great, due to overwintering mortality that can result in high inter-annual variability. The life-history of KAS is characterized by starting with a small number of over-wintering adults. Population size increases throughout the season from recruitment. An associated KAS genetics project (Keim, Northern Arizona University) has provided preliminary indications that the KAS at Vaseys paradise is genetically distinct from Utah populations also identified as KAS. What this distinction means in taxonomic terms is yet undetermined.

Aquatic Biological Resources - Since 1998 work associated with aquatic biological resources have represented data collection efforts in support of eventual long-term monitoring programs. As with terrestrial biological resources, the emphasis for biological projects is moving toward long-term monitoring while transitioning from EIS related efforts associated with these resources. This transition has included attempts to maintain continuity among data sets that were collected prior to 1996. There has been a bit more emphasis put on research associated with aquatic resources when compared to terrestrial resource efforts to develop information that will be used in developing the long-term monitoring program. Current contracts are separated into aquatic foodbase (Blinn, NAU), Lees Ferry Trout (Persons AGFD), and Native Fish Monitoring (Gorman US FWS). The following is information provided from these monitoring projects.

Monitoring the Aquatic Foodbase in the mainstem Colorado River and its tributaries – Dr. Dean Blinn of Northern Arizona University has been studying aquatic biology of the Colorado River since the 1980's. Efforts since 1998 have focused on monitoring the productivity in the mainstem as influenced by dam operations and understanding the relationship and influence of tributary productivity on the mainstem. Results of these data collection efforts indicate that reducing fluctuations benefits productivity. Productivity is increased because areas available to colonize are stabilized. What is not known is if combinations of stability and short-term disturbance optimize productivity. Productivity increased following the 1996 BHBF, the subsequent flows in the summer of

1996 and in Spring/summer 1997 that were high and relatively steady compared to operations in previous years and may have been a contributing factor in the measured productivity. Tributary collections show that these streams are a source for benthic colonizers in the mainstem, but current mainstem conditions (constant cold temperatures) preclude their expansion into the mainstem. Some organisms found in tributaries need a range of temperatures as a growth cue. These cues are not available in the mainstem. Both of these pieces of information are important for managers trying to optimize mainstem productivity. Productivity might be limited by temperature (degree days) and other physical parameters, or by habitat instability (amount of fluctuations) or a combination of the two.

Monitoring the Lees Ferry Trout Fishery – Mr. Bill Persons of the Arizona Game and Fish Department has been overseeing the contract responsible for determining the effects of dam operations on rainbow trout in the Glen Canyon Reach. This contract has included a the collation of stocking and catch data since the 1960's
the effects of minimum flows on trout popul
fluctuations conducted d
popu

temperature as a key factor effecting humpback chub abundance and distribution in the mainstem. The reviews of GCES phase II humpback chub monitoring and research activities by Brunkow (in Patten) will be useful in designing the long-term monitoring program for native fish.

ATTACHMENT 2

SUMMARY BUDGET

GCMRC Program and Operating Costs

AMP Funding

A. Bureau Support Services	125,000
B. Operations, Personnel, Contract Services	1,969,000[1]
C. Physical Resources Science	950,000
D. Biological Resources Science	
i. Science Activities	1,180,000
ii. PEP	100,000
E. Socio-cultural Resources Science	
i. Science Activities	275,000
ii. PEP	55,000
iii. Public Outreach	35,000
F. Information Technologies Program	320,000
G. Remote Monitoring Technology	400,000
H. Independent Review Panels	
i. RFPs, unsolicited & in-house, and technical reports	95,000
ii. SAB	80,000
I. Unsolicited Proposals	
i. General	70,000
ii. Tribal	50,000[2]
J. AMWG/TWG Requests	60,000[3]
K. In-House Research	20,000
I. Logistics	
i. River Logistics	475,000
ii. Equipment, supplies, and maintenance	85,000
iii. Helicopter support & Emergency Evacuations	36,000
iv. NPS Permitting	54,000
TOTAL	**6,434,000**

Other Funding Sources

O&M -- Integrated water quality program (IWQP)	300,000
Sec. 8 -- TCD Related Activities	310,000

Revised page 117 (11/22/99)

[1] Salaries for GCMRC staff working on IWQP activities in Lake Powell are being charged to the IWQP - O&M account.

[2] $50,000 in funds from the cultural resources program has been moved into this category specifically to support unsolicited tribal proposals.

[3] $10,000 in funds from the cultural resources program have been added to the money set aside to address AMWG/TWG requests.

Table 2.1. Summary table of FY2001 Project titles and associated Management Objectives and Information Needs.

PROJECT TITLE	MANAGEMENT OBJECTIVE	INFORMATION NEED
TERRESTRIAL ECOSYSTEM ACTIVITIES		
Monitoring avifauna **NEW RFP IN SUMMER 2000**	**TERR MO 11:** Protect, restore, and enhance survival of native and special status species (federal, tribal, and state designations). Ensure that the required habitat for these species is preserved. **AVI MO 13:** Protect, restore, and enhance survival of native and special status avifauna.	TERR IN 11.2 Determine species population characteristics to detect departures from natural range of variation. TERR IN 11.3 Determine changes, declines in special status species and characterize ecosystem changes to benefit species. AVI IN 13.2 Determine impacts of dam operations under approved operating criteria on avifauna food chain associations
Monitoring Kanab ambersnail and habitat at Vaseys Paradise **NEW RFP IN SUMMER 2000 OR MAINTAINED INTERNALLY**	**AS MO 14:** Sustain populations of Kanab ambersnail wherever they currently exist within the Colorado River ecosystem.	KAS IN 14.1 Determine specific habitat characteristics required by the KAS. (T&C 3--p.41) KAS IN 14.2 Determine special flow impacts on Kanab ambersnail to assure that the level of incidental take is not exceeded. (I. T. - p.40) KAS IN 14.3 Complete a census of the population and characterize the habitat. Once habitat requirements are determined, other potential habitat sites within the Grand Canyon corridor will be surveyed to determine species presence and recovery potential. Conservation Recommendation 5--p.43) KAS IN 14.4 Survey KAS habitat before and after any flow greater than 25,000 cfs to determine population and its species response to disturbance and ability to recover. (T&C 4, p.42; and RPM) KAS IN 14.5 Determine Kanab Ambersnail life history schedule for populations in the Colorado River ecosystem. (Conservation Recommendation 5)

Ongoing research on terrestrial trophic linkages **ONGOING**	**TERR MO 11:** Protect, restore, and enhance survival of native and special status species (federal, tribal, and state designations). Ensure that the required habitat for these species is preserved **AVI MO 13:** Protect, restore, and enhance survival of native and special status avifauna.	TERR IN 11.1 Define and specify ecology of native faunal components, especially threatened and endangered species; including evolutionary and environmental changes, natural range of variation, linkages, interdependencies, and requirements AVI IN 13.1 Define and evaluate food chain associations, interdependencies, requirements, etc. for native avifauna, including the Peregrine Falcon, Southwestern Willow Flycatcher, and other special status species (e.g., Yellow-billed Cuckoo). AVI N 13.2 Determine impacts of dam operations under approved operating criteria on avifauna food chain associations.
Evaluation of cultural resource monitoring and mitigation strategies **NEW RFP IN 2000**	**CULT MO 1:** Conserve *in situ* all the downstream cultural resources and take into account Native American cultural resource concerns in the Colorado River ecosystem. **CULT MO 2:** If *in situ* conservation is not possible, design mitigative strategies that integrate the full consideration of the values of all concerned tribes with a scientific approach	CULT IN 1.1 Monitor cultural sites potentially impacted by Glen Canyon Dam operations to determine present condition and rate of change to assess: types of degradation, threats; rates of degradation; define immediacy of threats to resources; protection methodologies; protection, monitoring and research costs. CULT IN 2.1 Characterize through scientific study and data development all assumed historical and current values, including scientific values, of resources to tribal nations and to the general public.
Development of historic contexts to evaluate the significance of cultural resource data **NEW RFP IN 2000**	**CULT MO 4:** Maintain and integrate all appropriate cultural data recovered from monitoring, remedial, and mitigative action and incorporate these data into the evolving research designs and mitigative strategies for understanding the human occupation and use of the Colorado River ecosystem.	CULT IN 4.1 Develop evolving research designs and/or other methods including synthesis of existing available data and GIS for understanding human occupation and use.

AQUATIC ECOSYSTEM ACTIVITIES		
Ongoing monitoring phyto-benthic community and evaluating its quality for utilization **ONGOING WITH REVISIONS NAU (BLINN & SHANNON)**	**AFB MO 1:** Maintain and enhance the aquatic food base in the Colorado River ecosystem to support desired populations of native and non-native fish. At a minimum, maintain continuously inundated areas for *Cladophora* and aquatic invertebrates at or above 5,000 cfs discharge levels from Glen Canyon Dam.	AFB IN 1.1 Determine status and trends in aquatic food base species composition and population structure, density and distribution and the influence of ecologically significant processes. AFB IN 1.2 Determine the effects of past, present, and future dam operations under the approved operations criteria on the aquatic food base species composition, population structure, density, and distribution in the Colorado River ecosystem. AFB IN 1.3 Determine the aquatic food base species composition, population structure, density, and distribution required to maintain desired populations of native and non-native fish in the Colorado River ecosystem. HBC IN 3/4.7 Determine origins of fish food resources, energy pathways, and nutrient sources important to their production, and the effects of Glen Canyon Dam operations on these resources. (RPM 1.C.vi) Evaluate linkages between the aquatic food base and the health and sustainability of HBC populations.
Ongoing monitoring of status and trends of fish community **ONGOING WITH REVISIONS**	**HBC MO 2:** Maintain or enhance levels of recruitment of HBC in the mainstem as indexed by size frequency distributions and presence and strength of year-classes. (Focused at young-of-year and juvenile fish, and should include a fish health assessment.) **FMS MO 8:** Achieve healthy, self-sustaining populations of flannelmouth sucker, bluehead sucker, and speckled dace in the Colorado River ecosystem, with special emphasis on flannelmouth sucker in Glen Canyon based upon the capability of the habitat to support those fishes.	HBC IN 3/4.1 Determine adult HBC populations and evaluate life history schedules, population health, and reproductive success. *(Fall 97 RPM 1)* HBC IN 3/4.2 Determine levels of recruitment of humpback chub in the mainstem and the LCR. FMS IN 8.2 Determine population dynamics, distribution, and other life history traits of native fish species. FMS IN 8.3 Determine historic and current character and structure of native fish populations.

Monitoring the status and trends of the Lees Ferry Trout Fishery **NEW RFP IN SPRING 2000**	**TROUT MO 2:** In the Colorado River downstream of Glen Canyon Dam to the confluence of the Paria river, sufficient ecological conditions (such as habitat, foodbase and temperature) should be maintained, which in conjunction with management by Arizona Game and Fish will produce a healthy self-sustaining population of at least 100,000 Age II+ rainbow trout that achieve 18 inches in length by Age III with a mean annual relative weight (Wr) of at least 0.90.	TROUT IN 2.2 Determine trends in rainbow trout population size, character and structure in Glen Canyon. TROUT IN 2.3 Evaluate harvested and field sampled rainbow trout to determine the contribution of naturally reproduced fish to the population in Glen Canyon.
Integrated Water Quality Monitoring **ONGOING WITH REVISION AND COOPERATION BETWEEN GCMRC AND USGS (WRD AZ DISTRICT)**	**LP WQ MO 1:** Prevent impacts that adversely affect the water quality (physical, chemical, biological) of Lake Powell due to dam operations and ensure that fully informed AMWG decisions are possible both now and in the future. **WATER MO 2:** (water resources) Maintain water quality at levels appropriate to support physical, biotic, and human resource needs...	LP-LIMNO IN 1.1 Determine the effect of current dam operations (under approved operating criteria) on reservoir water quality, including but not limited to the following: (a) Determine near dam hydrogen sulfide levels (and other hazardous chemical constituents) within the hypolimnion occurring under current dam operating criteria. (b) Determine the dynamics of lake stratification and advective flows and their effects on chemical constituents (c) Determine/quantify the dynamics of major cations, anions, and nitrate/ phosphate ratios resulting from dam operations (d) Determine the effects of dam operations (under approved operating criteria) on the physical/chemical dynamics of Lake Powell side channels and embayments LP-BIO IN 1.1 Determine the impacts of dam operations and resulting water quality on primary and secondary productivity of Lake Powell, including: • algae (phytoplankton, periphyton) • Macrophytes • Zooplankton WATER IN 2.1 Monitor water quality, composition, temperature (a more comprehensive list of the INs that are addressed by the IWQP can be seen in Table 1 of the IWQP plan (Vernieu and Hueftle 1999)

		SED IN 2.7 Quantify the extent and location of existing sandbars, beaches and backwaters along the Colorado River corridor
	SED MO 4: Maintain system dynamics and disturbance by redistributing sand stored in the	SED IN 4.1 Define character and structure of all beaches and backwaters in system after 1996 test flows

Ongoing research on terrestrial trophic linkages **ONGOING**	**TERR MO 11:** Protect, restore, and enhance survival of native and special status species (federal, tribal, and state designations). Ensure that the required habitat for these species is preserved **AVI MO 13:** Protect, restore, and enhance survival of native and special status avifauna.	TERR IN 11.1 Define and specify ecology of native faunal components, especially threatened and endangered species; including evolutionary and environmental changes, natural range of variation, linkages, interdependencies, and requirements AVI IN 13.1 Define and evaluate food chain associations, interdependencies, requirements, etc. for native avifauna, including the Peregrine Falcon, Southwestern Willow Flycatcher, and other special status species (e.g., Yellow-billed Cuckoo). AVI N 13.2 Determine impacts of dam operations under approved operating criteria on avifauna food chain associations.
Evaluation of cultural resource monitoring and mitigation strategies **NEW RFP IN 2000**	**CULT MO 1:** Conserve *in situ* all the downstream cultural resources and take into account Native American cultural resource concerns in the Colorado River ecosystem. **CULT MO 2:** If *in situ* conservation is not possible, design mitigative strategies that integrate the full consideration of the values of all concerned tribes with a scientific approach	CULT IN 1.1 Monitor cultural sites potentially impacted by Glen Canyon Dam operations to determine present condition and rate of change to assess: types of degradation, threats; rates of degradation; define immediacy of threats to resources; protection methodologies; protection, monitoring and research costs. CULT IN 2.1 Characterize through scientific study and data development all assumed historical and current values, including scientific values, of resources to tribal nations and to the general public.
Development of historic contexts to evaluate the significance of cultural resource data **NEW RFP IN 2000**	**CULT MO 4:** Maintain and integrate all appropriate cultural data recovered from monitoring, remedial, and mitigative action and incorporate these data into the evolving research designs and mitigative strategies for understanding the human occupation and use of the Colorado River ecosystem.	CULT IN 4.1 Develop evolving research designs and/or other methods including synthesis of existing available data and GIS for understanding human occupation and use.

AQUATIC ECOSYSTEM ACTIVITIES		
Ongoing monitoring phyto-benthic community and evaluating its quality for utilization **ONGOING WITH REVISIONS NAU (BLINN & SHANNON)**	**AFB MO 1:** Maintain and enhance the aquatic food base in the Colorado River ecosystem to support desired populations of native and non-native fish. At a minimum, maintain continuously inundated areas for *Cladophora* and aquatic invertebrates at or above 5,000 cfs discharge levels from Glen Canyon Dam.	AFB IN 1.1 Determine status and trends in aquatic food base species composition and population structure, density and distribution and the influence of ecologically significant processes. AFB IN 1.2 Determine the effects of past, present, and future dam operations under the approved operations criteria on the aquatic food base species composition, population structure, density, and distribution in the Colorado River ecosystem. AFB IN 1.3 Determine the aquatic food base species composition, population structure, density, and distribution required to maintain desired populations of native and non-native fish in the Colorado River ecosystem. HBC IN 3/4.7 Determine origins of fish food resources, energy pathways, and nutrient sources important to their production, and the effects of Glen Canyon Dam operations on these resources. (RPM 1.C.vi) Evaluate linkages between the aquatic food base and the health and sustainability of HBC populations.
Ongoing monitoring of status and trends of fish community **ONGOING WITH REVISIONS**	**HBC MO 1:** Maintain or enhance levels of recruitment of HBC in the mainstem as indexed by size frequency distributions and presence and strength of year-classes. (Focused at young-of-year and juvenile fish, and should include a fish health assessment.) **FMS MO 8:** Achieve healthy, self-sustaining populations of flannelmouth sucker, bluehead sucker, and speckled dace in the Colorado River ecosystem, with special emphasis on flannelmouth sucker in Glen Canyon based upon the capability of the habitat to support those fishes.	HBC IN 3/4.1 Determine adult HBC populations and evaluate life history schedules, population health, and reproductive success. *(Fall 97 RPM 1)* HBC IN 3/4.2 Determine levels of recruitment of humpback chub in the mainstem and the LCR. FMS IN 8.2 Determine population dynamics, distribution, and other life history traits of native fish species. FMS IN 8.3 Determine historic and current character and structure of native fish populations.

Monitoring the status and trends of the Lees Ferry Trout Fishery **NEW RFP IN SPRING 2000**	**TROUT MO 2:** In the Colorado River downstream of Glen Canyon Dam to the confluence of the Paria river, sufficient ecological conditions (such as habitat, foodbase and temperature) should be maintained, which in conjunction with management by Arizona Game and Fish will produce a healthy self-sustaining population of at least 100,000 Age II+ rainbow trout that achieve 18 inches in length by Age III with a mean annual relative weight (Wr) of at least 0.90.	TROUT IN 2.2 Determine trends in rainbow trout population size, character and structure in Glen Canyon. TROUT IN 2.3 Evaluate harvested and field sampled rainbow trout to determine the contribution of naturally reproduced fish to the population in Glen Canyon.
Integrated Water Quality Monitoring **ONGOING WITH REVISION AND COOPERATION BETWEEN GCMRC AND USGS (WRD AZ DISTRICT)**	**LP WQ MO 1:** Prevent impacts that adversely affect the water quality (physical, chemical, biological) of Lake Powell due to dam operations and ensure that fully informed AMWG decisions are possible both now and in the future. **WATER MO 2:** (water resources) Maintain water quality at levels appropriate to support physical, biotic, and human resource needs...	LP-LIMNO IN 1.1 Determine the effect of current dam operations (under approved operating criteria) on reservoir water quality, including but not limited to the following: (a) Determine near dam hydrogen sulfide levels (and other hazardous chemical constituents) within the hypolimnion occurring under current dam operating criteria. (b) Determine the dynamics of lake stratification and advective flows and their effects on chemical constituents (c) Determine/quantify the dynamics of major cations, anions, and nitrate/ phosphate ratios resulting from dam operations (d) Determine the effects of dam operations (under approved operating criteria) on the physical/chemical dynamics of Lake Powell side channels and embayments LP-BIO IN 1.1 Determine the impacts of dam operations and resulting water quality on primary and secondary productivity of Lake Powell, including: • algae (phytoplankton, periphyton) • Macrophytes • Zooplankton WATER IN 2.1 Monitor water quality, composition, temperature (a more comprehensive list of the INs that are addressed by the IWQP can be seen in Table 1 of the IWQP plan (Vernieu and Hueftle 1999)

Ongoing research associated with population genetics of HBC in Colorado River ecosystem	**HBC MO 6:** Establish a second spawning aggregation of HBC downstream of Glen Canyon Dam (RPM 4).	HBC IN 6.1 Develop criteria for defining self-sustaining populations of HBC. HBC IN 6.2 Assess feasibility of establishing a second population of HBC downstream of Glen Canyon Dam including other current aggregations.
Native fish/non-native competitive interactions **NEW IN SPRING 2000**	**N/NN FISH MO 10:** Minimize, to the extent possible, competitive and predatory interactions between native and non-native fishes.	N/NN FISH IN 10.1 Define areas and conditions of existing and potential interactions N/NN FISH IN 10.4 Determine the species composition, relative abundance, and size class structure of non-native fishes in the Colorado River ecosystem and important tributaries
Section 8 funded research associated with experimental flows which include temperature control device evaluation and assessment. **NEW IN SPRING 2000**	**FMS MO 9:** Attain riverine conditions, including appropriate habitat, that support all life stages of endangered and native fish species. **HBC MO 5:** Remove jeopardy for the HBC in the Colorado River ecosystem *(B.O. 1994)*.	FMS IN 9.2 Quantify to the extent possible the effects of spring high steady flows and summer and fall low steady flows on endangered and native fish (RPM 1.a). FMS IN 9.4 Assess biotic interactions between native and non-native fishes, particularly those that occur in nearshore rearing habitats affected by dam operations (RPM 1.C.iv). HBC IN 5.1 Determine a set of possible temperature changes in the mainstem Colorado River resulting from implementing selective withdrawal (RPM 1.B.i). HBC IN 5.2 Determine the anticipated effects on HBC and other native populations which may result from installing a selective withdrawal structure for thermal modification in the mainstem of the Colorado River downstream of Glen Canyon Dam. Determine the range of temperatures for successful larval fish development and recruitment and the relationship between larval/juvenile growth and temperature (RPM 1.B.ii).

New research associated with water quality in Lake Powell **NEW SPRING 2000 AS RFP(?)**	**LP WQ MO 1:** Prevent impacts that adversely affect the water quality (physical, chemical, biological) of Lake Powell due to dam operations and ensure that fully informed AMWG decisions are possible both now and in the future.	LP LIMNO-IN 1.1(e) Quantify/model the heat budget for Lake Powell to determine near-term and long-term (monthly/weekly and annual summaries respectively) effects of a selective withdrawal system
INTEGRATED TERRESTRIAL AND AQUATIC ECOSYSTEM ACTIVITIES		
Long-term monitoring of fine-grained sediment storage throughout the main channel **NEW RFP IN SPRING 2000**	**SED MO 1:** (sediment resources) Maintain a long-term balance of river-stored sand to support maintenance flow, BHBF flow and unscheduled flood flows…	SED IN 1.1 Define historical and current levels of river stored sediment. SED IN 1.2 Define minimum levels of river stored sediments necessary to maintain sandbars, backwaters and in-stream sediment deposits. SED IN 1.3 Develop procedures to monitor and predict impacts of alternative operating criteria (flow regimes) on river stored sediment, and impacts in select reaches SED IN 1.4 Measure and model sediment contributions from all contributing sources, including tributary and high terrace sources. SED IN 1.5 (sediment) Evaluate the geology/geomorphology within Glen Canyon to: (1) determine historical changes in size and extent of beaches, sandbars and backwaters, (2) quantify sediment (size class and quantity) input from side channels, (3) understand bed morphology dynamics, (4) evaluate high terrace erosion and contribution to river sediment.
	SED MO 2: : As a minimum for each reach, maintain the number and average size (area and thickness) of sandbars and backwaters between the stages associated with flows of 8,000 and 45,000 cfs that existed during the 1990/91 research flows.	SED IN 2.4 Evaluation of flow regime (under the approved operating criteria) impacts on terrace and cultural resources SED IN 2.6 Determine implications of dam operating criteria on beach and sandbar and backwater character and structure, including suitability of camping beaches.

		SED IN 2.7 Quantify the extent and location of existing sandbars, beaches and backwaters along the Colorado River corridor
	SED MO 4: Maintain system dynamics and disturbance by redistributing sand stored in the river channel and eddies to areas inundated by river flows up to 45,000 cfs in as many years as possible when BHBF hydrologic and resource criteria are met.	SED IN 4.1 Define character and structure of all beaches and backwaters in system after 1996 test flows
	REC MO 2: Maintain flows (under approved operating criteria) and sediment processes that create an adequate quantity, distribution and variety of beaches for camping, as long as such flows are consistent with management of natural recreation and cultural resource values (other natural resource values).	REC IN 2.2 Evaluate impacts of operating criteria on establishing and maintaining adequate beaches and distribution of other resources, quality, character and structure.
		REC IN 2.3 Develop methodology to evaluate distribution, quantity and quality changes in all campable beaches through time
	AFB MO 1: Maintain and enhance the aquatic food base in the Colorado River ecosystem to support desired populations of native and non-native fish. At a minimum, maintain continuously inundated areas for *Cladophora* and aquatic invertebrates at or above 5,000 cfs discharge levels from Glen Canyon Dam.	AFB IN 1.3 Determine the aquatic food base species composition, population structure, density, and distribution required to maintain desired populations of native and non-native fish in the Colorado River ecosystem.
	TROUT MO 2: In the Colorado River downstream of Glen Canyon Dam to the confluence of the Paria river, sufficient ecological conditions (such as habitat, food base and temperature) should be maintained, which in conjunction with management by Arizona Game and Fish will produce a healthy self-sustaining population of at least 100,000 Age II+ rainbow trout that achieve 18 inches in length by Age III with a mean annual relative weight (Wr) of at least 0.90.	TROUT IN 2.4 Determine the availability and quality of spawning substrates in the Glen Canyon reach, necessary to sustain the rainbow trout fishery.
	HBC MO 4: Maintain or enhance levels of recruitment of HBC in the mainstem as indexed by size frequency distributions and presence and strength of year-classes. (Focused at young-of-year and juvenile fish, and should include a fish health assessment.)	HBC IN 3/4.5 Determine the effects of mainstem hydrology on the number of nearshore rearing habitats, environmental conditions in these habitats, and their successful utilization by HBC. (RPM 1.C.iii)

		HBC IN 3/4.8 Determine effects on physical habitat used by young fishes, food base, and direct effect on larval, juvenile, and adult native and non-native fishes of 1996 BHBF. Develop methods to detect changes in numbers of HBC or their habitat from 1996 BHBF. (1996 BHBF HBC RPM 3)
	CULT MO 1: Conserve *in situ* all the downstream cultural resources and take into account Native American cultural resource concerns in the Colorado River ecosystem.	CULT IN 1.4 Preservation, stabilization and/or documentation of cultural resources as impacted by sediment resources associated with alternative operating criteria CULT IN 1.5 Preservation, stabilization of flood terraces holding cultural resources CULT IN 1.6 Evaluate flood terrace stability necessary to maintain cultural resources and terraces at pre-dam conditions
Long-term Streamflow and fine sediment transport in the main channel Colorado, Paria and Little Colorado Rivers **ONGOING WITH REVISION THROUGH SOLE SOURCE TO USGS (WRD AZ DISTRICT)**	**WATER MO 1:** ...Operate GCD in a manner fully consistent with the ROD and subject to the "Law of the River"... **WATER MO 2**: Maintain water quality at levels appropriate to support physical, biotic, and human resource needs of various ecosystems downstream of Glen Canyon Dam as mandated by the Grand Canyon Protection Act and incorporated into the Record of Decision. **SED MO 1:** Maintain a long-term balance of river-stored sand to support maintenance flow (in years of low reservoir storage), beach/habitat-building flow (in years of high reservoir storage), and unscheduled flood flows. Maintain system dynamics and disturbance by annually (in years which Lake Powell water storage is low) redistributing sand stored in the river channel and eddies to areas inundated by river flows between 20,000 cfs and maximum power plant capacity.	WATER IN 1.1 Annually collect and report GCD flow release information. WATER IN 2.1 Characterize sandbar/backwater baselines and character and structure in 1990/1991 WATER IN 2.2 Working with various resource agencies and specialists, select most appropriate flow levels/regimes under the approved operating criteria to determine baseline for comparisons for all resources. SED IN 1.2 Define minimal levels of river stored sediments necessary to maintain long term sandbar, backwater, instream sediment deposits SED IN 1.3 Develop procedures to monitor and predict impacts of alternative operating criteria (flow regimes) on river stored sediment, and impacts in select reaches SED IN 1.4 Measure and model sediment contributions from all contributing sources, including tributary and high terrace sources

		SED IN 1.5 Evaluate the geology/geomorphology within Glen Canyon to: (1) determine historical changes in size and extent of beaches, sandbars and backwaters, (2) quantify sediment (size class and quantity) input from side channels, (3) understand bed morphology dynamics, (4) evaluate high terrace erosion and contribution to river sediment.
	SED MO 4: Maintain system dynamics and disturbance by redistributing sand stored in the river channel and eddies to areas inundated by river flows up to 45,000 cfs in as many years as possible when BHBF hydrologic and resource criteria are met	SED IN 4.2 Develop methodologies to define future flow regimes under approved operating criteria to maximize benefit to sediment and backwater character and structure SED IN 4.3 Develop an assessment of dam operations under approved operating criteria impacts on range of variation in sediment and other resources within Colorado River ecosystem and the associated processes that created these ranges
	REC MO 4: Maintain flows (under approved operating criteria) and habitat suitable for quality cold water fishery opportunities in Glen Canyon.	REC IN 4.1 Determine flow regimes (under approved operating criteria) necessary to maintain fish populations of 100,000 adult Trout (age class II plus)
Long-term monitoring of coarse-sediment inputs, storage and impacts to physical habitats **NEW RFP IN SPRING 2000**	**REC MO 1:** Provide quality recreation experiences consistent with other resource objectives.	REC IN 1.1 Determine criteria and aspects that are important to or detrract from recreational experience.
	SED MO 1: Maintain a long-term balance of river-stored sand to support maintenance flow (in years of low reservoir storage), beach/habitat-building flow (in years of high reservoir storage), and unscheduled flood flows. Maintain system dynamics and disturbance by annually (in years which Lake Powell water storage is low) redistributing sand stored in the river channel and eddies to areas inundated by river flows between 20,000 cfs and maximum power plant capacity.	SED IN 1.4 Measure and model sediment contributions from all contributing sources, including tributary and high terrace sources
	AFB MO 1: Maintain and enhance the aquatic food base in the Colorado River ecosystem to support desired populations of native and non-native fish. At a minimum, maintain continuously inundated areas for *Cladophora* and aquatic invertebrates at or above 5,000 cfs discharge levels from Glen Canyon Dam.	AFB IN 1.3 Determine the aquatic food base species composition, population structure, density, and distribution required to maintain desired populations of native and non-native fish in the Colorado River ecosystem.

	TROUT MO 2: In the Colorado River downstream of Glen Canyon Dam to the confluence of the Paria river, sufficient ecological conditions (such as habitat, food base and temperature) should be maintained, which in conjunction with management by Arizona Game and Fish will produce a healthy self-sustaining population of at least 100,000 Age II+ rainbow trout that achieve 18 inches in length by Age III with a mean annual relative weight (Wr) of at least 0.90.	TROUT IN 2.4 Determine the availability and quality of spawning substrates in the Glen Canyon reach, necessary to sustain the rainbow trout fishery.
	FMS MO 8: Achieve healthy, self-sustaining populations of flannelmouth sucker, bluehead sucker, and speckled dace in the Colorado River ecosystem, with special emphasis on flannelmouth sucker in Glen Canyon based upon the capability of the habitat to support those fishes.	FMS IN 8.4 Determine historic and current ecosystem requirements (habitat, spacing, food source, interdependencies, etc.) of native fish species.
	TERR MO 11: Protect, restore, and enhance survival of native and special status species (federal, tribal, and state designations). Ensure that the required habitat for these species is preserved.	TERR IN 11.4 Identify and characterize riparian wildlife habitat types along the river corridor
	VEG MO 16: Maintain, enhance or restore vegetative communities made up of diverse groups of native riparian and upland species with special emphasis on preservation of unique plant communities and special status species at different stages of succession and at different elevations above the water line.	VEG IN 16.1 Determine distribution and abundance of native and non-native riparian and upland vegetation, including federal-, state- and tribal-listed sensitive species, old high water zone, new high water zone, and nearshore marshes
Modeling reach-averaged sandbar evolution in response to discharge and sediment conditions **NEW RFP FOR SPRING 2000**	**SED MO 1:** Maintain a long-term balance of river-stored sand to support maintenance flow (in years of low reservoir storage), beach/habitat-building flow (in years of high reservoir storage), and unscheduled flood flows. Maintain system dynamics and disturbance by annually (in years which Lake Powell water storage is low) redistributing sand stored in the river channel and eddies to areas inundated by river flows between 20,000 cfs and maximum power plant capacity.	SED IN 1.2 Define minimal levels of river stored sediments necessary to maintain long term sandbar, backwater, instream sediment deposits SED IN 1.3 Develop procedures to monitor and predict impacts of alternative operating criteria (flow regimes) on river stored sediment, and impacts in select reaches SED IN 1.5 Evaluate the geology/ geomorphology within Glen Canyon to: (1) determine historical changes in size and extent of beaches, sandbars and backwaters, (2) quantify sediment (size class and quantity) input from side channels, (3) understand bed morphology dynamics, (4) evaluate high terrace erosion and contribution to river sediment.

	SED MO 2: As a minimum for each reach, maintain the number and average size (area and thickness) of sandbars and backwaters between the stages associated with flows of 8,000 and 45,000 cfs that existed during the 1990/91 research flows. **SED MO 4:** Maintain system dynamics and disturbance by redistributing sand stored in the river channel and eddies to areas inundated by river flows up to 45,000 cfs in as many years as possible when BHBF hydrologic and resource criteria are met.	SED IN 2.4 Evaluation of flow regime (under the approved operating criteria) impacts on terrace and cultural resources SED IN 4.2 Develop methodologies to define future flow regimes under approved operating criteria to maximize benefit to sediment and backwater character and structure SED IN 4.3 Develop an assessment of dam operations under approved operating criteria impacts on range of variation in sediment and other resources within Colorado River ecosystem and the associated processes that created these ranges
Development of one-dimensional fine sediment routing model along the main channel **NEW RFP FOR SPRING 2000**	**SED MO 1:** Maintain a long-term balance of river-stored sand to support maintenance flow (in years of low reservoir storage), beach/ habitat-building flow (in years of high reservoir storage), and unscheduled flood flows. Maintain system dynamics and disturbance by annually (in years which Lake Powell water storage is low) redistributing sand stored in the river channel and eddies to areas inundated by river flows between 20,000 cfs and maximum power plant capacity.	SED IN 1.2 Define minimal levels of river stored sediments necessary to maintain long term sandbar, backwater, instream sediment deposits SED IN 1.3 Develop procedures to monitor and predict impacts of alternative operating criteria (flow regimes) on river stored sediment, and impacts in select reaches SED IN 1.5 Evaluate the geology/geomorphology within Glen Canyon to: (1) determine historical changes in size and extent of beaches, sandbars and backwaters, (2) quantify sediment (size class and quantity) input from side channels, (3) understand bed morphology dynamics, (4) evaluate high terrace erosion and contribution to river sediment

Advance conceptual modeling of coarse-grained sediments related to evolving physical habitats and aquatic processes **ONGOING WITH REVISION THROUGH ECOMENTRIC RESEARCH (KORMAN ET.AL.)**	**SED MO 1:** Maintain a long-term balance of river-stored sand to support maintenance flow (in years of low reservoir storage), beach/habitat-building flow (in years of high reservoir storage), and unscheduled flood flows. Maintain system dynamics and disturbance by annually (in years which Lake Powell water storage is low) redistributing sand stored in the river channel and eddies to areas inundated by river flows between 20,000 cfs and maximum power plant capacity. **SED MO 4:** Maintain system dynamics and disturbance by redistributing sand stored in the river channel and eddies to areas inundated by river flows up to 45,000 cfs in as many years as possible when BHBF hydrologic and resource criteria are met. **REC MO 2:** Maintain flows (under approved operating criteria) and sediment processes that create an adequate quantity, distribution and variety of beaches for camping, as long as such flows are consistent with management of natural recreation and cultural resource values (other natural resource values).	SED IN 1.4 Measure and model sediment contributions from all contributing sources, including tributary and high terrace sources. SED IN 1.5 Evaluate the geology/geomorphology within Glen Canyon to: (1) determine historical changes in size and extent of beaches, sandbars and backwaters, (2) quantify sediment (size class and quantity) input from side channels, (3) understand bed morphology dynamics, (4) evaluate high terrace erosion and contribution to river sediment. SED IN 4.3 Develop an assessment of dam operations under approved operating criteria impacts on range of variation in sediment and other resources within Colorado River ecosystem and the associated processes that created these ranges REC IN 2.1 Determine adequate beach quantity, quality, distribution, character and structure for camping throughout system. REC IN 2.2 Evaluate impacts of operating criteria on establishing and maintaining adequate beaches and distribution of other resources, quality, character and structure.
Evaluating ground-based and airborne remote sensing technologies	**GIS MO 1:** Creation of GIS base coverages in support of integrated monitoring efforts.	GIS IN 1.1 Develop a comprehensive GIS base map for topography, geology and soils for the Colorado River ecosystem
IT/GIS development	**GIS MO 1:** Creation of GIS base coverages in support of integrated monitoring efforts	GIS IN 1.1 Develop a comprehensive GIS base map for topography, geology and soils for the Colorado River ecosystem

Summary Budget for Scientific Activities

Table 2.2. Summary table of projected FY2001 budget for projects and by GCMRC program allocations.

TERRESTRIAL ECOSYSTEM ACTIVITIES										
Project title	Physical	Biological	Cultural	GIS[1] Support	Survey support	Remote sensing	Database mgmt	Estimated Logistics	GCMRC Personnel	Total (Program costs & Logistics)
Monitoring Avifauna **NEW RFP IN SUMMER 2000**	---	90,000	---	0	0	0	X	32,000	Ralston 5% Lambert 5%	$ 122,000
Monitoring terrestrial habitat and evaluating its quality for utilization **NEW RFP IN SUMMER 2000**	---	90,000	75,000	X	X	X	X	~10,000	Ralston 10% Lambert 10% Melis 3%	$ 175,000
Monitoring Kanab ambersnails and habitat at Vaseys Paradise **NEW RFP IN SUMMER 2000 OR MAINTAINED INTERNALLY**	---	10,000	---	0	X	X	X	30,000	Ralston 10% Kohl 20% Lambert 5%	$ 40,000
Ongoing trophic interactions research **ONGOING**	---	30,000	---	0	0	0	X	20,000	Ralston 5%	$ 50,000

Evaluation of Cultural Resource Monitoring and Mitigation Strategies **NEW RFP IN 2000**	---	---	65,000	X	X	0	X	40,000	Lambert 15% Melis 3% Ralston 5% Gonzales/ Kohl 10% Mietz 5%	$ 105,000
Development of historic contexts to evaluate the significance of cultural resource data **NEW RFP IN 2000**	---	---	25,000	0	X	0	X	26,000	Lambert 15% Melis 3% Ralston 5%	$ 51,000
AQUATIC ECOSYSTEM ACTIVITIES										
Ongoing monitoring phyto-benthic communiy and evaluating its quality for utilization **ONGOING WITH REVISIONS NAU (BLINN & SHANNON)**	---	230,000	---	O	O	O	X	~10,000	Ralston 5% Yard 10% Melis 3%	$ 240,000
Ongoing monitoring of status and trends of fish community **ONGOING WITH REVISIONS**	---	460,000	---	O	O	O	X	90,000	Ralston 5% Yard 20% Melis 3%	$ 550,000

Monitoring the status and trends of the Lees Ferry Trout Fishery **NEW RFP IN SPRING 2000**	---	120,000	---	0	0	0	X	10,000	Ralston 5% Yard 5% Melis 3%	$ 130,000
Integrated Water Quality Monitoring **ONGOING WITH REVISION AND COOPERATION BETWEEN GCMRC AND USGS (WRD AZ DISTRICT)**	---	95,000[2] 10,000[3]	---	0	0	0	X	20,000 8,000	Ralston 5% Hueftle 75% Vernieu 80%	$ 115,000[2] $ 18,000[3]
Ongoing research associated with population genetics of HBC in Colorado River ecosystem	---	50,000	---	0	0	0	X	---	Ralston 5%	$ 50,000
Native fish/non-native competitive interactions **NEW IN SPRING 2000**	---	TBD	---	0	0	0	X	TBD	Ralston 5% Yard 5%	TBD

Section 8 funded research associated with experimental flows which include temperature control device evaluation and assessment. **NEW IN SPRING 2000**	---	310,000	TBD	0	0	0	X	TBD	TBD	$ 310,000
New research associated with water quality in Lake Powell **NEW IN SPRING 2000 AS RFP (?)**	---	30,000[4] 20,000[5]	---	0	0	0	X	Logistics cost are included in the research costs	Hueftle 15%	$ 30,000[4] $ 20,000[5]
INTEGRATED TERRESTRIAL AND AQUATIC ECOSYSTEM ACTIVITIES										
Long-term monitoring of fine-grained sediment storage throughout the main channel **NEW RFP IN SPRING 2000**	225,000	30,000	85,000	0	X	X	X	60,000	Melis 15%, Ralston 3%, Lambert 3%, Gonzales 25%	$ 400,000

Long-term Streamflow and fine sediment transport in the main channel Colorado, Paria and Little Colorado Rivers **ONGOING WITH REVISION THROUGH SOLE SOURCE TO USGS (WRD AZ DISTRICT)**	400,000	70,000[6]	---	0	0	X	X	30,000	Melis 10%, Ralston 5%,	$ 500,000
Long-term monitoring of coarse-sediment inputs, storage and impacts to physical habitats **NEW RFP IN SPRING 2000**	75,000	---	---	0	X	X	X	18,000	Melis 10%, Ralston 5%, Lambert 5%, Gonzales 20%	$ 93,000
Modeling reach-averaged sandbar evolution in response to discharge and sediment conditions **NEW RFP IN SPRING 2000**	75,000	---	25,000	X	X	X	X	18,000	Melis 15%, Ralston 5%, Lambert 5%, Gonzales 20%	$ 118,000

investigator responsible for native fish monitoring in the mainstem since 1998. Work in this project has included mainstem data collection and tributary data collection. The emphasis has been on evaluating recruitment in the tributaries, primarily the Little Colorado River, and characterizing relative abundance of species in the mainstem. The intensity of sampling in the mainstem may not have equaled historic levels, but gear-types are comparable. Data from these monitoring trips indicate that rainbow trout is the most common fish, followed by speckled dace and humpback chub in the mainstem. The addition of mini-hoopnet to the sampling regime has resulted in the capture of an increased number of smaller humpback chub in the mainstem. This result suggests that either gear types are biased against this size fish, that recruitment and survivorship has increased in this size class, or that new habitats are being sampled that were previously not sampled. The latter is not a likely explanation for this data. Included in this contract was research associated with juvenile growth and temperature. Preliminary results indicate that young fish provided unlimited food that are in 12°C water do not grow over a 6 month time period and loose body mass over time. Fish in 18°C and 24°C tanks showed changes in growth rates after the first month with those fish in the warmest water growing the greatest. These data have direct application for TCD operations. A question that this study indicates needs to be addressed is if the small but now older fish are moved from the 12°C tanks to warmer tanks will they respond in a similar fashion to temperature increases.

Native Fish Syntheses - Additional synthesis and modeling work on native fish has been conducted by SWCA (data integration report), Duncan Patten (compilation of GCES Phase II aquatic biology studies) and Walters et al. (modeling abundance trends in native fish). Population estimates for Humpback chub in the LCR have been published by Douglas for 1991 - 93 and additional estimates for 1993 - 95 are in press. In addition, modeling work by Walters et al., in preparation, suggests that populations of humpback chub in the LCR are stable or possibly declining slightly over the period 1991 - 96. The work of SWCA highlights the importance of life history parameters on the survival of humpback chub and points to the potential of predator-prey interactions in addition to

temperature as a key factor effecting humpback chub abundance and distribution in the mainstem. The reviews of GCES phase II humpback chub monitoring and research activities by Brunkow (in Patten) will be useful in designing the long-term monitoring program for native fish.

Development of one-dimensional fine sediment routing model along the main channel **NEW RFP IN SPRING 2000**	100,000	---	---	0	X	X	X	18,000	Melis 10%	$ 118,000
Advance conceptual modeling of coarse-grained sediments related to evolving physical habitats and aquatic processes **ONGOING WITH REVISION THROUGH ECOMETRIC RESEARCH (KORMAN ET.AL.)**	75,000	---	---	X	0	X	X	---	Melis 15% Ralston 10% Yard 10%	$ 75,000
PEP ACTIVITIES										
IWQP PEP	---	30,000[7]	---	0	0	0	X	TBD	Huftle Vernieu Ralston	$ 30,000[7]
Aquatic Foodbase PEP	---	40,000	---	0	0	0	X	TBD	Ralston Yard	$ 40,000

Native Fish PEP	---	30,000[8]	---	0	0	0	X	TBD	Ralston Yard	$ 30,000
Evaluate Cultural Resources PEP	---	---	55,000	X	X	X	X	20,000	Lambert 10% Kohl 5% Mietz 5%	$ 75,000
ITP ACTIVITIES										
Evaluating ground-based and airborne remote sensing technologies	---	---	---	---	X	400,000	X	X	Liszewski	400,000
IT/GIS development	---	---	---	TBD	---	---	X	---	Mietz	TBD
PUBLIC OUTREACH ACTIVITIES										
Public Outreach Activities[9]	---	---	35,000	X	X	0	X	15,000	Lambert 10%	$ 50,000
TOTALS										
AMP FUNDS	950,000	1,280,000[10]	365,000	---	---	---	---	475,000	---	$3,070,000
OTHER FUNDS	---	610,000	---	---	---	---	---	----	---	$ 610,000
TOTAL PROGRAM FUNDS	950,000	1,890,000	365,000	---	---	---	---	475,000	---	$ 3,680,000

Footnotes:

[1] Entries in columns under GIS Support, Survey Support, Remote Sensing and Database management indicate whether or not a specific project requires technical support from GCMRC. Entries noted with an "X" indicate some level of support is needed. Entries noted with an "O" indicate that support is believed to not be needed.

[2] O&M funds are used to support these IWQP activities in Lake Powell.

[3] AMP funds are used tosupport these IWQP activities in the tailwaters of Glen Canyon Dam.

[4] The funds to support this research activity will come from O&M funds for activities in Lake Powell. In FY 2001, these funds may be used to support the PEP.

[5] The funds to support this research activity will come from AMP funds for activities in the mainstem. In FY 2001, these funds may be used to support the PEP.

[6] These funds are provided from the IWQP - AMP budget to support water quality work in the mainstem through a contract that was competitively awarded in FY 1998 to the USGS.

[7] O&M and/or AMP funds will be used to support this activity, as appropriate.

[8] Funds to support the native fish PEP may be supplemented from the 460,000 proposed for monitoring of status and trends of native fish, as needed.

[9] These activities are not included in Chapter 2 but are described as a cultural resource project in Chapter 3 (see Public Outreach, page 113) and contribute to the total expenditures for the Cultural Resources program.

[10] Sec. 8 and O&M funds are not included in this total. In addition, funds used to support the IWQP PEP are not included in this total since they will come from proposed research and or monitoring activities, as appropriate.

Figure 2.1 PEP SCHEDULE

PEP/DATE	2000 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	2001 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
SEDS[1]				RFP						LTM[2]														
Aquatic Foodbase										PEP			REPORT			RFP						LTM		
Lees Ferry Trout				PEP			RFP							LTM										
Native Fish								EVAL TRIP		PEP			REPORT			RFP						LTM		
Terrestrial Veg		PEP		REPORT		RFP							LTM											
Kanab Ambersnail		PEP		REPORT		RFP							LTM											
Avifauna		PEP		REPORT		RFP							LTM											
IWQP										PEP			REPORT			RFP/ In-House						LTM		
Cultural / PA		PEP			REPORT					EVALUATE PEP RECOMMENDATIONS														
Recreation - Fishing	CONDUCTED AS PART OF THE LEES FERRY TROUT PEP																							
Recreation - Camping Beaches	NOT SCHEDULED																							
Economics	NOT SCHEDULED																							
Remote Sensing[3]	ONGOING EVALUATIONS. PEP SCHEDULED FOR FY 2002																							

[1]Two PEP workshops were held for SEDS, the first on August 1998 and the second in August 1999. Draft reports were produced following each of these workshops. The final PEP report was received in October 1999. All reports of the SEDS PEP are available on the GCMRC website.

[2]Five-year contracts will be issued for LTM. In year 5, another PEP will be convened to see if any modifications are required to the existing long-term plan. RFPs will be issued in time to ensure continuity in the monitoring program.

[3]A PEP for remote sensing was held in May 1988 and the report of that panel was received in June 1999. That report was used to develop the strategy which will guide the evaluation of remote sensing technologies for FY2000 through FY2002. A second PEP will be convened in FY2002 to provide recommendation for the remote sensing protocols to be implemented by GCMRC. Activity in FY2000, 2001, and 2002 will consist primarily of field testing potential technologies and evaluating the value of the products resulting from the deployment of those technologies.