

FINAL

**A REPORT ON ACTIVITIES AND
ACCOMPLISHMENTS OF THE GCD AMP
SCIENCE PLANNING GROUP: 2005-2006**

**GCD AMP SCIENCE PLANNING GROUP
AND
L. D. GARRETT,
EXECUTIVE SECRETARY
SCIENCE ADVISORS**

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EXECUTIVE SUMMARY

THE GCD AMP SCIENCE PLANNING GROUP (SPG):

“A Report on Activities and Accomplishments of the GCD AMP Science Planning Group: 2005-2006”

Responding to an AMP Need: The Science Planning Group (SPG) was authorized by the AMP Secretary’s Designee and AMWG in 2005 at the request of GCMRC and TWG. A 12 month focused effort of AMP managers and scientists was approved to develop the AMP five year experimental plans and associated science programs plans. The Science Advisors group was appointed to direct and facilitate the process. The SPG, led by GCMRC and TWG members, was an experimental adaptive management task group developed specifically to assure involvement of all AMP programs and groups in the planning process.

Evaluation of Effectiveness: Although effectiveness evaluations of the SPG as a AMP task group will come from other parties, the SPG has documented their process and performance in “A Report on Activities and Accomplishments of the GCD AMP Science Planning Group: 2005-2006”. In brief, the SPG:

- Developed and followed a twelve month plan of specific objectives, proposed schedules, costs and outcomes.
- Utilized an open process of AMP parties’ involvement in multiple workshop meetings over 12 months to develop all plans.
- Produced and evaluated in twelve months and within budget;
 - Three five year experimental plan alternatives
 - A five year Strategic Science Plan (SSP)
 - A five year Monitoring and Research Plan (MRP)
 - A 2007 Annual Work Plan and Budget (AWP)

In conducting its activities, the SPG found the lack of full development in several aspects of the GCD AMP structure and processes created weaknesses in the science planning process. The SPG concluded that these weaknesses will likely affect other future management and science activities in a similar nature. These findings prompted a set of recommendations from the SPG to the TWG, AMWG, and Secretary’s Designee.

Recommendations of the SPG: The SPG felt its size, composition and task orientation contributed strongly to its performance. However, it also determined that its performance and the performance of future task groups could be improved if resolve could be gained in several critical aspects of the structure and processes of the AMP.

The SPG also identified 10 issues for continued effort by committees or task groups in FY 2007 and 2008. To this end the SPG recommends that the

TWG consider charging another task group in 2007 to provide resolve to one or more of five critical issues.

- Develop improved methods and/or procedures for managers to establish and articulate priorities for specific 3-5 year time intervals.
- Develop improved methods for managers and scientists that permit more effective tradeoff assessments.
- Develop more effective scientist/managers collaborative working procedures.
- Implement methods to monitor and improve the adaptive management process.
- Implement methods to define future conditions (dfcs) for the Colorado River Ecosystem resources of concern.

**A REPORT ON ACTIVITIES AND ACCOMPLISHMENTS
OF THE GCD AMP SCIENCE PLANNING GROUP: 2005-2006**

**By
Science Planning Group (SPG)¹
L. D. Garrett, Executive Secretary,
Science Advisors²**

INTRODUCTION

This report is not a formal requirement of the GCD AMP Science Planning Group (SPG). When formed by the Secretary's Designee, a set of science plans was specified as required outputs. However, documenting the accomplishments of the SPG, including its collaborative workshops for developing the plans, and its identification of unresolved AMP needs, are ample justification for the SPG to develop this report. It is presented with the hope that procedures used in this process may apply to other areas of the AMP, and that issues identified by the SPG for additional work will be addressed by the AMP leadership.

SPG FORMATION AND CHARGE

Impetus for Developing the SPG

In 2005, the GCD AMP Technical Work Group (TWG) and the Grand Canyon Monitoring and Research Center (GCMRC) approached the Secretary's Designee regarding concerns over completion of the Long Term Experimental Plan and other science planning documents. In response, the Secretary's Designee specified a one year procedure be developed to assure completion of GCMRC science plans by scientists and managers of the GCD AMP. Both GCMRC and TWG felt that a collaborative effort of managers and scientists was needed to develop an effective long term experimental program direction.

The Secretary's Designee formally requested support for the science planning process by correspondence to AMWG and at the AMWG 2005 summer meeting. The effort was approved, funded and assigned specific accomplishments for the period August 2005-September 2006 (Appendix A).

The Executive Secretary of the Science Advisors was requested to facilitate and direct the one year program of development, working with the Chief of GCMRC and TWG membership to fulfill the program requirements. A program prospectus was required of the Science Advisors Executive

¹ The SPG was comprised of twenty one active GCD AMP representatives. AMP representatives who attended one or more meetings are listed in Appendix B.

² Dr. L.D. Garrett, Executive Secretary of the GCD AMP Science Advisors, directed the SPG program activities for 2005/2006, and assisted in documenting the activities for the SPG.

Secretary, which characterizes the full program development process (Appendix A). Several key attributes were specified for the program as follows:

- The science program development process would be driven by managers goals and information needs.
- Scientists (GCMRC) and managers (TWG) would collaborate in the development process.
- GCMRC staff would be the primary writers of the science plans with the program development process driven by managers' information needs and strategic science questions.
- The collaborative process would involve one year of multiple workshops, potentially on a monthly schedule.
- The development process would terminate October 2006, with the completion of several outcomes, including strategic, operational and annual work plans, as well as associated budgets and a long term experimental plan.

As noted, although a final written report of the SPG was not required as an outcome, the SPG membership felt it was important to document the effort.

SPG Participants and Roles

Development of science plans for the AMP is primarily the responsibility of the GCMRC. However, SPG proposed in this effort that a collaborative process be developed among scientists and managers to structure the AMP science plans. The approach specified that the GCMRC, TWG and SAs develop a SPG, representing a broad cross section of membership of scientists and managers from various AMP technical groups and committees.

This proposal resulted in 15-21 individuals some with overlapping responsibilities, performing on the SPG as follows:

- TWG Chair
- GCMRC Chief
- GCMRC Cultural Resources Program Manager
- GCMRC Physical Resources Program Manager
- GCMRC Biology Resource Program Manager
- Budget Ad Hoc Group (BAHG) Chair
- Humpback Chub Comprehensive Plan (HBCCP) Ad Hoc Group Chair
- Core Monitoring Planning (CMP) Group Chair

- Cultural Resource Ad Hoc Group (CRAHG) Chair
- Long Term Experimental Plan (LTEP) Ad Hoc Group Chair
- Nine (9) other members of TWG
- Executive Secretary of Science Advisors, and Science Advisors

In addition, three members of AMWG participated in five or more of the SPG meetings. A majority of the SPG agreed that the group should be open to input from individuals other than SPG members, but that when voting occurred, only SPG members would be eligible.

The actual participants in the SPG process and their affiliation are provided in Appendix B. All of these persons attended 5 or more of the scheduled meetings for the SPG, including, as noted above, three AMWG members. In addition, members of the Science Advisors attended the initial meeting of the SPG, provided advice on alternate science direction and reviewed all planning documents.

In the formation of the SPG, explicit roles were developed for the three participating technical groups as follows.

1. SA Executive Secretary and SAs. The SA Executive Secretary was charged with the tasks of developing a prospectus for this project, and directing and facilitating the SPG to complete the GCDAMP Strategic Science Plan (SSP), CMP, Research Plan (RP), LTEP, and Biennial Work Plan (BEWP). The SAs were charged to provide advisory support to the process, primarily through document reviews. The SAs met with the SPG in the group's initial meeting.
2. The GCMRC, as the specified GCD AMP Research Center, has the primary role of taking all ongoing SPG input on science projects and experiments, and crafting them into workable science plans; utilize all SPG, SA and other multiple reviews to improve the science plans; evaluate alternative experimental options developed by the SPG and establish final science plans and experiments. Because of schedule lags, this also included development of a transitional FY 2007 Annual Work Plan and budget.
3. TWG and various subcommittees and working groups, i.e. LTEP Ad Hoc Group, CRAHG, CMP Ad Hoc Group, HBCCP Ad Hoc Group, etc. have a very critical role of articulating the managers' priority research information needs. This also includes collaborative efforts with the scientists to articulate science questions to be answered, and review of science programs, projects, and documents to assure research and monitoring outputs will respond to the managers' needs.

Secretary's Designee Charge and SPG Response to Charge

The original charge to the SPG specified development of several primary documents as follows:

1. Strategic Science Plan (SSP)
2. Core Monitoring Plan (CMP)
3. Biennial Work Plan and Budget (BWPB)
4. Long-Term Experimental Plan

The collaborative development process was to be directed by the SA Executive Secretary with leadership by GCMRC and a broad cross section of the TWG including subcommittee chairs. All plans were to be completed by October 1, 2006 with draft plans submitted to the full TWG for approval (Appendix A).

ESTABLISHING GOALS, OBJECTIVES AND INCORPORATING ONGOING AMP PLANNING

To accomplish SPG objectives, the members outlined explicit objectives for the 12 month program as follows (Appendix A):

1. The science and development planning documents were developed in two phases. Phase I occurred between May 2005-November 2005; sentence outline drafts of four plans (SSP, CMP, RP, BWPB) were to be produced but not completely specified. Phase II occurred between November 2005-September 2006, when the above four plans were to be completed, and become the scientific, technical and budget basis for the FY 2007 GCD AMP Programs and future programs.
2. Direction, coordination and facilitation of the program was assigned to the SA Executive Secretary. The SAs were to provide review and guidance procedures for incorporating integrated ecosystem approaches into research and monitoring programs.
3. A Science Planning Group (SPG) was to be formed with members from GCMRC, TWG, BAHG, LTEP, CMT, HBCPG, and SAs, and was to report progress to TWG and AMWG and at regular TWG and AMWG meetings
4. Incorporation of outputs from other operating GCD AMP Groups was specified, such as information from GCMRCs' knowledge assessment, HBCPC planning, BAHG programs, CMPG process, etc.

5. Regular workshops of GCMRC and the SPG were to occur from June 2005 - October 2006, with aggressive monthly development of science alternatives by GCMRC, and review and revision by the SPG in the workshops.
6. The planning and development process was to be merged with all other ongoing GCD AMP program and budget activities to assure they were supported and not impacted.

In developing these objectives and the Secretary Designee's charge, the SPG realized other diverse objectives had to be addressed at least in part for the project to be successful (Appendix C).

These objectives were outlined by the group and progress monitored quarterly to assure that accomplishments

occurred. Significant interactions were necessary with several TWG subgroups to obtain the level of planning outcomes desired by the SPG.

Protocols for Operation of the SPG

Although not specifically documented, and approved by the SPG, the following protocols were generally adhered to by the group. All disagreements were resolved through group interaction. In the 12 months of operation no major conflicts occurred among members of the Science Planning Group regarding its operating procedures and protocols.

- A prospectus on goals, project operation, time schedule, costs, expected outcomes, etc., was adopted and provided to all GCD AMP parties, before initiating the project.
- All interested TWG members and ad hoc committee chairs were invited to attend meetings. Three interested AMWG members also participated in the process. The GCMRC Chief and project managers participated in all 11 meetings, as did the SAs Executive Secretary, and several TWG members.
- All specific issues, proposals, reports, activities etc., were noticed in agendas for each meeting and the overall program direction noticed in the prospectus.
- Objectives sought by SPG were monitored by the group quarterly.
- Notes on actions taken were developed for meetings of the SPG.
- All SPG members were provided full opportunity for input and participation.
- All proposals, issues, agreements, and reports were presented, discussed and reviewed at multiple meetings before adoption.

OVERVIEW OF MEETINGS, AGENDAS AND OUTCOMES

Meetings were organized one to three months in advance. All meetings (11 total) except one, were held at the Bureau of Indian Affairs, APS Building Arizona Center, Phoenix, AZ, BIA Conference Room A, 12TH Floor.

Generally, dates for meetings were established more than one month in advance. Longer term agendas and monthly meeting agendas were maintained to facilitate accomplishment requirements outlined in the prospectus. Although some variance in planned accomplishments did exist, the original schedule of accomplishments outlined in the prospectus was generally maintained. Examples of SPG agendas and meeting actions are provided in Appendix D.

The following sections relate the general focus of accomplishments that occurred through four time periods, with approximately 3 months in each period, i.e.

- Period 1: July-October 2005
- Period 2: November 2005-February 2006
- Period 3: March 2006-June 2006
- Period 4: July 2006-September 2006

For each period we briefly describe the issues addressed by the SPG.

July 2005 – October 2005 SPG Activities

The SPG focused on three principal activities in this period.

- Defining goals and objectives
- Resolving protocols and procedures
- Completion of first draft outlines for the Strategic Science Plan (SSP), Core Monitoring Plan (CMP) and Research Plan (RP).

Goals and Objectives as presented above were defined for the one year operation of the Science Planning Group as follows:

Goal: Conduct an aggressive one year science planning effort involving TWG, AMP Ad Hoc groups, GCMRC and Science Advisors and complete the GCMRC SSP, CMP, RP, LTEP and Work Plan (BWP).

Objectives: The overarching objectives were to develop sentence outlines for all plans by December 1, 2005 and complete all final planning documents, including review and approval by TWG, by October 1, 2006.

As noted above, the formal prospectus with goals and objectives was completed by the Executive

Secretary of the Science Advisors, and approved for implementation by the TWG Chair, GCMRC Acting Chief, Secretary Designee and GCD AMP (Appendix A). After organizing, the Science Planning Group (SPG) developed an extended set of objectives and tracked them through the planning process to assure that specific issues were addressed.

Some of the objectives identified by the SPG and listed in Appendix C were only partially met in this planning effort. The SPG worked on these objectives only to the point necessary to complete the required science planning documents. Several of these objectives are discussed in the final section of this report as issues proposed to be addressed by the GCD AMP in FY 2007 or 2008. For example, objectives such as development of desired future resource conditions (dfcs), management procedures for clearly identifying program priorities, and criteria for specifying management actions, as well as others, should be resolved by the GCD AMP in the earliest possible time frame.

Protocols and Procedures, as noted above, were incorporated in part in the operating prospectus for the planning effort (Appendix A), and adhered to as closely as possible throughout the planning process. Critical in the protocols and procedures was the requirement to form and operate the Science Planning Group (SPG).

The SPG was proposed as a new collaborative approach for development of GCMRC science plans. The approach permitted managers to be intimately involved in formulating all aspects of science plans, from science strategies to specification of sampling protocols and procedures.

The above defined level of science collaboration is not normally invoked by science bureaus, choosing instead to accept guidance from managers on information needs and priorities, but developing science plans as an independent science activity. In the SPG process, the GCMRC scientists become an active member of a larger body of managers and scientists in developing its science plans.

Completion of GCMRC science plans is the primary outcome for this planning exercise. The SPG, and the SPG process was in and of itself an experimental collaborative process. It did complete its charge within its twelve month allocated time. In that regard, it was successful. Opportunities to improve upon several objectives are outlined in the final section of this report.

The science planning effort became more difficult than expected due to inability to define endpoints or solutions to several objectives such as specifying desired future resource conditions (dfcs). As noted above, many of these sub-objectives could not be completed adequately. This contributed to increased time requirements for some planning activities. It also contributed to more uncertainty in resolving several courses of action in the planning process. For example, issues and/or potential

objectives such as lack of explicit definition by managers for current priorities, desired program focus, desired level of data resolution, etc. caused the science planning process to also lack focus at times and struggle with priorities. As a result, in several areas the science approach became too broad because clear priorities from managers were lacking. Several of these problems are given more definition in the final section of this report.

In spite of the above difficulties, the SPG did complete outlines of the SSP, CMP, and RP in phase I. However, all of these outlines were revised in Phase II, and final plans were developed on the revised approaches.

November 2005 – February 2006 SPG Activities

This period involved significant starts and stops by the SPG in trying to move from outlines of the plans to completing actual draft write-ups of the documents. As noted above, several critical aspects of planning needs became obstacles to completion of plan specification. The following key activities occurred in this period

- Improvement in specification of program priorities
 - Overall program priorities
 - Research and monitoring priorities
- Specification of process to define future core monitoring projects/programs
- Initiation of activities to specify desired future resource conditions
- Characterizing critical science strategies
- Specifying science questions
- Drafting a strategic science plan
- Revised outlines for CMP/RP: MRP
- Specifying potential experimental options
- Specifying potential research design approaches

Specifying Program Priorities become critical early in the process due to the broad issues being addressed in the science program. The SPG felt a critical objective needed from managers was to establish science program priorities and attempted to revisit the original AMP goals and at least develop a priority listing of the AMP goals. Although research information needs had been sequenced earlier by TWG, monitoring projects were not sequenced. SPG developed an approach to address this objective.

An effort was committed to establish a “ranking” of goals and monitoring information needs, so that the overall list of program information needs could be potentially reduced to fit available budgets.

Although accomplishments were made it became apparent that more time would have to be committed to this objective at a later date. Selected results of this process are presented in Appendix E.

Specification of future core monitoring project priorities also proved to be a difficult process. As noted above, attempts were made to prioritize the monitoring information needs with limited success. In FY 2004 all listed monitoring information needs were categorized by color into three groups; green, yellow and red. Adopting developed criteria and outcomes of the Core Monitoring Group, the green monitoring projects would be proposed for evaluation and implementation first as provisional core monitoring projects. However, they would have to be subjected to a review process and revision before being accepted as a core monitoring projects. The review and revision process would be accomplished by a combination of managers and scientists.

A process and a set of criteria as specified for FY 2007-2011 to be used in evaluating all monitoring projects being considered for core monitoring status. The process and criteria provided in Appendix F is a revision of a process originally drafted by the Core Monitoring Group. The first projects to be evaluated using this process are scheduled for FY 2007. The SPG recommended additional workshops to refine this process.

Characterizing critical science strategies in a Strategic Science Plan was one of the first steps in developing planning documents. Initially, GCMRC felt the SSP and related strategies should be developed and approved by the Center. A draft was created by GCMRC and reviewed by the Science Advisors, who felt a more collaborative effort to developing strategies might assist the process. GCMRC decided to develop a second approach in concert with the SPG. The resulting SSP, which lays out several collaborative approaches for improving science in the GCD AMP, received positive reviews from the Science Advisors.

Characterizing critical science questions to guide GCD AMP science has been adopted by the SAs, GCMRC, SPG and TWG as a potentially improved method for driving the science planning and implementation process. For this planning effort, GCMRC commissioned a formal Knowledge Assessment to fully characterize areas of uncertainty (lack of complete knowledge). Where knowledge on an information need does not exist, science questions were structured to guide research in developing the needed information.

The Science Advisors were asked to review the assessment and reported a favorable review. However, the SAs felt the number of questions was too large and too specific. Using the developed questions and the KA, a smaller set of more focused critical questions was recommended. Members of

the SPG developed information sets and a table to document the linkage of the new science questions to the set of information needs previously used to guide research additional efforts will be needed to complete the table (Appendix G).

A developed word outline for the CMP/RP was continued at the start of this period. The most important change that occurred during the period was to depart development of a Core Monitoring Plan and a Research Plan as separate documents and merge the two efforts into one document, the Monitoring and Research Plan (MRP). This action was taken to improve the integration of monitoring and research activities and enhance the ecosystem science designs being developed for all GCMRC science. Initially this new approved outline for the MRP targeted a very detailed specification of individual projects.

Specifying potential experimental options is the effort by the SPG to design a Long Term Experimental Plan (LTEP) that would best follow the past ten years of evaluation of the Secretary's Modified Low Fluctuating Flows (MLFF). In 1996 the Secretary of Interior issued a Record of Decision (ROD) to implement and evaluate the MLFF flow regimes impacts on resources downstream of Glen Canyon Dam. The MLFF regime has been subjected to extensive research which culminated in a 2005 USGS conference.

The conference proceedings and related science have provided mixed support for the MLFF regime. Sufficient questions existed about its effectiveness, that the Secretary has requested evaluations of several alternative flow regimes. These include flow and non-flow elements, most specifically a Temperature Control Device (TCD)/Selective Withdrawal Structure (SWS) that could potentially be used to warm water in the CRE to improve HBC habitat.

Efforts to develop a LTEP have been ongoing since 2004 by the TWG. An AMP LTEP Committee determined in 2004 a hybrid design that included both management actions and experimental actions would best support the AMP. In this science planning process the SPG first developed, evaluated and reviewed four differing experimental options that include both flow and non-flow elements. The four options were fully specified by the SPG and the flow regimes evaluated by GCMRC as to probable impacts on resources. A potential significant range in impacts was indicated, but subject to uncertainties as related in the KA. GCMRC did not evaluate selected non-flow activities as mitigative strategies that could influence the outcomes of the evaluation, due to general lack of knowledge of their potential impacts.

Specifying an operable experimental research design is a significant science concern in the AMP. The CRE is a very difficult location to conduct experiments with statistical reliability. The associated variance in response variables is high, with limited options for reducing the variance. In this setting, longer term block designs with minimal variables evaluated often improve chances for statistical reliability. However, since flows through the system in any one time period are not fully controllable, questions exist as to the applicability of a specific design over a time frame of five years or longer. The SPG developed information sets on design alternatives and associated benefits and limitations. This information is presented in GCMRCs' final assessment report on four developed options.

March 2006 – June 2006 SPG Activities

The March – June 2006 period was utilized to develop refinements on all previously developed proposals, and began to finalize drafts of documents. Activities occurred in all of the following areas.

- Strategic Science Plan
- Experimental Design
- Monitoring and Research Plan
- Biannual work Plan
- Annual Work Plan
- Long Term Experimental Plan

The Strategic Science Plan was rewritten into a final new revised draft for SPG review in this period. The new revised SSP presents a strategy for engaging in a five year collaborative working relationship of TWG, GCMRC, the Science Advisors and other GCD AMP groups to address the following issues.

- Improved working partnership of GCMRC and TWG
- Developing funding capability to improve science program effectiveness, especially experimental tests, i.e., BHBF, TCD, etc.
- Developing funding approaches for critical issues outside of the GCD AMP that effect CRE resources
- Developing improved manager decision tools for establishing program priorities and tradeoff analysis
- Assisting managers to develop desired future conditions (dfcs) for CRE Resources
- Developing improved approaches for CRE interdisciplinary ecosystem science

In this period, the SPG approved the new SSP and forwarded it to the TWG for adoption.

The Monitoring and Research Plan had been developed through outline and first draft stages in the first two planning periods. The concept used was that the MRP would, in significant detail, outline specific science and collaborative science/manager programs and approaches over five years to implement the strategic elements of the SSP and other necessary science approaches. The MRP would respond specifically to manager's questions and science questions developed in the KA. The biennial work plan (AWP) would then be used annually to step the proposed programs/projects/approaches into a cost frame work (annual budget) annually.

During initial development on the Biennial Work Plan, approaches taken on the MRP were reevaluated and the SPG decided to revise its philosophy in structuring the MRP and AWP. It was decided to revise the MRP outline to document a more general specification of programs and projects over a five year period. The BWPB would then be used to provide more explicit specification of projects, objectives, designs, data collection and analysis etc. This change in approach required the SPG to specify a new outline for the MRP and BWPB and redraft the MRP. This change resulted in significant detail on program/project descriptions to be deleted from the MRP and transferred to the AWP for 2007.

The development of a BWPB for 2007/2008 was determined to not be appropriate until the TWG, AMWG and Secretary could be reached agreement on the LTEP. As such, for FY 2007, it was determined that a transition Annual Work Plan (AWP) and budget be developed. However, because of the effort put into out-year planning, it was decided that as appropriate, proposed FY 2007 activities would specify related out year (08-09) activities programming.

An Annual Work Plan was proposed for development in FY 2007 and a general outline drafted for the document. The science program was to be presented in three categories of programs/projects, research and development, monitoring and experiments.

The AWP projects and programs are specified in response to GCD AMP Goals and specifically in response to a combination of developed questions from AMWG and questions from the science community as specified in the knowledge assessment. Further, for each project, data are provided for over a dozen elements, clarifying methods, linkages to other projects, costs, etc.

The four **Long Term Experimental Options** developed in planning periods 1 and 2 were further refined in this period. It was assumed that the Secretary and the AMWG desired from SPG a single recommendation for the LTEP. As such, attempts were made to take the four proposed options and build consensus for one experimental option. Generally consensus could be reached on a few issues

such as implementation of BHBF's, TCD, ramping rate studies, selected HBC activities, etc. However, differences could not be resolved regarding flow regimes that favored higher fluctuating flows versus lower steady flows with equal monthly volumes.

The SPG attempted to use voting to resolve the differences, but from the original four options only the option that emulated the MLFF could clearly be excluded from the set. A more narrow vote defined differences in support for steady flow and fluctuating flow options.

The process of extensive evaluation of options revealed that one flow attribute, and one non-flow attribute, were significant sources of conflict in the group. The conflict over the flow attribute related to how best to mitigate yoy HBC impacts in the July-October period as they are forced into the mainstem by high LCR flows. Should it be accomplished with flow regimes, i.e. low steady flows or should it be accomplished with the TCD. The non-flow attribute of greatest conflict is augmentation of the HBC population with hatchery fish, i.e., stocking of pond reared HBC.

Toward the end of this planning period the Secretary provided guidance to the AMWG, TWG and SPG that it was not necessary to provide one recommendation. As a result, the SPG decided to provide detailed write-ups on the original four options and the three revised options.

Evaluations of the three revised options, (SPG A and B and C) were made. SPG A was structured around a fluctuating flow regime and variable monthly volumes (600K-900KAF) permitting more significant fluctuations (5-20 cfs) during peak summer (June-August) and winter (Dec.-Feb.) power demand, with steady flows in September and October. Other non-flow strategies are involved to mitigate resource impacts of high flows to HBC, sediment, etc, including; TCD, HBC translocation, HBC enhancement plans, non-native fish control etc. In general this option was a modification of option 3 from the initial planning period. It was characterized by its proponents as a "kitchen sink" approach in which many actions were undertaken at once in an effort to benefit target resources.

SPG B was structured around a steady flow regime (approximately 8-12 cfs, emphasizing equal monthly volumes (600KAF) to benefit HBC habitat, sediment retention and other resource values. Other non-flow strategies are included, such as BHBF, non-native fish control, TCD, etc, but in a restricted format. This option was generally referred to as option 4b from the first planning period.

SPG C was structured around a slightly suppressed fluctuating flow regime 5-18 cfs (as contrasted with A), with a steady flow component (8-12 cfs) in Sept. and Oct, and variable monthly volumes (600-900 KAF). Non-flow strategies include; TCD, non-native fish control, HBC

translocation, HBC enhancement plans, BHBF, etc. This option was a modification of what was originally characterized as option 2.

The original option 1 is similar to the MLFF approved in the ROD of 1996.

Potential resource impact assessments of the three revised flow options were completed. It revealed differences between A and C, but much greater differences between each of these and option B. Resource impact information developed on these three options were provided to the TWG.

The SPG attempted to finalize these three options during the planning period. No new options were developed. It was generally accepted that option 1 would not be proposed for continued testing.

July – October, 2006 SPG Activities

This final planning period of the SPG was dedicated to refining and finalizing all SPG member input to the FY 2007 AWP and budget, revised MRP and the SPG proposed experimental options.

Issues such as future program funding, appropriate specification and administration of management actions, program prioritization, tradeoff methods, desired future condition of resources, etc, resurfaced, but time did not permit providing any resolve to these issues. As noted above, was decided to identify these unresolved issues to TWG and propose TWG, AMWG or another SPG like group resolve the issues as soon as possible.

The FY 2007 AWP and Budget, as noted earlier, displaced the planned FY 2007/2008 BEWP due to a necessity for TWG to approve the FY 2007 AWP by July 2006. The first BEWP for GCD AMP was proposed to be moved to years FY 2008-2009. The FY 2008/2009 BEWP was determined by the SPG to not be a required output of its deliberations. Instead completion of the activity would be recommended to a FY 2007 successor to the SPG, the TWG or another GCD AMP group. The FY 2007 AWP and Budget would normally be developed by the Budget Ad Hoc Group (BAHG). However, the SPG included the membership of the BAHG. As such, the BAHG decided to have the SPG conduct development of the FY 2007 program and budget, as an expanded BAHG.

Several critical issues were addressed in the AWP, including:

1. Implementation of needed research and development, monitoring and experimental activities to support new science, technology and monitoring approaches.
2. Approve continuation of monitoring activities deemed critical until such time that GCMRC and TWG and/or another GCD AMP Group could complete the MRP process for specifying future core monitoring programs/projects.

3. Implementation of needed strategic processes and/or programs to address critical GCD AMP issues including; improved manager/scientist working relations, core monitoring programs, funding programs external to CRE, procedures for establishing program priorities and defining desired future resource conditions, developing new interdisciplinary science approaches, etc.
4. Resolving balanced funding needs for continuing programs, new starts, research staff and the adaptive management process.

The Science Advisors reviewed the AWP and recommended it for approval by the SPG based on proposed revisions. The SAs proposed restructuring the text to illustrate linkages among programs, better focus in science questions, and identification of priorities.

Final AWP projects for inclusion in the FY 2007 budget were developed, reviewed and approved by SPG. SPG identified a small set of projects for further review by TWG. The TWG review provided final AMWG recommendations on the SPG developed program and budget with minor revisions.

The AMWG review and approval process was developed in a September 6, 2006 conference call. Minor revisions were made to the SPG and TWG proposed programs.

The FY 2007-2011 MRP and, its various components and drafts were developed and reviewed by the SPG from June through August. Elements of the core monitoring proposed direction had been evaluated previous to June. The direction for the core monitoring effort was initiated by the Core Monitoring Plan Group(CMPG) in a Provisional Core Monitoring Plan (PCMP). Selected elements were redrafted into the Monitoring and Research Plan (MRP) by adding sections in research, development and experimentation.

The Science Advisors reviewed the revised MRP and recommended it for adoption by the SPG based on proposed revisions. In an earlier review of the first draft MRP the SAs had proposed significant revision which had been accomplished. Proposed revisions in the second draft related to; developing better linkage of MRP programs, improved linkage of SSP, MRP and AWP with science questions, greater specification of processes for program implementation, improved prioritization methods.

The final structure of the MRP follows closely the format of the SSP and AWP, in that the programs respond to manager goals and strategic questions. The structure of the MRP responds to the key science strategies drafted in the SSP, priority manager goals and questions and key strategic science questions from the KA.

The MRP calls for new processes and/or programs over the five year plan to address;

- New modeling efforts for water quality and sediment resources, including TCD implementation
- Extensive research efforts in food base, HBC habitat assessments, and HBC population, predation and competition evaluations
- Cultural resource benchmark studies on site characteristics
- Building bridges between scientists and managers
- Core monitoring programs
- Managers approaches to setting priorities and establishing tradeoffs
- New ecosystem science approaches
- Funding needed for programs outside the AMP

The MRP was recommended for TWG approval, based on reviews and proposed revisions in the July SPG meeting. The GCMRC and SPG revised MRP was provided to TWG in October to be considered for approval in the November.

The Long Term Experimental Plan Options were revised into their final form during this planning period. Additional issues of funding and resource impact assessments were also evaluated.

The Office of the Secretary requested evaluations of all proposed options be expanded to include both flow and non-flow components, specifically the implications of a selective withdrawal structure (SWS/TCD). Also, because of high costs of the SWS/TCD, a longer planning period was proposed, i.e. 10-20 years.

To conduct these additional assessments and eliminate redundancy in options evaluated to date, i.e. options 1, 2, 3, 4, and SPG A, B, C, it was decided to merge all the previous options to a reduced set. A baseline which would represent current ROD flows was chosen and three experimental alternatives, SPG A, B, and C. The only option to have significant revision in this process was option A, which removed the September/October steady flows. The SPG accepts the final option distributed by e-mail.

In the final month of the SPG tenure (September) it assigned a task team to complete its final task, two assessments of the three options. One assessment conducted by WAPA was to determine hydropower economic resource impacts of the four options. A second conducted by GCMRC was to determine Biophysical, Socio-Cultural resource impacts of the four options. The SAs were to provide final reviews of the assessments.

During the assessments two additional options were proposed. Because the SPG was to be terminated October 1, 2006 the TWG evaluated the two proposals and voted to include only one into the

final assessments. Because it was an optimum power option and similar to option A it was identified as A variant (Av).

A brief description of the four final options, including in the baseline, is provided in Table 1. Generally, the baseline represents ROD flows (MLFF); A variant, optimum power flows; SPG A, high power flow fluctuations; SPG B, steady flows; SPG C slightly reduced fluctuating flows. All options include operation of the SWS/TCD as a non-flow alternative.

All final required plans, assessments, reviews, reports, etc. of the SPG process were provided to be Technical Work group for review and approval between June and October 2006. These included the following.

1. Strategic Science Plan (SSP)
2. Monitoring and Research Plan (MRP)
3. FY 2007 annual Work Plan and Budget
4. Documentation on four recommended experimental options
5. Hydropower Economic Impact Assessment Report of Experimental Options and SA review Report
6. Biophysical and Socio-Cultural Resource Impact Assessment of Four Experimental Options and SA review Report

Table 1. Summary of flow and nonflow components of the four experimental options under consideration by the Glen Canyon Dam Adaptive Management Program. BASE operations (modified low fluctuating flow regime) are provided for comparison. Each option is described as it would be implemented under an annual release of 8.23 million acre-feet.

	Flow/Nonflow Treatment	BASE operations	Option A	Option A Variation	Option B	Option C
Flow	Increased daily flow fluctuations	No	Yes (increased by 50% to 66% in winter months and by 25% in summer months)	Yes (increased by 25% to 66% in all months except April and May)	No	Yes (increased by 50% to 66% in winter months)
Flow	Stable flows	No	No	No	Yes, (tests of 4, 8, and 12 months)	Yes, (September through October)
Flow	Beach/habitat-building flows	Possible, but only under hydrologic triggers	Yes, as tests under sediment input triggering	Yes, as tests under sediment input triggering	Yes, as tests under sediment input triggering	Yes, as tests under sediment input triggering
Flow	Alternative ramping rates	No	Yes (hourly down ramping rate increased 100% in all months)	Yes (hourly down ramping rate increased 100% in Apr–Oct and 167% in Nov–Mar)	No	Yes (hourly down ramping rate increased by 100% in Nov–Jul only)
Nonflow	Temperature control device	No	Yes	Yes	Yes	Yes, 2 units assumed
Nonflow	Control of nonnative coldwater fish	No	Yes, as needed	Yes, as needed	Yes, as needed	Yes
Nonflow	Control of nonnative warmwater Fish	No	Yes, as needed, with R&D starting in 2007	Yes, as needed, with R&D starting in 2007	Yes, as needed, with R&D starting in 2007	Yes, with R&D starting 2007
Nonflow	Humpback chub disease/parasite research	No	Yes	Yes	Yes	Yes, with R&D starting 2008
Nonflow	HBC translocation	No	Yes	Yes	No	¹ Yes
Nonflow	Humpback chub refuge(s)	No	Yes	Yes	Possibly	¹ Yes
Nonflow	HBC population augmentation planning	No	Yes, Planning efforts toward implementation, as needed	Yes, Planning efforts toward implementation, as needed	No	¹ Yes, planning phase
Flow and Nonflow	² Mini experiments	No	Yes	Yes	Yes	¹ Yes
Experimental Design		Not applicable	Reverse Titration	Reverse Titration	Factorial	Forward Titration

NOTE: 1) For Option C: Ancillary projects not considered part of the main experiment; implementation decision includes consideration of confounding the main experiment. 2) Mini experiments are short-term field experiments that do not confound main experimental treatment

OBSERVATIONS ON EFFECTIVENESS OF SPG AND RECOMMENDATIONS FOR IMPROVEMENT OF THE AMP PROCESS

Although established by the Secretary's Designee, and commissioned by the AMWG, the Science Planning Group submitted their recommendations to the TWG for approval and development of recommendations to AMWG. The SPG adopted this protocol at the request of the AMWG to send SPG recommendations to the TWG. The TWG and GCMRC are charged generally to provide technical and science program recommendations to the AMWG after concurrence.

The activities charged for completion by the TWG and GCMRC were extensive science planning documents. Because the intensity and detail required in the planning activity was concluded to be inefficient for assignment to the entire TWG body, GCMRC and TWG established the Science Planning Group to conduct the planning.

Effectiveness of SPG

This experimental collaborative task group agreed to and implemented the following procedures for the project, which is felt to contribute to the project success.

1. Agreement to a plan of action, and allegiance to the plan.
2. Completion of assigned tasks/objectives within agreed upon schedules and budget.
3. Ability for extensive interactive participation of stakeholders, scientists and managers in development of plans.
4. Inclusion of stakeholder proposals and recommendations for change.

Development of the project from an agreed upon plan was required by the Secretary's Designee. Methods, schedules, costs and outcomes were specified in the project plan and adhered to throughout the planning period.

Accomplishment of Objectives did occur, in that plans were completed, including four options for the Long Term Experimental Plan. Further, multiple assessment of these options and science plan drafts also was completed, including independent reviews during the development process.

Compliance to schedule and budget constraints did occur. The SPG completed the assigned tasks on schedule. All proposed outputs were provided to TWG by October 2006. Further, additional tasks were performed by the SPG in the scheduled period.

Extensive involvement and participation of diverse stakeholders in the process was one of the key elements of this experimental approach for developing the plans. Strong feelings existed in both scientists and managers that a more collaborative approach would produce a more robust planning

effort. As noted above, the fact that the task group of 15-21 had extensive workshops over 12 months attests to the stakeholder level of involvement and participation.

The SPG with its lead contributor GCMRC, feels it produced a successful science planning effort, especially when measured against the above criteria. Its success can also be measured by the objectives pursued beyond the scope of the original tasks assigned. In many of these objectives, the SPG revealed aspects of the AMP process that could and should be improved to advance the GCD AMP.

Recommendations for Improvement

Throughout the process of planning, the SPG felt constrained by not having more complete/robust information from managers. It was not so much that information requested of managers did not exist, although this was an issue in selected cases. Most often the information needed was incomplete, not specified adequately, not prioritize, or lacked the focus necessary to assist science planning. Issues also existed regarding the effectiveness of science processes.

Based upon its twelve months of activity, and dependence on information from various sources, the SPG proposes several recommendations as follows.

- **The AMP, under AMWG direction, and utilizing the leadership of the TWG and GCMRC, should consider initiating a second task work group in FY 2007, with possibly similar structure and format to that used in the SPG process.** The group should be chartered, as the SPG, for only one year. It should be assigned the task of developing approaches and/or resolves to several critical issues that currently impact the AMP organization.

Following are a listing of 10 issues that were determined by the SPG to affect their ability to conduct effective science planning. Some of these issues have surfaced as areas of concern in other AMP programs by other groups.

1. **Develop improved methods and/or procedures for managers to establish and articulate priorities for specific 3-5 year time intervals.** With constrained budgets, a need exists to define a process or processes to focus at least part of AMP's resources on specific high priority programs that offer resolve to critical resource issues in 3-5 year planning periods.
2. **Develop improved methods for managers and scientists that permit more effective tradeoff assessments.** To establish program priorities and select among programs competing for the same funding, AMP managers and scientists need efficient methods to conduct tradeoff analysis among programs. Procedures do exist that are objective, low cost, time efficient and repeatable.

GCMRC has identified this need in their five year SSP as a collaborative program of GCMRC and TWG.

3. **Develop more effective scientist/manager collaborative working procedures.** Managers and scientists of AMWG, TWG, GCMRC and the SAs have always interacted in meeting environments, workshops and on specific science projects. A higher level of interaction is needed in the next five years on collaborative work tasks. Many issues facing the AMP would benefit greatly from this effort, including resolving desired future conditions for resources, a core monitoring program, defining approved management actions, etc. Both GCMRC and AMWG have recognized this issue in their strategic plans. The GCMRC SSP proposes a process for FY 2007 that will build bridges between scientists and managers for improved interaction.
4. **Implementing methods to monitor and improve the adaptive management process.** The GCD AMP continues to be a progressive experiment in adaptive management. It has successes in science development, application of improved resource management practices, and improved adaptive management processes, among others. However, opportunities for additional improvements in adaptive management processes still exist in several areas of the AMP including; communication, improving program focus, setting priorities, scientist/manager working relations, evaluating program tradeoffs, implementing ecosystem science etc. Both GCMRC and AMWG have proposed programs for improving the adaptive management process, including a FY 2007 program in the GCMRC's SSP.
5. **Defining manager's desired future conditions (dfcs)** for resources of the Colorado River Ecosystem has been identified in several AMP plans over the past decade, including both AMWG and GCMRC's strategic plans. Lack of defined dfcs creates difficulties in both science and management planning and implementation. In 2006 the Grand Canyon National Park had to proceed with these definitions without explicit guidance from the AMP. To resolve this issue, a process should be developed and implemented in FY 2007 to develop dfcs. This process should be integrated into the revision of the GCD AMP Strategic Plan.
6. **Resolving a process for defining core monitoring projects and appropriate monitoring and research balance in the AMP science program.** With complete knowledge of resource interactions, the AMP could focus its science efforts on monitoring for resource change or event monitoring. However, much is still uncertain, requiring a strong research effort. Processes are needed to resolve over this 5 year planning cycle, the capabilities of the AMP to move to specific

levels of monitoring and its implications to overall program funding. Procedures are needed to define and implement final criteria for selecting core monitoring projects, and the flexibility of these programs for change.

7. **Implementing explicit interdisciplinary ecosystem science attributes.** GCMRC has defined several key attributes of interdisciplinary science that are proposed for implementation. Actual implementation and integration of the attributes is often a difficult process, requiring more complex research designs, data collection methods, analysis procedures and modeling. Developing these approaches with manager involvement so as not to invalidate the adaptive management process requires effective documentation of the processes.
8. **Developing effective funding process to accommodate increasing science and management program needs.** The current scope of management information needs specified for the AMP far exceeds current and anticipated funding levels. Even with more aggressive priority setting procedures, needs will likely overwhelm existing funding. And, the problem will be even greater as more management applications are developed. It is unclear, however, without a system of prioritization which of the science questions and information needs should be addressed overtime. Managers have repeatedly stressed the need to prioritize projects and budgets, but thus far a system for doing so has not been fully developed.
9. **Developing science and management approaches to understand and mitigate external impactors to CRE resources** is an ongoing issue addressed in both AMWG and GCMRC strategic plans. Managers and scientists have tried to understand and mitigate this issue by such actions as funding and participating in management and science projects occurring in areas, especially watersheds, adjacent to the CRE. However, a more comprehensive assessment is needed of potential CRE resource risks to negative impacts from external sources. A risk assessment with mitigative strategies would be one possible approach.
10. **Defining criteria and processes for determining the transition of the GCD AMP from science efforts to management actions.** Criteria and procedures for determining management actions are needed, as well as definition of changes in the funding and administrative oversight. The TWG and AMWG have agreed to a definition of a management action for use in developing the Long Term Experimental Plan. The definition is restrictive and requires that an action be known to have desired effects and implemented throughout the course of the plan. This is in contrast to treatments which would be turned on and off during course of implementation. The

GCD AMP needs to develop a broader definition of management actions, complete with criteria and a process for applying those criteria so that deliberations can occur as to whether doing so would require any change in funding or administrative oversight.

APPENDIX A
A PROSPECTUS FOR GCD AMP SCIENCE
ADVISOR PROGRAM SUPPORT TO GCMRC
AND THE GCD AMP FOR COMPLETION
OF SCIENCE AND DEVELOPMENT PLANS



United States Department of the Interior

BUREAU OF RECLAMATION
PO Box 25007
Denver, Colorado 80225-0007



IN REPLY REFER TO:

D-2000
PRJ-5.10

July 11, 2005

VIA ELECTRONIC MAIL

To: All on the Attached Mailing List

Subject: Transmittal of "A Prospectus from Glen Canyon Dam Adaptive Management Program (GCDAMP) Science Advisor Program to the Grand Canyon Monitoring and Research Center and GCDAMP for Completion of Science and Development Plan for Fiscal Years 2005-2007"

Enclosed is a prospectus for the Science Advisors to assist the Technical Work Group, the Grand Canyon Monitoring and Research Center, the Budget Ad Hoc Group, as well as other groups in preparing the following science planning documents:

- Strategic Science Plan
- Core Monitoring Plan
- Long Term Experimental Plan
- Humpback Chub Comprehensive Plan
- Research Plan
- Annual Work Plan and Budget

Dr. David Garrett, executive director for the Science Advisors, will provide facilitation and coordination between the various groups involved in preparing the documents. More details on how the work will be accomplished along with schedules for completed products can be found in the prospectus. In addition, Dr. Garrett will provide an update on the process at the upcoming Adaptive Management Work Group meeting scheduled for August 30-31, 2005.

Sincerely,

Michael R. Gabaldon
Secretary's Designee
Adaptive Management Work Group

Enclosure

SUPPORT TO GCMRC AND GCD AMP FOR COMPLETION OF SCIENCE AND DEVELOPMENT PLANS FY 2005-FY2007

Introduction

The Grand Canyon Monitoring and Research Center (GCMRC) has launched an aggressive science planning effort with the Technical Work Group (TWG) and other Glen Canyon Dam Adaptive Management Program (GCDAMP) ad hoc groups. The effort is to formulate initial versions of several science planning and development documents during the period May to November, 2005. These initial planning documents are developed with the intent to use the FY 2006 annual program cycle (10/05-7/06) to revise the plans for use in the FY 2007/2008 program period. Interim planning documents will be used for the FY 2006 program period.

To assist in this effort, GCMRC, in collaboration with TWG and GCDAMP ad hoc groups, proposes that the Executive Director (Dr. David Garrett) for the GCDAMP Science Advisors (SAs) will provide facilitation and coordination for this effort, and also engage the SAs in an advisory capacity. The GCDAMP Science Advisors Program has authorities approved by the Adaptive Management Work Group (AMWG) to provide ongoing advisory support to the differing entities of the GCDAMP.

Dr. Garrett and the SAs propose that procedures drafted in this prospectus be followed to accomplish the requested support.

Proposed Science Advisor Procedures for Support to GCMRC in Developing GCDAMP Science Planning Documents

The period of commitment for Phase I of this effort is proposed to extend from May 2005 to November 2005. Phase II will extend from November 2005 to July 2006. The length of the total development period is 15 months; May 2005-July 2006. Two major accomplishments are proposed for the period as follows:

1. In Phase I, May-November, 2005, initial versions of at least four integrated planning documents will be drafted; a Strategic Science Plan, Core Monitoring Plan, Research Plan and the FY 2007/2008 Annual Work Plan and Budget. The Research Plan will contain a Long Term Experimental Plan, elements from the Humpback Chub Comprehensive Plan (HBCCP) and other related research activities. Although these plans will contain agreed upon integration, programs, projects etc., for the overall science strategy and research and monitoring programs, all individual program elements, projects etc., will not be completely specified in Phase I.
2. In Phase II, November 2005 to July 2006, the integrated plans will be fully specified, revised, and finalized to implement a two-year program cycle in FY 2007/2008, as well as out year programs. The FY 2007-2008 period has been proposed as the first iteration of a two year program and budget for the GCDAMP. This action was agreed to by AMWG in 2004. Ideally, this budget and work plan process would be outlined, at least conceptually, during the summer of FY 2005. If the GCDAMP is comfortable with progress related to the Phase I elements of the planning documents, details for the individual elements of the plans would then ensue during

winter, spring and summer 2006, culminating with formal adoption of a two-year program and budget, FY 2007/2008, prior to the end of fiscal year 2006.

Several procedural issues have been identified regarding this planning effort and are addressed in the following sections. Other procedural issues relating to this effort will be addressed as this prospectus is developed into a working plan by the SAs and GCDAMP parties.

AMWG Briefing on the First Iteration of Two Year Program/Budget Cycle

A primary need in this planning direction will be information to design all plans toward a two year program and budget cycle. The involved GCDAMP parties will develop a “Prospectus for a Two Year GCDAMP Program/Budget Cycle” and present it at the FY 2005 summer AMWG meeting to fully inform AMWG of the two year program and budget strategy. The Budget Ad Hoc Group (BAHG), in collaboration with TWG and GCMRC, is best prepared to develop the prospectus for the FY 2007/2008 program/budget cycle. All science and development plans should reflect this AMWG proposed direction.

Maintaining the Independence of Science

Adaptive management programs by their very nature force scientists and managers to work very closely together on many applied science efforts, including the development of science and technical planning approaches. In these efforts, the responsibility falls upon the science community to preserve the basic tenant of the scientific method, i.e., objective, unbiased science pursuits. In this effort, GCMRC must respond to managers needs with proposed objective science alternatives, with managers having the responsibility to weigh social issues of priorities and costs.

The SAs have to date contributed reviews of GCMRC science documents after their development. In the effort proposed in this prospectus, the SAs will advise on alternative science approaches during the actual development of the plans. To ensure their objectivity and independence are not compromised by participating in document development after completion of the plans, the SAs will commission a separate group of scientists to review the documents for appropriate science methods. The SAs have employed external independent reviewers on three previous reviews. Dr. Garrett and the SAs will develop explicit procedures to maintain independence in providing facilitation and science advisory services to the GCDAMP.

Implementation of a Collaborative Process

At least two quite different interactive approaches could be used to develop the required plans by the GCDAMP.

1. Using existing stakeholder concerns, GCMRC could develop the plans independent of close interaction with AMWG/TWG/SAs. GCMRC could then obtain AMWG, SAs and TWG reviews and revise the plans so as to best meet the needs of managers, while maintaining scientific rigor.
2. GCMRC could involve AMWG/TWG/SAs and ad hoc groups in a sustained interactive collaborative process, with stakeholders providing input on management information needs and GCMRC and the SAs providing technical input on the most effective and innovative science

methods and experimental approaches. Through this ongoing process, the plans might become a set of documents that the entire GCDAMP would support.

On the basis of eight years of experience working within the stakeholder process, the GCMRC, GCDAMP ad hoc members, and the TWG propose that a hybrid of the first and second approaches be utilized. In the hybrid approach, the first step in planning allows GCMRC to confer with the greater scientific community to evaluate its current level of knowledge on stakeholder issues. The second step is intended to create greater involvement of stakeholders in the science planning process to identify approaches to resolving information voids. GCMRC initiated this type of process for the CMP, but the process has occurred over such a protracted time period that it is not fully recognized to have occurred efficiently. To be effective, the hybrid approach must be conducted efficiently over a relatively compressed timeframe. The SAs would be involved to provide facilitation, coordination, and advice on integrated ecosystem science approaches, as well as other input. The need to involve cooperating scientists early in the hybrid approach comes with the knowledge that their expertise is invaluable in seeking new science approaches.

Using this approach involves clear tradeoffs that must be recognized and managed from the outset. If they are not managed, the process will fail due to the short development period in the first phase, i.e., six months, May-November, 2005. The general tradeoffs and their potential resolution follow:

1. Managers must contribute information on goals, objectives, information needs and questions to be resolved by science. A tradeoff is that they are to avoid explicit specification of science design and procedures. However, managers will have to make recommendations on allocation of budgets when designs and procedures are incorporated into work plans.
2. GCMRC staff and cooperating scientists must provide timely and unbiased information on alternative science designs/methods to respond to stakeholders (managers) information needs and questions. As a tradeoff, they are to avoid qualitative value judgments (opinions) on any requested need of managers. One vital key to keeping scientist and manager interactions productive and efficient rests with the role of effective meeting facilitation support.
3. Dr. Garrett is requested to provide specific support in facilitation and coordination of the development effort, and the Science Advisors are to provide specific input on differing science designs and procedures, especially as relates to science and management program integration, implementation of ecosystem science design, assessment of science alternatives, etc. As a tradeoff, they are to avoid leading the GCDAMP process in selection of specific designs/methods.
4. All participating entities must adopt the protocols of collaboration, which excludes aggressive personal confrontation with other parties. Participants who began to depart from “the grounds rules” of collaboration will be reminded of appropriate process. If necessary, participants having difficulty with the process should recuse themselves.
5. All participating GCDAMP groups must agree to specific schedules of meetings and planned accomplishments between May and November 2005, to permit development of the initial set of plans. In the first two meetings for each plan, the meeting schedule and a general set of

accomplishments will be established. Time allocation will be discussed regarding differing management needs and science approaches. However, opportunity for repeated “do loops” of differing approaches will be limited. This is a critical tradeoff associated with the constrained time schedule. Opportunities to revisit these assessments will exist in FY 2006.

6. The level of completeness sought for each initial plan in Phase I will be decided in advance on the basis of what will be needed for the two-year plan and budget process in the winter of 2006. It is anticipated that a required complete set of components, projects, programs, etc., be formulated for each plan. However, complete specification of all elements, projects etc., will not be possible within Phase I efforts, and is proposed to continue through FY 2006. This tradeoff exists to accomplish an overall set of integrated plans with all critical components in Phase I. A formal process will be structured and included in each plan for completion, review and revision of each plan in FY 2006.
7. One planning group, comprised of the AMWG/TWG/GCMRC/SA bodies should be formed to develop the initial plan documents. Because this is a comprehensive effort, it is proposed that can a cross-section of members from the existing planning ad-hoc groups, (CMT, HBCCPG, LTEP) form this group, and it be named the “GCDAMP Science Planning Group.” Its membership should include the following:
 - GCMRC and select cooperating scientists
 - TWG
 - BAHG
 - SAs
 - HBCCP GROUP
 - LTEP GROUP
 - Additional science, technical, or management experts as need dictates.

Generally most of the required group is already in place as active members of the Core Monitoring Team, who also are members of the other ad hoc groups. To accelerate and jumpstart the science and technical output of the planning process to the Science Planning Group, SAs should convene a strategic science planning meeting with GCMRC staff and key cooperating scientists early in the process.

A tradeoff for Phase I is that due to its size, it is impossible to have the entire TWG body conduct this planning effort. However, the TWG will review interim products in May, June, and July 2005, and review draft plans in October, November, 2005. The TWG will be directly involved in the FY 2006 activities for final development and revision of all plans.

General Science/Technical Procedure and Schedule

The explicit procedures for drafting the components for each science and management planning document must be left to the collaborative interaction of AMWG/TWG/GCMRC/SA specialists of the proposed GCDAMP Science Planning Group. However, general procedures, such as those noted above, and timelines can be proposed in this prospectus and refined by the Science Planning Group.

Table 1 presents general draft task specification and schedules for the overall planning effort. The Strategic Science Plan is in draft form and will be revised in this process. A CMP Process has been

drafted for use in developing the new CMP. Proposed efforts to merge elements of the Long Term Experimental Plan (LTEP), Humpback Chub Plan (HBP), and related research efforts into other planning documents such as a Research Plan, will require significant initial effort.

The general procedure for developing the plans will include, but not be limited to, the following activities and schedules.

April, 2005:

The Secretary's Designee approves the Science Advisors to assist (facilitate/coordinate/advise) the GCMRC/TWG focused effort to complete science/technical planning documents. GCMRC modifies the SAs FY 2005 contract. SA Executive Director develops a prospectus on the assignment.

May, 2005:

The SA Executive Director, working with GCMRC and the Science Planning Group establishes the following:

- A timeline for SAs to provide advisory service and external review, including initial meetings with GCMRC and cooperating scientists.
 - A work plan for the overall planning activity including alignment of Science Plan with AMWG Strategic Plan.
 - A proposed collaborative procedure and schedule
 - Formal review of planning program by TWG
 - Initiation of development activities on all plans. Some activity is underway, i.e., CMP, SSP, LTEP, HBCP

June/July, 2005:

- Work plan final for development of all plans, including alignment with AMWG Strategic Plan and merging LTEP, HBCP and other research into other defined planning documents such as a Research Plan.
- BAHG “Two Year GCD AMP Program Prospectus” reviewed by TWG.
- Development of all plans in process.
- Completion of concept ecosystem design and integration strategy.
- Completion of draft Strategic Science Plan.
- Knowledge assessment Workshops attended by managers and cooperating scientists, and facilitated by GCMRC and SAs, in support of experimental design planning.

**GENERAL DESCRIPTORS OF CURRENT AND PROPOSED ACTIONS
FOR DEVELOPING GCD AMP SCIENCE/TECHNICAL PLANS**

Planning Document	Current Status and Planning Group	Proposed Planning Actions and Planning Group	Phase I Development Status: 11/2005	Phase II Development Status:7/2006
Strategic Science Plan (SSP)	Draft SSP by GCMRC, with input and assistance from the GCD AMP. GCMRC	Revise current draft GCMRC Strategic Science Plan so as to ensure cross-walk with AMWG Science Plan, using input from Science Planning Group. SPG	GCMRC;s Draft Final Ecosystem-Scale Strategic Science Plan with input from the GCD AMP/ Strategic Planning Group. GCMRC/SPG	Final SSP for FY 2007-2011. Ready for implementation in AMP approved Annual work Plan for FY 2007-08. Contains approved elements for CMP, LTEP, HBCCP and RP. GCMRC/SPG
Core Monitoring Plan (CMP)	Draft FY 2006 Provisional CMP. Draft FY 2007 CMP Process. GCMRC/CM Ad Hoc	TWG & AMWG adopt FY 2006 Provisional CMP. FY 2007/2008 CMP developed with new process. SPG	Draft text of science design and methods and all general plan elements; draft detailed outline of all ecosystem program areas and related budgets. One program area fully	Final CMP and Budget, FY 2007/2008. SPG

Planning Document	Current Status and Planning Group	Proposed Planning Actions and Planning Group	Phase I Development Status: 11/2005	Phase II Development Status:7/2006
			specified. SPG.	
Long Term Experimental Plan (LTEP)	Draft concept abstract. AMWG LTEP Ad Hoc Committee	Integrate into Research Plan		
Humpback Chub Comprehensive Plan (HBCP)	Draft HBCCP. AMWG's HBCCP Ad Hoc Committee	Finalize HBC Comprehensive Plan. TWG, HBCP Ad Hoc	Finish HBC Plan. HBCCP Ad Hoc	Allocate HBC projects among other plans. SPG
Research Plan (RP)	No current document or proposal.	A Research Plan developed that contains all GCMRC research activities, LTEP, research programs and related management activities. SPG	Detailed outline of all research elements, programs, projects, with example ecosystem program fully specified for one or more goals/resources. SPG	Final RP and Budget, FY 2007/2008. SPG
Annual Work Plan and Budget (AWP)	FY 2006 draft AWP & Budget by AMWG Budget Ad Hoc Committee/GCMRC	A two year AWP (FY 2007/2008) by GCD AMP SPG/GCMRC/BAHG	Detailed sentence outline of all plan elements for each program area. Proposed FY 2007/2008 budget. BAHG/GCMRC	Final AWP and Budget, FY 2007/2008

August/-October, 2005:

- GCMRC report to AMWG on GCDAMP SPG Progress
- BAHG/GCMRC presentation to AMWG on key elements of two year pilot program/budget proposed for FY 2007/2008.
- Completion of draft Research Plan
- Completion of draft FY 2007 Annual Plan and Budget.
- SA workshops on program/project specification for all plans.
- Facilitated discussion panels focused on Long-term Monitoring and Experimental Design held immediately after technical session during the GCMRC's October 2005, Biennial Science Symposia. Tempe, AZ.

November, 2005:

- Release of all draft plans and completion of Phase I.

December, 2005-July 2006:

- The Phase II program will be fully defined at completion of Phase I, and will include a complete review and specification of all plans by June 2006, and a Two Year Work Plan and Budget by July 2006.

Science Advisor Planning Program Requirements

The primary increased requirements of this planning effort will fall on the GCMRC Program Managers and its Chief, the SA Executive Director, the BAHG Chair, and TWG Chair.

The SAs workload will also significantly increase. And, additional meetings and conference calls will be required of the BAHG, TWG, GCMRC, SAs and all proposed members of the new GCD AMP Science Planning Group.

Additional planning is required to specify all probable increased requirements. This will be accomplished in the initial meetings of the GCD AMP Science Planning Group. It will be captured in the work plan for this planning effort, to be completed in May.

Dr. Garrett has projected additional SA contract costs at approximately \$70,000 for the Phase I (May-October 2005) and \$80,000 for Phase II (October 2005-July 2006). Although costs for Phase II will depend upon the level of detail developed in all the planning documents.

Outcome

Initial drafts of four planning documents are to be produced between July and November, 2005 as follows:

- Strategic Science Plan
- Core Monitoring Plan
- Research Plan
- Work Plan and Budget; FY 2007/2008

The Strategic Science Plan and the AMWG Strategic Plan are the documents that establish a strategy for ecosystem science and management in the Colorado River Ecosystem (CRE). An integration strategy will also be presented for both science and management programs, clarifying the requirements from each to understanding ecosystem integration and resource response. The integrated linkages of research and monitoring programs will also be specified.

The Core Monitoring Plan will present the short and long term contributions of monitoring programs and metrics to resolving AMWG goals, objectives and information needs and understanding the CRE. Integration and linkages of specific monitoring and research outcomes will be specified.

The Research Plan will comprise two primary sections, one on long term experimentation and a second committed to needed research and development. The experimental segment will focus on defining cause and effect relationships for development of longer term management strategies, i.e., regulated flow regimes, water quality management, etc.

The research and development segment will focus on answering specific resource questions of concern, and increasing knowledge necessary to implement monitoring programs. Specific linkages will be established to define integrated monitoring and research efforts.

The FY 2007/2008 work Plan and Budget will be drafted from the research and monitoring plans. It will provide emphasis to science activities required to support long term experimentation, as well as the redefined core monitoring program.

APPENDIX B
LIST OF PARTICIPANTS ON THE
SCIENCE PLANNING GROUP

TO: M3 Research Files
 FROM: LDG, SA Executive Secretary
 DATE: November 11, 2005
 SUBJECT: SPG Participants; One or more meetings

1

SPG MEMBER LIST

• Matthew Andersen - GCMRC	mandersen@usgs.gov
• Mary Barger - WAPA	Barger@wapa.gov
Jill Baron – Science Advisor	jill@nrel.colostate.edu
Mike Berry - BOR	mberry@uc.wbr.gov
• Gary Burton - WAPA	burton@wapa.gov
Wayne Cook – WAPA	
Lew Coggins – GCMRC	lcoggins@usgs.gov
• Kerry Christensen – Hualapai Tribe	cuszhman@yahoo.com
Virginia Dale – Science Advisor	dalevh@ornl.gov
• Helen Fairley – GCMRC	hfairley@usgs.gov
• Dave Garrett – Executive Director SA	m3research@aol.com
• Llyod Greiner - UAMPS	lgreinerl@mindspring.com
Lance Gunderson – Science Advisor	lgunderson@emory.edu
• John Hamill – GCMRC Chief	jhamill@usgs.gov
• Norm Henderson – NPS	Norm_henderson@nps.gov
Alan Howard – Science Advisor	ahop@virginia.edu
Loretta Jackson - Hualapai Tribe	lorjac@frontier.net
• Rick Johnson – Grand Canyon Trust	Rick.johnson@npgcable.com
Ted Kennedy – GCMRC	tkennedy@usgs.gov
• Chris Kincaid – NPS	Chris_kincaid@nps.gov
Jim Kitchell – Science Advisor	kitchell@wisc.edu
• Glen Knowles – FWS	Glen_knowles@fws.gov
Josh Korman - ESRI	jkorman@ecometric.com
• Dennis Kubly – BOR	dkubly@uc.wbr.gov
Lisa Leap – NPS	Lisa_leap@nps.gov
Mike Liszewski – GCMRC	mliszewski@usgs.gov
• Mark McKinstry – BOR	mmckinstry@uc.usbr.gov
• Ken McMullen – NPS	Ken_mcmullen@nps.gov
• Ted Melis – GCMRC	tmelis@usgs.gov
• Clayton Palmer – WAPA	cspalmer@wapa.gov
• Bill Persons – AZG&F	bpersons@azgfd.gov
• Barbara Ralston – GCMRC	bralston@usgs.gov
Dale Robertson – Science Advisor	dzrobert@usgs.gov
• Mark Steffens – Federation of Flyfishers	steffenvlyrod@lycos.com
Larry Stevens – Grand Canyon Wetlands Council	farvana@aol.com
Bill Vernieu – GCMRC	bvernieu@usgs.gov
• Mike Yeatts – Hopi Tribe	Micheal.yeatts@nau.edu
• Andre Potochnik – Grand Canyon River Guides	arp4@infomagic.net
Kurt Dongoske – CREDA & TWG Chair	kdongoske@cableone.net
• David Siebert – Student from Piute Tribe	
John O'Brien – Grand Canyon River Guides	johnob@npgcable.com

¹ Members attending five or more meetings.

APPENDIX C
DEVELOPED OBJECTIVES
FOR THE SPG PROCESS

DRAFT

PURSUING SPG OBJECTIVES

OBJECTIVE	ACTIVITY ON OBJECTIVES FOR PLANNING PERIOD MONTHS: FY 2005/2006				OUTCOME
	5-8/05	9-12/05	1-4/06	5-8/06	
1. Involve managers and scientists in science planning	X	X	X	X	Attempt to involve as broad of cross section of GCD AMP entities as possible
2. Outline and follow objective process	X	X	X	X	Develop, approve and follow objective processes in planning
3. Incorporate CMPT in SPG	X	X	X	X	Incorporate CMPT objectives and tasks into SPG. Complete by 7/06
4. Incorporate LTEP in SPG		X	X	X	Incorporate LTEP objectives and tasks into SPG. Complete by 7/06
5. Gain input from HBCCP and utilize		X	X	X	Gain input from HBCCP and include in final plans. 7/06
6. Provide input to BAHG on AWP and budget		X	X	X	Provide input to BAHG and GCMRC for AWP and Budget proposal. 7/06
7. Gain input from CRAHG and utilize		X	X	X	Gain input from CRAHG and incorporate in final MRP. 7/06
8. Develop adaptive management ecosystem process	X	X	X	X	Develop and incorporate adaptive management and ecosystem science process in plans by 7/06.
9. Develop Goal/In ranking process in planning		X			Develop and implement goal and CMIN ranking process in specifying CMINS in FY 2007/2008 MRP by 7/06.
10. Develop a process for determining desired future conditions (DFC) of CRE resources		X	X		Develop a process for determining desired future conditions for resources in the CRE. Recommend to TWG/AMWG for adoption in FY 2007/2008 plans.
11. Knowledge assessment process		X	X		Complete knowledge assessment and identify knowledge gaps. Review by SAs/TWG 3/06.
12. Develop science questions to respond to knowledge gaps		X	X		Develop and include science questions to address knowledge gaps. Review by SAs/TWG 3/06.

13. Link goals, INs science questions		X	X	X	Provide linkage of goals, INs, science questions, and GCMRC projects in final MRP. 7/06
14. Assessing core monitoring project options	X	X	X	X	Evaluate proposed core monitoring options and determine final FY 2007/2008 core monitoring projects for MRP. 7/06
15. Assessing research study options		X	X	X	Evaluate research project options for final FY 2007/2008 research program in MRP. 7/06
16. Assessing experimental plan options		X	X	X	Evaluate all experimental designs and experimental options (flow and non-flow) for FY 2007/2008. 3/06
17. Evaluating statistical design issues		X	X		Evaluate and determine implications of statistical and experimental design on ability to learn from experiments. Clarify to SPG/TWG/AMWG. 3/06
18. Developing SSP, MRP sentence outlines	X	X			Complete SSP, MRP sentence outlines; 11/05
19. Specify project science approaches i.e., design, parameters, metrics, data resolution, etc.		X	X		Complete specification of science project operations for research and monitoring; i.e., sampling, parameters, metrics, resolution. 5/06
20. Involving general science community in process	X	X	X	X	Obtain reviews of SSP, MRP, AWP by SAs, contract scientists, other scientists. 9/05; 11/05; 6/06
21. Involving TWG in process	X	X	X	X	Obtain TWG review and present to TWG (SSP, MRP, AWP)
22. Involving AMWG in process	X	X	X	X	Present SPG Plan and SSP, MRP and AWP for AMWG review and approval 8/05; 3/06; 8/06.
23. Developing final draft SSP, MRP, AWP			X		Complete draft SSP, MRP, AWP. 5/06
24. Developing Final SSP, MRP, AWP				X	Complete final SSP, MRP, AWP. 6/06
25. Engaging independent reviews		X	X	X	Complete SA and independent science reviews of SSP, MRP, AWP. 11/05; 3/06; 6/06

APPENDIX D
EXAMPLE MEETING
SCHEDULES AGENDAS AND
ACTIONS TAKEN

M3 RESEARCH

L. David & Pamela Garrett, Principals
53716 Falcon Rd
Olathe, CO 81425
970-323-9511 (Ph)
970-323-9512 (Fax)
E-Mail: m3research@aol.com

DRAFT

TO: GCD AMP Science Planning Group
FROM: L.D. Garrett, Executive Director SAs
DATE: November 28, 2005
SUBJECT: Schedule for Continued Development of Science Planning Documents

As we continue our development of the science planning documents, we need to continually revise our schedule of meeting dates and targeted outcomes of each meeting. Our two critical dates were to have sentence outline documents by November 2005 and final plans by June 2006. Sentence outlines were presented in November for the SSP and MRP, but much work remains to be accomplished.

The new schedule retains our activities from September to date. It also includes presentations to and reviews by TWG in January and April, and presentations to AMWG in 3/06 and 7/06.

We also added the following set of tasks, slightly revised from our original plan.

- In the fall (Sept/Oct) ranked AMWG goals by defined criteria using approved objective process
- In fall (Oct/Nov) defined proposed “core” CMINS
- In fall (Nov) defined parameters for core data needs
- In winter (Jan/Feb) define selected parameters, metrics, and data specification (resolution, spatial/temporal need, accuracy, etc)for core information needs and specify core CMINS.

Following is the schedule approved at our September 21-23, 2005 meeting and revised November 9. All our meetings are planned for the BIA Building, Phoenix, unless otherwise noticed.

<u>SPG/GCMRC MEETING DATE</u>	<u>PLANNED SPG/GCMRC OUTCOMES</u>
September 21-23, 2005	SSP <ul style="list-style-type: none"> • None CMP <ul style="list-style-type: none"> • Present and discuss partial sentence outline • Review and approve AMWG goal ranking • Review and approve criteria for CMIN

	<p>sequencing</p> <ul style="list-style-type: none"> • Sequence CMINS • Define core CMIN criteria and core CMINS • Approve process for defining parameters, metrics, data specification <p>RP</p> <ul style="list-style-type: none"> • Knowledge assessment review • Review of critical questions • Review of experimental scenarios <p>AWP</p> <ul style="list-style-type: none"> • None
October 5-6, 2005	<p>SSP</p> <ul style="list-style-type: none"> • None <p>RP & CMP</p> <ul style="list-style-type: none"> • Completion and approval of goal and CMIN ranking. Approval of proposed core monitoring data need • Discussion workshop on parameters proposed for core monitoring data need • Discussion of RP outline • Specification of one or more research projects required for development of monitoring procedures. Research projects necessary to move yellow or red monitoring projects to green at future date. • Specification of one or more research projects required for needed information for scientists or managers for required decisions and/or actions. • Specification of one or more experimental options required to evaluate management actions and/or treatments (flow and non-flow) over the period 2007-2011. • Proposal for merged CMP/RP sentence outline <p>AWP</p> <ul style="list-style-type: none"> • None
November 8-9, 2005	<p>SSP & MRP</p> <ul style="list-style-type: none"> • Presentation and approval of merged approach to RP and CMP documents. The documents will now be integrated to

	<p>one document to develop improved ecosystem science planning. A sentence outline Monitoring & Research Plan (MRP) was proposed to support new direction. The document is reviewed and revised.</p> <ul style="list-style-type: none"> • Presentation of core monitoring data information needs for FY 2007/2008 for MRP with selected parameters specified. • Presentation of selected 2007/2008 research projects necessary to develop or validate effective and acceptable monitoring procedures for proposed future core monitoring data needs; i.e., monitoring data currently identified as red or yellow as defined by SPG. • Presentation of selected FY 2007/2008 research projects required to resolve specific information needs of scientists/managers. • Presentation and review of revised FY 2007/2011 experimental programs to evaluate flow and non-flow management actions and treatments. <p>AWP</p> <ul style="list-style-type: none"> • General discussion of overall budget requirement and potential split between research and monitoring. • Additional reviews of all documents requested by 1/06 SPG meeting.
<p>Joint SPG, TWG Meeting November 29-30, 2005</p>	<ul style="list-style-type: none"> • Presentation of GCMRC/SPG sentence outline science Plans (SSP, MRP) for review and recommended changes by TWG. TWG requested to approve the plans for continued development.
<p>January 9-10, 2006</p>	<p>SSP: Review draft SSP sentence outline and approve for development of complete text. MRP: SPG review of Experimental options and recommendations for change. Discussion of example parameters, metrics, data specification for one or two core monitoring projects. Review of example parameters, metrics, and data specification for one or two research projects. Discussion of GCMRC budget procedures for FY 2007..</p>

January 25-26, 2005	Meeting of SPG with TWG to review SSP, MRP and budget documents to be discussed at AMWG meeting March 7-8, 2006
February 21 (SA meeting)	Science Advisors meet in Phoenix to review revised SSP, MRP plans and draft recommendations.
February 22, 23, 2006	SAs meet with SPG on February 22, 2006 and interact with SPG to discuss any potential changes in plans. SSP: Approve SSP complete draft document with recommended revisions: MRP: Workshop to develop parameter, metric, data specification for monitoring and research projects for FY 2007. Proposed changes specified for FY2007 research and monitoring projects. AWP: Discuss draft FY 2007/2008 AWP sentence outline and budget.
March 7, 8, 2006 SPG/AMWG Meeting	Progress report to AMWG on all science planning documents. Request for recommended changes.
April 19-20, 2006 SPG Meeting with TWG	SSP: SPG approval for presentation to TWG. MRP: SPG revisions for presentation to TWG. SPG final approval of Experimental Options for presentation to TWG. AWP: SPG approval of final revisions on AWP for presentation to BAHG and TWG.
May 1 - 10	Review of final plan drafts by SAs, selected science reviewers, TWG.
May 24,25, SPG Meeting	SSP: Complete SPG and others revisions for AMWG MRP: Complete SPG and others revisions for AMWG AWP: Complete SPG and others revisions for AMWG
June 14, 15 SPG Meeting	Final SPG changes and release of planning documents for AMWG approval on June 20, 2006.

M3 RESEARCH

L. David & Pamela Garrett, Principals
53716 Falcon Rd
Olathe, CO 81425
970-323-9511 (Ph)
970-323-9512 (Fax)
E-Mail: m3research@aol.com

DRAFT

TO: SPG Sub-group on Experimental Options: Knowles, Kubly, Henderson, Persons, Palmer, Steffen, Hamill, Stevens, Melis, Fairley, Anderson, Johnson, Griener
FROM: L.D. Garrett, SA Executive Director
DATE: March 30, 2006
SUBJECT: SPG Sub-group Meeting Changed to Friday April 7, 2006

I apologize to all the members for a second change in this meeting date. This final date, April 7, is the one we will keep. The draft agenda remains unchanged.

**DRAFT AGENDA
SPG SUB-GROUP MEETING ON RESOLVING
DIFFERENCIES IN EXPERIMENTAL OPTIONS
USGS CAMPUS, FLAGSTAFF ARIZONA
GCMRC CONFERENCE ROOM, BUILDING 3**

FRIDAY APRIL 7, 2006

TIME	DISCUSSION ITEM	LEAD
9:00 AM	Review of March 22/23 SPG meeting outcomes on Experimental Options	Garrett/Hamill
9:30 AM	Presentation and discussion of science information specified by SPG to resolve June/August fluctuating flows issue	Hamill/GCMRC scientists
11:00 AM	Resolve resource impact differences from June/August fluctuating flows for options 2 and 3	Sub-group
12:00 noon	Working lunch	
12:30 PM	Draft recommendation to SPG for merging Experimental Options 1, 2 and 3	Sub-group
1:30 PM	Evaluate a potential trigger for steady flows in August and its implications to original or revised Experimental Options 1-4	Sub-group
3:00 PM	Adjourn	

M3 RESEARCH

L. David & Pamela Garrett, Principals
53716 Falcon Rd
Olathe, CO 81425
970-323-9511 (Ph)
970-323-9512 (Fax)
E-Mail: m3research@aol.com

TO: GCMRC Management Team, Clayton Palmer, Rick Johnson
FROM: L.D. Garrett, SA Executive Director
DATE: February 3, 2006
SUBJECT: GCMRC Meeting to Review Experimental Options for GCD AMP

Our meeting is still on for Friday February 17, 9:00 AM to 1:00 PM to discuss developed experimental options for the GCD AMP. The objectives for this meeting are as previously outlined.

1. Evaluate SPG documents to determine if additional information is needed.
2. Conduct discussions of developed data to determine if chosen format for SPG meeting provides clarity and balanced explanations for each option.
3. Evaluate common elements of each proposal, areas of primary differences, and avenues for seeking compromise on February 21.

Hopefully this pre meeting will make our February 21 SPG meeting more efficient and effective.

The following general agenda will be followed.

9:00 AM	Presentation of four alternatives by GCMRC	Hamill/Melis
9:30 AM	Discussion of additional documentation to assist process and best approaches for presentation and discussions with SPG to obtain maximum understanding	Garrett/Group
11:00 AM	Break	
11:15 AM	Discussion of defined approaches, areas of common agreement and areas of significant differences. Defining approaches/avenues for reaching compromise in the SPG	
12:00 noon	Adjourn for lunch	

**GCD AMP SCIENCE PLANNING GROUP
 APRIL 20, 21, 2006
 BUREAU of INDIAN AFFAIRS
 [APS BUILDING]
 ARIZONA CENTER, PHOENIX, AZ
 BIA CONFERENCE ROOM A
 12TH FLOOR**

THURSDAY APRIL 20, 2006

TIME	TOPIC	LEAD
10:00 AM	Objectives and Outcomes for Meeting	Garrett
10:10 AM	New published science on HBC	Andersen
10:30 AM	Reducing uncertainty regarding the HBC	Korman
11:00 AM	Concerns regarding the modified experimental option	Knowles
11:30 AM	Lunch	
12:30 PM	Hydropower cost analysis	Palmer
1:00 PM	Review modified option 3 and Kubly modification to add out years	Hamill/Kubly/Group
2:00 PM	Clarify non-flow options and implications to flow options, compliance etc.	Hamill/Palmer/Kubly/Group
2:30 PM	Discuss potential August trigger and potential merging of modified option 3 and option .0 and 4.b	Garrett/McMullen/Ramsey/Group
3:30 PM	Break	
3:45 PM	Discuss implications of other hydrology issues in basin, i.e., equalization, drought, upper basin removals, etc.	Group
5:00 PM	Adjourn	

FRIDAY APRIL 21, 2006

TIME	TOPIC	LEAD
8:00 AM	Discussion of SSP	Hamill/Group
10:00 AM	Break	
10:15 AM	Discussion of MRP	Hamil/Group
12:00 Noon	Lunch	
1:00 PM	Continue MRP discussions	Hamill/Group
3:00 PM	Adjourn	

DRAFT

**AGENDA
GCD AMP SCIENCE PLANNING GROUP
BUREAU of INDIAN AFFAIRS
[APS BUILDING]
ARIZONA CENTER, PHOENIX, AZ
BIA CONFERENCE ROOM A
12TH FLOOR**

TUESDAY MAY 23, 2006

TIME	TOPIC	LEAD
10:00 AM	Review of meeting objectives and planned outcomes. <ul style="list-style-type: none"> • Experimental Options transfer to TWG • Schedule for completion of plans • SSP transfer to TWG • MRP review and proposed changes • BAWP review and proposed changes 	Garrett
10:15 AM	Review of developed TWG presentation of Experimental Options: SPG A and SPG B. Flow and non-flow components.	Melis/Hamill
10:45 AM	Changes to TWG presentation on Experimental Options proposed by group.	Garrett/Hamill/Group
11:30 AM	Presentation of schedules for completion of all science planning documents including FY 2007 transition plan and budget.	Garrett/Henderson/Hamill
12:00 Noon	Lunch	
1:30 PM	Presentation of SSP for approval by TWG	Hamill
2:00 PM	SA review of MRP and BAWP.	Garrett
2:30 PM	Presentation of draft MRP for SPG discussion and proposed changes.	Hamill/Melis/Fairley/Andersen
3:00 PM	Break	
3:15 PM	Finalize recommended MRP changes.	Hamill/Melis/Fairley/Andereon/Group
4:00 PM	Presentation and discussion of FY 2007/2008 BAWP and budget proposal for changes.	Hamill/Melis/Fairley/Andersen/Group
5:00 PM	Adjourn	

WEDNESDAY MAY 24, 2006

8:00 AM	Discussion of FY 2007/2008 BAWP and budget and proposals for change; complete review.	Hamill/Melis/Fairley/Andersen/Group
10:00 AM	Presentation and discussion of AWP and budget for FY 2007 transition year	Hamill/Group/Kubly
11:45 AM	Complete FY 2007 transition year AWP and budget proposed changes and June meeting topics.	Hamill/Group/Garrett
12:00 noon	Adjourn	

**AGENDA
 SPG MEETING
 JANUARY 9-10, 2006
 BIA BUILDING
 ARIZONA CENTER, PHOENIX, AZ
 12TH FLOOR
 CONFERENCE ROOM A-B**

JANUARY 9, 2006

TIME	TOPIC	LEAD
10:00 AM	Proposed agenda changes and objectives for meeting	Garrett
10:15 AM	Presentation and discussion of potential experimental options for FY 2007-2011	Hamill/Melis/ Andersen/Fairley/ SPG/Garrett
12:00 Noon	Lunch	
1:15 PM	Continue discussion of experimental options	GCMRC/SPG/Garrett
3:00 PM	Break	
3:15 PM	Continue discussion of experimental options	GCMRC/SPG/Garrett
4:30PM	ACTION ITEM: Selection of the recommended FY 2007-2011 experimental flows/non-flows program	Garrett/SPG/GCMRC
5:00 PM	Adjourn	

JANUARY 10, 2006

8:00 AM	Presentation of SSP and discuss proposed changes to develop final SSP	Garrett/GCMRC/SPG
9:00 AM	Presentation and discussion of example detail for individual project elements of the MRP	Andersen/Garrett/SPG
10:30 AM	Break	
10:45 AM	Discussion of proposed approaches for FY 2007-2008 work plan and budget	Hamill/Kubley- BAGH/SPG
12:00 Noon	Lunch	
1:15 PM	Discussion of Potential DFC approach	McMullen/Garrett/SPG
3:00 PM	Break	
3:15 PM	Establish February SPG agenda and adjourn	SPG



M3 RESEARCH

L. David & Pamela Garrett, Principals
53716 Falcon Rd
Olathe, CO 81425
970-323-9511 (Ph)
970-323-9512 (Fax)
E-Mail: m3research@aol.com

DRAFT

TO: SPG Members
FROM: L.D. Garrett, SA Executive Director
DATE: March 27, 2006
SUBJECT: Actions and Discussions of March 21-23, 2006 SPG Meeting

The SPG meeting for March 21-23, 2006 was held in Phoenix, AZ at the BIA Offices. In attendance were Dave & Pamela Garrett, Kerry Christensen, Gary Burton, Mike Berry, Mary Barger, Clayton Palmer, Dennis Kubly, Norm Henderson, Nickoli Ramsey, Andre Potochnik, Rick Johnson, Lloyd Griener, Bill Persons, John Hamill, Mark McKinstry, Scott White, David Topping.

Over the three days of meetings the following discussions were held and agreements were developed.

Day 1

- Garrett outlined planned outcomes for March 21, 22, 23; and procedures. Kubly and Barger were introduced as facilitators for March 21 and 22.
- The outcome for day 1 was to evaluate the Knowledge Assessment (KA) for potential management actions.
- Kubly reviewed science planning since 2002, and the block design over 4, 8 and 12 years. Discussions were held on; management actions, need for advanced experimental design, high variance of CRE.
- Palmer expressed concerns over the KA and provided suggestions for change in a written document.
- Mark McKinstry went through a composite analysis of all the resources and how they rank as a whole regarding uncertainties presented in the KA.



- Kubly discussed the four experimental options to try to determine if there is consensus on what management activities are considered management actions.
- Kubly conducted a survey of the SPG to identify who of the SPG members would identify management activities to be implemented as management actions or treatments.
- Kubly summarized the results of the survey. It revealed 1 person views all activities as management actions, 4 view all of them as treatments and 4 a mix. Kubly recommended that the presentation and exercise be presented to TWG and AMWG. He also, recommended that a section be added to the KA written by managers, that addressed the issue of evaluating management actions.

Day 2 and 3

- On March 22 the group discussed experimental options. This discussion continued through March 23rd.
- Garrett introduced the proposed outcomes for day 2, and 3, i.e. to develop a compromise of 1, 2, 3, 4 experimental Options if possible.
- Potochnik and Johnson presented the background that contributed to a new Option 5 and what it was designed to accomplish. Its primary purpose was to provide a bridge to Option 2 from Option 4. Garrett proposed that Option 5 be considered as a variant on Option 4, i.e. Option 4.b, since insufficient time was available to fully develop another option using GCMRCs' assistance.
- Barger outlined the goals for the day, which was to discuss the 7 listed differences among the four options and try to develop a compromise among 1, 2 and 3 or 1, 2, 3 and 4.

Barger began the evaluation of differences with a discussion of ramping rates.

The following discussions/agreements/actions were developed during the March 22 and 23rd meetings.

- **SPG Agreement/Action on Ramping Rates:**
Agree that longer term research is needed to determine the efficacy of using the 3000 cfs down ramping rate, that considers the effects on a variety resources

including sediment, HBC, trout (food, mud snails), stranding boats, etc. The specific study design (e.g., alternating blocks, time of year, number/location of sites) to be drafted by GCMRC for the Monitoring and Research Plan. The study may look at sediment effects first, HBC second, then other resources. The study should not compromise primary experimental design issues, and could require the 2007-2011 period to complete. Does not resolve concerns from Option 4.

- **SPG Agreement/Action on Steady Flows**

GCMRC will develop a proposal to test ecologically steady flows in September, October, and possibly November to improve HBC. Tests would be targeted at defining an ecologically steady flow, the level of steady flow, and the effect of a short duration spike (e.g., 1 hr/5000 cfs) to benefit food base drift. Flow can not drop below 7000 cfs. Combine Options 1, 2, 3 but not 4. Proposal supported by eight yes votes and one abstention. Rationale: the initial test should consider whether steady flows in September, October, and November will benefit HBC. Steady flows in August are not considered because of adverse impacts to power generation. Potential need for steady flows could cause Option 1 to not be

- **SPG Agreement on Sediment Trigger:** Steady flows in August may be important to YoY HBC in the main stem and to minimize export of sand following tributary input. GCMRC would evaluate developing a trigger for putting steady flows into effect in the future.
- **SPG Agreement on BHBF:** Agreed not to have full BHBF. GCMRC will develop a proposal for spring BHBF's based on Rubin's "new trigger" subject to reasonable decision guidelines (not rules):
 - Special steady flows are not required to retain sand until the trigger is achieved
 - Funding is available to monitor effects
 - Adequate water is available (260 KAF)
 - BHBF's do not result in unacceptable adverse impacts (e.g., tamarisk reproduction, impact HBC, food base)
 - Flows promote ecological integrity

Decision guidelines should be flexible enough to allow for BHBF's on a frequent basis.

- **SPG Agreement on Summer Fluctuating Flows:** Deviation from ROD (Options 2 and 3) to allow for increased fluctuating flows in Jun, Jul, and Aug. FWS: No rationale for allowing for increased fluctuations over the ROD during summer months. WAPA: Impacts will be offset by other measures in the package. Increased fluctuations should not be looked at in isolation of other measures included in the package. Agreed to develop more information to gain a resolve.

Proposal: Develop a trigger for initiating summer steady flows. Trigger would only be implemented in Segment 3. Rationale: Other measures (TCD) may alleviate the need to use the trigger, and thus avoid hydro power impacts

Next Steps:

1. WAPA will produce corrected hydrographs for Option 3 based on agreed upon changes in the steady flow component and a BHBF;
 2. WAPA will produce power cost analysis;
 3. GCMRC will produce corrected hydrographs for Option 2 based on agreed upon changes;
 4. GCMRC will compare sediment and biological impacts of alternative 2 and 3 after WAPA supplies relevant data;
 5. Dave, Mark, Bill, Clayton, Larry, Glenn, Norm and/or Dennis and GCMRC will meet on April 3 in Flagstaff to review and attempt to reach an agreement on a unified flow regime.
 6. Rick and Andre will work with GCMRC to adjust monthly flows in Option 5 to account for inclusion of BHBF
- **SPG Agreement on HBC Augmentation Planning:** Agreed to develop planning for catastrophic event. This will be included as a planning element of segment 1 of the LTEP under options 1, 2 and 3. It is defined to include developing a captive brood stock/refuge population, a genetics management plan, a stocking plan, and identification of production/grow out facilities in preparation for possible need for future augmentation (as determined by FWS). Rationale: needed as a safe guard in case of catastrophic loss associated with possible negative

effects of the LTEP e.g., TCD, proliferation of warm and cool water nonnative fish, other, etc. The relationship to the LTEP is that future augmentation may have a confounding effect on other experiments and stocking may be used for mitigation for the LTEP and/or other losses of HBC. Thresholds need to be established in the genetics management plan for stocking. Issue: Should augmentation planning be an element of the LTEP.

- **SPG Agreement on Power Costs:** WAPA committed to provide estimated power costs and methods of calculation for each option and to submit to SA by April 3 for independent peer review prior to the SPG/TWG meeting. The cost analysis will include BHBF's (assumed to occur in April) and Options 1-4, including 4.b.
- **SPG Agreement on TCD/SWS:** The group endorses implementation of the TCD by 2011 or sooner if possible. The goal of the TCD will be to maintain ecological integrity in the CRE, coldwater trout fisheries in Lees Ferry reach, and improve main stem habitat for HBC and other native fishes. Issue: How many units to implement to achieve desired effects (are 2 units enough?).
- **SPG Agreement on Mechanical Removal:** Scope: Will be based on the GCMRC proposal/plan for developing, testing and implementing methods for control of problematic non native fishes in main stem below Lees Ferry and tributaries targeted for translocation/control. GCMRC plan will be coordinated with NPS efforts. Issue: need to develop justification for continuing the effort to gain for public support.
- **SPG Agreement on Experimental Design:** All Options are forward titration in first segment (based on implementation schedule realities) with review in 2011 (or when TCD becomes operational) to determine actions and design for second segment. Actions and experimental design in the 3rd segment will be determined by the response of HBC and sediment to the actions implemented in segment 1 and 2.
- **SPG Agreement on DRAFT SSP:** Presentation and discussion of SSP by SPG. Recommendations for change provided to Hamill. SPG to provide additional

comments to Hamill by April 3, 2006. Hamill will provide revised SSP for additional SPG comment and review and approval by TWG in April.

- **SPG Agreement for Experimental Design** over three time periods or segments.

Proposal: a modified design that sequences actions over three time periods 4-5 years each is to:

- Implement the compromise hydrograph that merges aspects of the different proposals under consideration for segment 1; identify and implement humpback chub actions from the comprehensive plan as planning is completed, technology becomes available, and funding is provided.
- Implement the TCD in segment 2, with construction complete by 2011 or sooner. Continue the compromise hydrograph in segment 1. Consider what other actions, such as warmwater nonnative fish control, would be added with the onset of TCD operations to offset potential negative effects and avoid confounding.
- In segment 3 use the responses of the key resources, endangered fish and fine sediment, to determine what change in actions will be included in that segment; i.e. steady flows. Triggers for this determination will be developed in segment 1

TO: Science Planning Group
FROM: L.D. Garrett, SAs Executive Director
DATE: July 10, 2006
SUBJECT: Notes from July 5-7 SPG Meeting

In attendance: Dave Garrett, Norm Henderson, Kerry Christensen, Rick Johnson, Lloyd Greiner, Mike Yeatts, Dennis Kubly, Larry Stevens, Ken McMullen, Dave Siebert, Robert King, Leslie James. Andre Potochnik, Mary Barger and Gary Burton. Kurt Dongoske, Glen Knowles, John Hamill, Matt Andersen, Ted Melis, Chris Beard, Glenn Bennett, Helen Fairley

DISCUSSION OF LIMBAUGH MEMO; ISSUES RAISED

- Review Limbaugh letter to the AMWG, specifically suggestion for a longer science planning timeline, perhaps as long as 25 years; and SPG request to provide more information on long term program, TCD, and Experimental Options.
- FY07 work plan and hydrograph to be reviewed and approved during one hour AMWG conference call in first week of September (tentative).
- Bring to closure experimental plan/final option and MRP recommendation in October. The MRP should be started in FY08.
- Where does AMWG have the opportunity to weigh in on policy issues, if not through the work plan and budget process?
- This is the 7th year of 8.23 maf flows without implementing steady flows.

REVIEW OF ANNUAL WORK PLAN; 2007

- Hamill presents an overview of the MRP to assist the AWP review. This topic will be revisited on the last day of the meeting (Friday)
- Questions exist as to why GCMRC is not stated as lead on core monitoring and experimental plan issues. And, why have original elements of the core monitoring plan and the experimental plan not been merged into the MRP. GCMRC agrees to revisit this issue.
- GCMRC notes that reviews of the core monitoring projects will involve both managers and outside independent scientists.
- GCMRC notes there will be a workshop(s) or some kind before the monitoring project reviews are undertaken to establish program priorities/set funding limit etc.
- Is GCMRC planning to fund the refuges and other items on the HBC initiative list. This remains to be discussed and decided.

- There is no apparent prioritization process established, either for core monitoring or research. There already are prioritized RINs and prioritized CMINs, but they are not referenced in the MRP.

AWP GOAL 1 DISCUSSIONS

- Members want number of trips per project identified upfront in project descriptions. NPS needs this information in order to decide whether or not to support a given project.
- A Parking lot is established for unsolved issues. Submerged aquatics vegetation is placed in parking lot.

AWP GOAL 2 DISCUSSIONS

- Three HBC monitoring trips will occur more or less concurrently in the spring (March-April) and early fall (Sept-Oct) to strengthen reliability of the results for modeling purposes.
- Appropriateness of funding the chute falls work out of the AMP funds is questioned.
- Potential need exists for marking technology for YOY fish, so that it is possible to track them more effectively.
- More focus needed on removal of carp and other non-natives from the LCR specifically.
- Project dates don't match the FY07 fiscal year.
- Decision to park discussions to remove mechanical removal. Time to move mechanical removal into the management action realm.
- Consensus is to provide the briefing on the fall steady flow experiment at the next TWG meeting.
- Also resolution on the definition of management actions to be on the next TWG agenda.

AWP GOAL 3

- No project identified for dfc. McMullen offers to write a paragraph on this subject for inclusion in the MRP.

AWP GOAL 4

- RBT GCMRC salaries to be included in the project budget.

AWP GOAL 5

- Concern that no funding for tribal vegetation monitoring is explicitly identified in the AWP or the MRP.
- A concern exists that significant funds have been spent without producing a single peer reviewed publication or any interpretable results about effects of flows and sediment on vegetation/riparian zone.
- Field sampling project should be put on hold until after the PEP in spring of 07. NPS has interests in having input into the veg mapping/monitoring program also. GCMRC would like to rescope this project and come back with a new proposal.
- Noted that strategic science questions don't match what is in the MRP.

MONITORING OF LAKE POWELL

- Pulling of water from the upper levels of the Lake is important to continue to monitor.

AWP GOAL 7

- Goal 7 – No modeling in FY06.
- Even though the water quality monitoring project is billed as core monitoring, this project could evolve and budget could go up or down.
- Interest in seeing LCR gage upgraded to monitor sediment inputs. Require approx. \$30K extra.
- Emphasis should be placed on monitoring “pea gravel” since this is presumably the type of substrate that would benefit HBC for spawning purposes.
- Backwater temp modeling will go on about as long as the food base program is underway. Is GCMRC getting sufficient guidance from the SPG/TWG on where this effort needs to go?

AWP GOALS 9, 10, 11

- Need to evaluate how changes in vegetation in campsite affect quality of visitor experience.
- How sand bars change under varying flows could be better understood through comparisons with bar changes occurring on a unregulated part of the river system, e.g. Cataract Canyon.
- Tribes unhappy with lack of funding for tribal monitoring.
- Request for break down of cultural R&D project costs by tasks. Pie chart provided.

AWP GOAL 12

- No major issues.

BUREAU OF RECLAMATION BUDGET

- Request that 25K per tribe be taken out of experimental carry over fund to pay for tribal monitoring programs in FY07.
- NPS request that 7K extra be provided to pay for additional permitting costs in FY 07.
- Request that new research project be developed to evaluate marking techniques for very YOY fishes, so effects of TCD can be tracked and evaluated in less than 4 yrs.
- **Proposed that the HBC Ad Hoc team identify the questions that need answering related to fate of very YOY HBC and define a scope of work for GCMRC to implement fully in FY 08, but GCMRC needs to start working on researching available technologies for marking/tracking very YOY starting in FY 07.**
- **Vote on SAV project: To not do at all in FY 07 (5 votes in favor); To do part in FY07 and part in FY 08 (1 vote). To do all of project in FY 07 (4 votes). Three (3) people abstain all together.**
- **Conclusion on Chute Falls translocation project. Wait until the PEP is concluded before proposing additional translocation.** If necessary can probably come up with an additional 15K if after the process reaches its conclusion more translocation is necessary.
- Trout removal – NPS has no funding, nor any intention of taking over this program if it is deemed to be a management action
- Management Action Issue. Clearly a policy decision that needs to be resolved at a higher level about how management actions will be paid for in the future.

MECHANICAL REMOVAL

- Recommend sticking with the original plan (turn it off) until a decision about the new plan is made officially, or RBT rebounds. Define a trigger for reinstating RBT removal.
- GCMRC update the TWG on the status of RBT in the LCR reach after each monitoring trip or every six months or so.

REVIEW OF PARKING LOT ISSUES

- **SAV – Ted Kennedy will present on this project at the next TWG. SPG will pass up to the TWG the results of the split vote and TWG can decide if will be in or out. GCMRC will present two budgets. Other projects to be funded with this money, if we decide not to include it.**
- **KAS/SWWF monitoring GCMRC and USF&WS could work out the differences. Maintain the fall river trip component, but make the spring monitoring trip a hike-in trip only.**

- Economic analysis. SPG reviews approach in July conference call and makes sure that the right questions are asked of the contractors.
- Mechanical Removal. **The SPG recommends that the non-native fish mechanical removal program focused primarily on trout be discontinued in FY 2007, as originally designed, and efforts be redirected at other non-native species, provided that appropriate monitoring of native and non-native fish populations is conducted. Such monitoring information may be used to evaluate the need to reinstate trout removal on schedule differing from the original experimental design.**

The SPG recommends that the AMP (TWG-AMWG-Secretary Designee) direct the SPG to proceed with long-term experimental design and planning using the most rigorous scientific logic and processes.

- Tribal Funding up to 125K is proposed from experimental fund. **The SPG recommends that funding up to 25K per tribe be made available in FY 07 from the experimental fund (and/or from the budget currently allocated for the SAV project, if the SAV project does not get approved for FY 07), PROVIDED that the tribes first complete their existing contractual obligations with BOR to refine and explicitly define their monitoring interests/needs and proposed monitoring protocols, and these monitoring programs and protocols are formally presented to the TWG for consideration as core monitoring projects.**
- 7k for NPS permitting – BOR and GCMRC will find the 7K to deal with this request.
- 30K for LCR gage GCMRC will continue the gauge and transfer money as needed to resolve funding.
- Continuation of SPG. Proposed that whatever this group produces in the form of a report to the Secretary's Designee and TWG, include explicit recommendations for the future role of this group (future needs for SPG services and associated budgets to meet those needs). The Secretary's Designee can then decide and direct TWG as to the future need/role for the SPG.
- Early marking of HBC – HBC Ad Hoc will review and discuss this issue and bring a recommendation forward to TWG.
- One hour SPG conference call starting at 9 am AZ time on July 20th. GCMRC will provide a briefing on GCMRC-USFWS resolution about KAS project and on economic analysis. Mary will report on CRAHG meeting discussion re: FY 07 budget.

DISCUSSION OF FY 2007 HYDROGRAPH

- SPG specifies all potential options with three being common, i.e.
 - 1) ROD flows (MLFF)
 - 2) Steady fall flows (Sept/Oct) Sept would be 6-9k, Oct steady 8K, otherwise ROD.
 - 3) Same as Option 2, but with winter fluctuations

- 6 people vote for MLFF and 6 people vote for MLFF with fall steady flows. No vote taken on Option 3, since option 3 is based on there being initial support for fall steady flows and the vote splits over 1 and 2.
- Proposed experimental components:
 - 1) March BHBF with no additional costs for studying effects beyond normal monitoring. (3 vote in favor, 7 are opposed)
 - 2) If we do steady fall flows, should we do them with or without winter fluctuations? Winter fluctuations would be 5-20K Monday through Saturday December through February, with steady 8K on Sunday, with ramping rates of 5000 up and 4000 down. Purpose is not to suppress trout (though there might be some impacts) but to mitigate effects to power.
- If TWG decides in favor of steady flows, 7 SPG members are in favor of including winter fluctuations as a mitigative action, 3 opposed.

EXPERIMENTAL OPTIONS

- The SPG approves GCMRC proposal to restructure developed options 1, 2, 3, 4 and SPG A & B into options SPG A, B, C and a no action alternative.
- WAPA is also willing to tweak the existing Option A, if the SPG is willing to consider additional tweaking at this time.
- SPG will consider tweaking of GCMRC proposed options A, B and C only, but this needs to be done in a timely manner. GCMRC will define the deadline for end of tweaking the existing options and need a firm commitment from BOR and WAPA that one or the other will deliver hourly volumes and ramping rates to GCMRC by a specified date.
- A diligent job of scientific analysis is requested including citable references for conclusions, etc.
- Analysis to be done by August, so all data about the experiments must be provided within next 10 days.
- SPG does not want GCMRC to rely exclusively on the KA as the basis for evaluating effects of the experiment. BOR and WAPA will provide an overview of changes they are proposing to Options A and C. The environmental community and boaters will evaluate potential changes to option B.
- GCMRC will sit down with principal proponent of each experimental design and define the details of each option for this analysis, including specifying which elements are truly experimental vs. management actions vs. mitigations.

MRP REVIEW

- Fly fishers and CREDA recommend revisions in writing, since they had to leave early.
- NPS provides comments on the MRP on the laptop computer.

- There may be some changes suggested based on CRAHG review. Notes on changes will be provided by Chair of CRAHG.
- Need clear definition of what will be included as core monitoring
- Concern about potential discrepancies between what MRP says and potential changes that may be necessitated based on what is included in the final experimental design.
- Concern that MRP is not structured explicitly around the strategic science questions and is not clearly tied to established priorities. Same applies to research plan – what are the real priorities? The program ought to be focused around the key strategic question, with program laid out for getting to resolution of key questions.
- MRP should lay the road map out for how we finally get to the integration of the individual goals/resources into an ecosystem context.
- SAs recognized some of the same issues, but they also saw that most of the critical gaps in the program have been explicitly recognized and are being addressed in the MRP. They also recognized the need for more focus on critical science questions.
- MRP should clearly define commitments to completing key elements of the plan in five years.
- Cross walk between strategic science questions and AMWG priorities and prioritized CMINS
- MRP is supported for recommendation to TWG with changes proposed. GCMRC agrees to give everyone one more week to submit comments, then we will make changes and forward to TWG for approval.

DRAFT

TO: SPG Members
FROM: L.D. Garrett, SA Executive Director
DATE: June 30, 2006
SUBJECT: Discussions and Agreements from May SPG Meeting

Following are notes from our May 23-24, 2006 SPG meeting which was held at the Phoenix BIA, 12th floor, conference room A.

The meeting was convened at 10:10 a.m. In attendance were Dennis Kubly, Bill Persons, Kerry Christiansen, Mark Steffan, Kurt Dongoske, Leslie James, Lloyd Greiner, Norm Henderson, Rick Johnson, Dave Garrett, John Hamill, Ted Melis, Matt Andersen, Helen Fairley, Tara Conrad, Glen Knowles, Mary Barger, and Gary Burton.

Two potential changes in the current SPG direction were proposed to provide improvements in decision processes on experimental options. They are precipitated by discussions with DOI leadership.

- 1) AMWG/TWG might be to report to the Secretary information on all experimental options that we have been considering up to now, rather than attempting to agree on one option.
- 2) AMWG/TWG may also want to consider how the SPG outcomes can be used to support the NEPA process.

Discussions on 1) above led to a conclusion to forward SPG developed information on all Options to the TWG, i.e., 1, 2, 3, and 4 and Options A and B. Consistent information would be provided for all options as originally developed for Options 1-4.

Discussions on 2) above, contributions of the SPG process to NEPA requirements, resulted in several resolves.

- The NEPA process for experimental options (flow and non-flow elements) may require an EIS.
- More clarification and improved specification is needed on flow and non-flow actions proposed for inclusion in each option.
- The SPG also requested that Hamill and Garrett obtain clarification from the Assistant Secretary on what specifically is needed from the SPG and other AMP groups regarding experimental options and science plans, i.e., MRP, and report back to the SPG.
- A list of 8 SPG questions, as follows, were developed to assist Hamill and Garrett in discussions with Gold and Limbaugh.

General Questions:

1. Does the Secretary want a recommendation on experimental options from the AMP? Or just the identification of the various options that should/could be considered by DOI?
2. In addition to the 6 experimental option alternatives, is there desire to evaluate the “no action” alternative (ROD)?
3. Should stakeholders continue to work towards consensus on trying to merge or revise experimental options?
4. What type of information/analysis and level of detail should be provided on each experimental option?
5. What will be the process for finalizing/approving the Strategic Science Plan, Monitoring and Research Plan and FY 07/08 Work plan and Budget (without experimental elements) by August? i.e. Can these documents be approved via conference call with the AMWG on or before August 31, 2006?
6. What is the deadline for the AMP to finalize and recommend the experimental option(s) to the Secretary?
7. Is there a need to develop a detailed experimental plan beyond the currently proposed 5-7 years?
8. What information from SPG (and at what level of specificity) is needed as input to the FY 2007-11 experimental program NEPA assessment

A discussion of SPG proposed economic analysis of the experimental options was proposed to be terminated for current planning and revisited at a later date, potentially in the NEPA process. More explicit guidelines and protocols would be needed for the analysis if and when it is revisited.

Discussions were opened on the MRP and BAWP. The SSP had been previously approved by the SPG for recommended to TWG.

Discussions of the MRP preceded the BAWP. Hamill provided clarification on how monitoring projects would be screened for inclusion in core monitoring, i.e., first green projects then current R&D projects for monitoring. Specific approaches are in the MRP, but concerns over time frames are not specified.

- Proposals were made for; including elements on timing of the analysis of green monitoring projects, hydropower costs; parasite projects; consistency of MRP and BAWP; and percentage budget allocations to core monitoring.
- Integrated interdisciplinary science with guidance from SAs would involve review of conceptual model and refinement of interdisciplinary science approaches. Review and recommendations for a revised direction is to be provided by SAs in FY 2007.

- Personnel changes to support MRP would include placement of a Deputy Chief for program integration from current staff, and an ecosystem scientist (part time) from outside GCMRC.
- Monitoring and Research programs outside AMP are proposed including LCR threats, Lake Powell water quality, and climate change impacts. Programs would be supported through supplemental funding outside AMP.
- The MRP table listing all proposal programs/projects was proposed to be reinstated.
- Emphasis on diction efforts to have alternate assessment criteria for recruitment was proposed.
- More specific linkage among programs/projects in SSP/MRP/BAWP is needed.
- GCMRC notes that trout mechanical* removal will cease in FY 2007, but it is listed in MRP.
- It is proposed that MRP be completed in July/August with options for revisions in October required by selected experimental option.
- Continued work on MRP will be in the July 5-7 SPG meeting. It was proposed that the June SPG/TWG meeting be cancelled and have a July 5-7 SPG meeting and July or August TWG meeting. All SPG MRP reviews are to be to Hamill by June 9, with new draft to SPG by June 28.

Review, discussions and decisions on the BAWP included:

- SA review to be mailed to SPG supports adoption of the SSP, MRP, and BAWP with proposed changes. Selected proposed changes were presented including: more robust three step approach to building bridges; complete green monitoring project analysis in year, etc. The complete SA review is to be mailed to SPG.
- GCMRC and some SPG members propose repeating ROD flows in FY 2007. Some SPG members propose steady flows of some extent in FY 2007. A discussion of the FY 2007 hydrograph was delayed to July 5-7.

A line by line review of all BAWP projects was proposed by SPG members, with the following outcomes accomplished.

- CM (core monitoring) projects should be restricted to green projects that will be reviewed and presumably approved in Fy07 – all others should be in R&D.
- Budget table should be reorganized to follow the order of projects presented in the BAWP (organized by Goal)
- Modeling project includes salary for Scott Wright and Steve Wiele to continue working on eddy storage modeling.
- Temperature modeling effort is being done by GCMRC and should be done by end of FY06, so no additional funding is proposed in FY07.
- Add additional temperature monitoring at additional mainstem/backwater sites in the future to the experimental part of the Integrated WQ project in FY07 (07.7.3) as well as potentially to the long-term core monitoring project (07.7.1). **(Parking lot).**
- Paria gage is not included in the core monitoring project, but food base researchers would like to see gage resurrected to track nutrient inputs when the Paria floods.

- There is insufficient detail in the BAWP about the core monitoring methods of Project 07.7.1. GCMRC commits to go back and add more information in the BAWP.
- When and where will a document be developed that actually spells out the details of core monitoring, project analysis, i.e., what will be done, when, and who will do it. **(Parking Lot)**
- Is campsite monitoring included in 07.8.1 project. GCMRC says yes.
- 07.12.1 – In preparation for remote sensing mission in FY 09, \$140K will be put in a working capital fund, approx. 1/3 in FY07, then another 1/3 in FY 08 and another in FY 09.
- 07.12. 6 – Should be either identified as part of vegetation monitoring, beach monitoring, etc. rather than as a stand-alone DASA project with no clear links to CM, R&D. **(Parking lot)**.
- Has GCMRC funded the appropriate level of resolution for remote sensing in FY09? **(Parking lot)**.
- 07.12.2 Database management – includes part of Glen Bennett’s salary and all of Chris Flaccus’s salary, plus a \$20,000 contract for support of the Oracle database.
- 07.12.3 – library support.
- 07.12.4 – legacy analog data conversion. Take all airphotos and convert them to electronic digital formats.
- Concern exists over the very significant increase in the DASA program funding
- Potential disconnect between the PEP review process and the core monitoring evaluation process.
- Where is the project/funding for reviewing the green projects? **(Parking lot)**.
- 07.1.1. Food base study – basically the same as in the past. Increase reflects hiring a biotech to assist Ted Kennedy and Wyatt.
- Can we pick up with current monitoring the effects of oxygen depletion from future dam releases?
- Submerged Aquatic Vegetation – potentially will become a core monitoring effort in the future. This is potentially one of the most important variables affecting trout fishery. Aquatic vegetation has been severely affected by recent flow regime and we need to understand how/why it has been affected. Is this being captured under Project 07.1.1? **(Parking lot)**.
- 07.1.22 – Complete diet/drift/predation study. Analysis and write-up should have been completed with the prior budget allocated to this project. The SPG wants more detail about how many samples are left to analyze, what is the status of the data base, what exactly would the analysis entail.
- Identify its priority projects and/or priorities within projects. GCMRC should identify which projects are truly critical, important vs. less so or less immediate.

M3 RESEARCH

L. David & Pamela Garrett, Principals
53716 Falcon Rd
Olathe, CO 81425

970-323-9511 (Ph)
970-323-9512 (Fax)
E-Mail: m3research@aol.com

DRAFT

TO: Science Planning Group and Science Advisor Files
FROM: L.D. Garrett, Executive Director, SAs
DATE: November 20, 2005
SUBJECT: Actions Taken at November 8-9, 2005 SPG Meeting

The November 8-9, 2005 SPG meeting was attended by the following representatives: Bill Persons, Barb Ralston, Helen Fairley, Ted Melis, Mary Barger, Gary Burton, Dave Garrett, Pamela Garrett, Chris Kincaid, Ken McMullen, Lisa Leap, Mike Yeatts, Mike Berry, Lloyd Greiner, Mark Steffens, Glen Knowles, Norm Henderson, Mark McKinstry, Dennis Kubly, Claton Palmer, Wayne Cook, Dave Siebert.

The goals of the meeting were to accomplish the following:

1. Revise and agree to a SPG schedule, general agenda and outcomes for the period 11/05-7/06.
2. Discuss Experimental Options. Options were presented across a range of alternatives by GCMRC and stakeholders.
3. Agree to revised set of objectives for SPG for the 11/05-7/06 period.
4. Review HBCCP projects and evaluate which research, monitoring and management actions are to be evaluated in the GCD AMP for FY 2007/2011.
5. Review new merged monitoring and research plan format for adoption.
6. Review and propose changes to SSP.
7. Discuss and propose changes to MRP.

Actions taken by SPG at the meeting include the following.

1. Agreed to a revised SPG schedule to be developed by Garrett for next SPG meeting.



2. Agreed to revised set of objectives for SPG. Garrett to draft proposed set of outcomes for objectives for next SPG meeting (1/06).
3. The SPG objective to develop a process to determine DFCs for CRE resources is led by K. McMullen. Ken will use a GCNP process for defining DFCs and provide presentation at the January SPG meeting.
4. Because of concerns over the need to merge disparate views on DFCs, Mark McKinstry agreed to evaluate computer based models to assist the group in the process, and present an assessment at a future SPG meeting.
5. The proposal to merge the Research Plan and Monitoring Plan is accepted by the group with the caveat of continued review of MRP revisions at the January and February meetings. A "Monitoring Research Plan" is the proposed title (MRP). It is recommended that the document title demonstrate that is an outcome of the GCD AMP.
6. The review of the HBCCP revealed 9 listed project areas as potentially requiring a research or monitoring effort by GCMRC in FY 2007/2008. The HBCCP Group will develop potential costs for all proposed HBC projects and provide to the SPG in January or February.
7. Three primary Experimental Options were reviewed. Options one and two, as presented at the meeting, include a combination of flow and non flow activities. Two differs from one only in the addition of low a flow option in the fall. Both one and two combine elements of factorial and forward titration experimental processes. Option three includes the flow and non flow elements of one and two, with additional emphasis on winter and summer trout suppression/stranding flows. The option is presented as a reverse titration design. GCMRC will provide evaluations of options 1, 2, and three at the January SPG meeting.
8. The GCMRC/SPG/SA review of the SSP resulted in significant recommendations for change. The SPG was asked to provide to GCMRC any additional recommendation for change by 12/20/05. GCMRC will revise SSP for January or February presentations and discussions with SPG.

9. The GCMRC/SPG/SA discussion of the MPR resulted in several proposals for change. However, the document was presented at the meeting, and SPG members had no opportunity for a review. The review period was extended to 12/20/05.

SPG members were encouraged to attend the November TWG meeting for additional input on science planning.

APPENDIX E
EXAMPLE SPG PROCESS
FOR RANKING GOALS

ADDRESSING AMWG GOALS THROUGH STRUCTURED SCIENCE QUESTIONS

LAKE POWELL RESOURCES

AMWG Goals: None specified; although INs are specified

Potential Science Question

- How would potential future climate changes for the Southwest impact resources of the Lake Powell Ecosystem and Colorado River Ecosystem of the GCD AMP?
- How would the CRE and Lake Powell ecosystems and resources respond to an extended drought?

THE CRE PHYSICAL RESOURCES

AMWG Goals

- Maintain or attain necessary levels of useable sediment storage in CRE for desired CRE resource conditions and ecosystem function.
- Establish water temperature, quality and flow dynamics to achieve CRE goals.

Potential Science Questions

- How are sediment fines routed and stored through the CRE under differing flow regimes?
- What flow regime strategies best maintain fines in the CRE and maintain beaches and cultural resources?
- What are the physical relationships of flows and terrestrial vegetation?
- How does the CRE respond to drought?
- How will changes in water temperatures effect distributions and trophic interactions of native and exotic fishes?
- Will a flow only option restore and maintain sandbar habitats over decadal time scales?
- What is the optimal BHBF and maintenance flow strategy to manage tributary inputs on an annual to inter-annual time scale
- What are the short-term responses of sandbars to BHBFs?
- What are the changes in eddy storage during time intervals between BHBFs?
- How does the grain size distribution of the deposits effect sandbars stability?
- What are the effects or ramping rates on sediment transport and sandbar stability?
- Can we develop a relationship between suspended sediment concentration and turbidity support fisheries research?
- How does the CRE and Lake Powell respond to drought?
- How will recent changes in water temperature effect distribution and trophic interactions of native and exotic fishes
- Do we need predictive capabilities for dissolved oxygen in dam releases, downstream?

- Can BHBF maintain sand bars (beaches) without sand augmentation?
- What BHBF strategy maximizes sand storage?
- What are the long term rates of eddy erosion between BHBF?
- What is the expected frequency of BHBFs without sediment augmentation?
- During the intervening periods, to what characteristic size are eddy bars expected to shrink?
- Would any change in dam operations have any measurable effect on the size of these bars?
- Would the cost of these operational changes be acceptable in a local and regional sense?
- What operational changes are necessary to increase the quality of fine sediment available for redistribution during a BHBF and to decrease the duration of time between BHBFs?
- If sediment were added to the system and the frequency or rebuilding events increased, to what larger size would be the average eddy bar condition? Would the increased costs of sediment augmentation be offset by the potentially decreased emphasis on restrictions of flows during the intervening periods?
- To what average bar condition do managers want the system to remain?

THE CRE BIOTOC RESOURCES

AMWG Goals

- Maintain or attain viable populations of existing native fish, remove jeopardy from humpback chub and razorback sucker, and prevent adverse modification to their critical habitat;
- Maintain a naturally reproducing population of rainbow trout above the Paria River consistent with maintenance of native fish below Paria
- Protect and improve the aquatic food base to support viable populations of desired species at higher trophic levels
- Restore, maintain or attain viable population of KAS and other TES as feasible and advisable
- Protect or improve the biotic riparian and spring communities, including TES and their critical habitat

Potential Science Questions

- What is the limiting lifestage controlling population size of HBC, mainstem spawning and juvi production from LCR, adult mortality in LCR and mainstem?
- What are the main factors effecting HBC recruitment dynamics?
- Given release temperatures and meteorological conditions along the river, can we predict sub-daily variation in mainstem river temperatures throughout the CRE?
- For a given mainstem temperature and meteorology, can we predict sub-daily nearshore temperatures (longitudinally, laterally and vertically) throughout the CRE?
- What is the effect of increased temperatures on recruitment to adult population of HBC?
- Do higher temperatures promote successful HBC spawning in the mainstem?
- Do higher temperatures increase the survival rate of juveniles?
- What is the effect of daily fluctuations on recruitment to adult population of HBC?
- Do increased fluctuations (daily range, etc.) decrease the survival rate of spawning, YoY and juvenile survival?
- Do fluctuations have an effect on backwater survival when releases from GCD are warm? Does a reduction in the abundance of BNT and RBT increase HBC recruitment?

- How will HBC and RBT respond to varied flows, temperatures, and populations?
- How do CRE biotic resources such as HBC and RBT respond to changes in water quality?
- What are the food base requirements for HBC and RBT?
- How are riparian and spring communities and habitat affected by flow regimes?
- What are the physical and biotic relationships of flows and terrestrial vegetation?
- How does the occurrence and state of marsh and backwater communities associated with different flow regimes effect fish reproduction and survival?
- How is the encroachment of native and non-native vegetation on recreation sites related to flow regimes?
- What is the contribution of the terrestrial ecosystem to the river?
- How do flows affect productivity and decomposition rates of riparian vegetation?
- How does vegetation composition change spatially (within zones and between beaches) and temporally (e.g., time since disturbance) with flows and sediment availability and grain size?
- How do warmer releases affect viability and productivity of native/non-native vegetation?
- To what extent and in what respects can BHBF's (magnitude and frequency) achieve reduction of exotic species?
- How could monthly volumes be changed to beneficially affect recreation, TCPs, and riparian habitat?
- Is the diversity of riparian species found along the river corridor constrained phylogenetically or by environmental factors?
- What are the rates of change for woody and perennial species and how are these rates affected by time since disturbance?

THE CRE SOCIAL CULTURAL RESOURCES

AMWG Goals

- Maintain or improve the quality of recreational experiences for users of the Colorado River ecosystem, within the framework of the Adaptive Management Program ecosystem goals.
- Maintain power production capacity and energy generation, and increase where feasible and advisable, within the framework of the Adaptive Management ecosystem goals.
- Preserve, protect, manage, and treat cultural resources for the inspiration and benefit of past, present, and future generations.
- Maintain a high quality monitoring, research, and adaptive management program.

Potential Science Questions

- Can recreational experience be quantified for single event opportunities vs. multi-opportunity experiences?
- What are the drivers for recreational experience?
- How important are flows relative to other drivers for recreational experience?
- What is the minimum size, quantity, distribution and quality of campsites to meet NPS goals for visitor experience?
- How are safety & navigability measured relative to flows?
- How does flows increase or decrease the rates of erosion at arch sites?
- To what extent and in what respects can BHBF's achieve systemwide mitigation to arch site erosion?

- What is the optimal return frequency for mitigation purposes?
- What, where and why are TCPs important? This information is needed to evaluate effects of flows on them?
- How can tribal data/analyses/values be incorporated into western science process to evaluate flow operations and management action effects on TCPs?
- What comprehensive cultural resource strategy is most appropriate for FY 2005-2009?
- How can flow impacted cultural resource loss be best mitigated in FY 2005-2009?
- How are current human uses of the CRE impacted by flow regimes and how do these current uses impact other components of the CRE?

APPENDIX F
A PROCESS FOR SPECIFYING AND
ADOPTING CORE MONITORING PROJECTS

AMP Goal	1st CMIN for inclusion in CMP	2nd CMIN for inclusion in CMP	3rd CMIN for inclusion in CMP	4th CMIN for inclusion in CMP	5th CMIN for inclusion in CMP
HBC	1) CMIN 2.1.2 Determine and track recruitment (identify life stage), abundance and distribution of HBC in the LCR.	2) CMIN 2.1.2 Determine and track recruitment (identify life stage), abundance and distribution of HBC in the mainstem.	3) CMIN 2.3.1 Determine and track the parasite loads on HBC and other native fish found in the LCR and in the Colorado River ecosystem.	4) CMIN 2.4.1 Determine and track the abundance and distribution of non-native predatory fish species in the Colorado River.	5) CMIN 2.6.1 Determine and track the abundance and distribution of flannelmouth sucker, bluehead sucker, and speckled dace populations in the Colorado River ecosystem.
Cultural	1) 11.1.1 Determine the condition and integrity of prehistoric and historic sites in the Colorado River ecosystem through tracking rates of erosion, visitor impacts, and other relevant variables. 2) 11.2.1 Determine the condition and integrity of TCPs in the Colorado River ecosystem.	3) 11.2.1 Determine the condition of traditionally important resources and locations using tribal perspectives and values.			
WQ	4) CMIN 7.4.2 Determine and track flow releases (gage data and SCADA data; time interval still TBD) from Glen Canyon Dam, under all operating conditions, particularly related to flow duration, upramp, and downramp conditions. (parameters are upramp and downramp rates, volume, daily minimum and max)	1) CMIN 7.1.1 Determine the water temperature dynamics in the mainstem, tributaries (as appropriate, temperature only in mainstem and LCR), backwaters, and near-shore areas throughout the Colorado River ecosystem.	3) CMIN 7.2.1 Determine the seasonal and yearly trends in turbidity, conductivity, DO, and pH, (decide below whether selenium is important) changes in the mainstem throughout the Colorado River ecosystem?	2) CMIN 7.1.2 Determine and track LCR discharge and temperature near mouth (below springs).	

Foodbase

- 1) CMIN 1.1.1 Determine and track the composition and biomass of primary producers below Glen Canyon Dam in conjunction with measurements of flow, nutrients, water temperature, and light regime. 2) CMIN 1.2.1 Determine and track the composition and biomass of benthic invertebrates below Glen Canyon Dam in conjunction with measurements of flow, nutrients, water temperature, and light regime.
- 3) CMIN 1.5.1 Determine and track the composition and biomass of drift in the Colorado River in conjunction with measurements of flow, nutrients, water temperature, and light regime.

Riparian

- 1) CMIN 6.1.1 Determine and track the abundance, composition, distribution, and area of the marsh community as measured at 5-year or other appropriate intervals based on life cycles of the species and rates of change for the community.
- 2) CMIN 6.2.1 Determine and track the patch number, patch distribution, composition and area of the NHWZ, OHWZ, and sand beach communities as measured at 5-year or other appropriate intervals based on life cycles of the species and rates of change for the community.
- 3) CMIN 6.5.1 Determine and track the distribution and abundance of non-native species in the Colorado River ecosystem as measured at 5-year or other appropriate intervals based on life cycles of the species and rates of change for the community.
- 4) CMIN 6.6.1 Determine and track the composition, abundance, and distribution of seep and spring communities as measured at 5-year or other appropriate intervals based on life cycles of the species and rates of change for the community.

Sediment

- 1) CMIN 8.1.1 Determine and track the biennial sand bar area and fine-sediment volume and grain-size changes within eddies below 5,000 cfs stage, by reach.
- 2) CMIN 8.1.2 What are the monthly sand and silt/clay –export volumes and grain-size characteristics, by reach, as measured at Lees Ferry, Lower Marble Canyon, Grand Canyon, and Diamond Creek Stations?
- 3) CMIN 8.1.3 Track, as appropriate, the monthly sand and silt/clay -input volumes and grain-size characteristics, by reach, as measured or estimated at the Paria and Little Colorado River stations, other major tributaries like Kanab and Havasu creeks, and “lesser” tributaries?
- 4) CMIN 8.2.1 Track, as appropriate, the biennial or annual sandbar area, volume and grain-size changes within and outside of eddies between 5,000 and 25,000 cfs stage, by reach.
- 5) CMIN 8.5.1 Track, as appropriate, the biennial sandbar area, volume and grain-size changes above 25,000 cfs stage, by reach.
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Recreation	4) CMIN 9.3.1 Determine and track the size, quality, and distribution of camping beaches by reach and stage level in Glen and Grand Canyons.	1) CMIN 9.1.1 Determine and track the changes attributable to dam operations in recreational quality, opportunities and use, impacts, serious incidents, and perceptions of users, including the level of satisfaction, in the Colorado River Ecosystem.	5) CMIN 9.5.1 Determine and track the frequency and scheduling of research and monitoring activity in Glen and Grand Canyons.	2) CMIN 9.1.2 Determine and track the frequency and scheduling of river-related use patterns.	3) CMIN 9.2.2 Determine and track accident rates for visitors participating in river-related activities including causes and location (i.e. on-river or off-river), equipment type, operator experience, and other factors of these accidents in the Colorado River ecosystem.
KAS	1) CMIN 5.1.1 Determine and track the abundance and distribution of Kanab ambersnail at Vasey's Paradise in the lower zone (below 100,000 cfs) and the upper zone (above 100,000 cfs).	2) CMIN 5.2.1 Determine and track the size and composition of the habitat used by Kanab ambersnail at Vasey's Paradise.			
Power	1) CMIN 10.1.1 Determine and track the marketable capacity and energy produced through dam operations in relation to the various release scenarios(daily fluctuation limit, upramp and downramp limits, list components, maximum flow limit of 25,000 cfs, minimum flow limit of 5,000 cfs).				
AMP	None identified				
Trout	1) CMIN 4.1.1 Determine annual population estimates for age II+ rainbow trout in the Lees Ferry reach.	3) CMIN 4.1.4 Determine annual growth rate, standard condition (Kn), and relative weight of rainbow trout in the Lees Ferry reach.	2) CMIN 4.1.2 Determine annual proportional stock density of rainbow trout in the Lees Ferry reach.		
Extirpated Species	None identified				

APPENDIX G
LINKING AMP SCIENCE QUESTIONS
AND INFORMATION NEEDS

Appendix X. Crosswalk between science questions and AMP research and core monitoring information needs.

AMP Goal (in priority order)	Overarching and refined science questions	Relevant CMINs (as redefined by SPG) and RINs	CMINs (as redefined and prioritized by SPG)
HBC (and other native fishes)	<p>a. Environmental affects on recruitment dynamics. What is the limiting life stage controlling recruitment of the HBC?</p>	RIN	<p>1) CMIN 2.1.2 Determine and track recruitment (identify life stage), abundance and distribution of HBC in the LCR.</p> <p>2) CMIN 2.1.2 Determine and track recruitment (identify life stage), abundance and distribution of HBC in the mainstem.</p> <p>3) CMIN 2.3.1 Determine and track the parasite loads on HBC and other native fish found in the LCR and in the Colorado River ecosystem.</p>
	<p>b. Environmental affects on recruitment dynamics. What are the dominant factors controlling recruitment of HBC?</p>	RIN	<p>4) CMIN 2.4.1 Determine and track the abundance and distribution of non-native predatory fish species in the Colorado River.</p> <p>5) CMIN 2.6.1 Determine and track the abundance and distribution of flannelmouth sucker, bluehead sucker, and speckled dace populations in the Colorado River ecosystem.</p>
Cultural	<p>a. How do flows, climate, and human use interact to impact historic properties in the CRE, and more specifically, do flows affect (increase or decrease) rates of erosion of the higher Holocene deposits where most archaeological sites occur? Subquestions (of Question a):</p> <ul style="list-style-type: none"> • To what extent do flows affect archaeological site stability/integrity in the CRE? • If dam controlled flows are contributing to (influencing rates of) archaeological site/TCP degradation, what are the optimal flows for minimizing future impacts to these historic properties? • To what extent and in what respects can BHBFs be used to achieve systemwide mitigation of 	<p>CMINS 11.1.1 and 11.1.2. RINS 11.1.1, 11.1.2 , 11.1.2a, EIN 11.1.1</p>	<p>1) 11.1.1 Determine the condition and integrity of prehistoric and historic sites in the Colorado River ecosystem through tracking rates of erosion, visitor impacts, and other relevant variables.</p> <p>2) 11.1.2 Determine the condition and integrity of TCPs in the Colorado River ecosystem.</p> <p>3) 11.2.1 Determine the condition of traditionally important resources and locations using tribal perspectives and values.</p>

	<p>archaeological site erosion?</p> <ul style="list-style-type: none"> If flows or BHBFs can not be applied to benefit cultural resources, can other sustainable treatment options be applied for preserving threatened heritage resources in the Colorado River corridor, and what are the best (most effective and least intrusive) options for in situ preservation of cultural resources? 		
	<p>b. How do flows positively or negatively impact the culturally-valued flora and fauna in the CRE (especially the biological communities associated with TCPs)?</p>	<p>CMIN 11.2.1 and RINS 11.2.1, 11.2.2, 11.2.3, and 11.2.4</p>	
	<p>c. What important historical/ legacy information about the CRE ecosystem and past human use of the CRE are embedded within the higher elevation Holocene deposits and will be lost due to the ongoing erosion of these older pre-dam deposits?</p>	<p>CMIN 11.1.1. and RINS 11.1.1a,b,c</p>	

WQ	<p>a. How do dam operations, reservoir conditions, tributaries, climate, canyon orientation/aspect, and the proposed temperature control device affect water temperature along the Colorado River in Grand Canyon, both in the main channel (1-dimensional) and in near-shore habitats (2 & 3-dimensional elements that tie 1-D responses to temperatures within backwaters)?</p>	<p>1) CMIN 7.4.2 Determine and track flow releases (gage data and SCADA data; time interval still TBD) from Glen Canyon Dam, under all operating conditions, particularly related to flow duration, upramp, and downramp conditions. (parameters are upramp and downramp rates, volume, daily minimum and max)</p> <p>2) CMIN 7.1.1 Determine the water temperature dynamics in the mainstem, tributaries (as appropriate, temperature only in mainstem and LCR), backwaters, and near-shore areas throughout the Colorado River ecosystem.</p> <p>3) CMIN 7.2.1 Determine the seasonal and yearly trends in turbidity, conductivity, DO, and pH, (decide below whether selenium is important) changes in the mainstem throughout the Colorado River ecosystem?</p> <p>4) CMIN 7.1.2 Determine and track LCR discharge and temperature near mouth (below springs).</p>
	<p>b. How does water temperature affect other water quality parameters and other resources such as the aquatic food base, fish, biological pathogens, recreation, etc? Question b. is determined via actual monitoring and research of other resources such as RBT, HBC, food base etc. However Question a. can be pursued under water quality, through several other sub-questions of a., including;</p> <ul style="list-style-type: none"> • What would release temperatures and downstream near-shore temperature be like under prolonged drought conditions? • How do backwater temperatures in the vicinity of the LCR differ under differing fluctuating versus steady flow alternative? • What temperature would the main channel achieve at a given location during a low steady flow during a typical summer with a TCD in place? 	

Foodbase	a. Basic understanding of food web linkages: What are the important pathways, and the rate of flux along them, that link lower trophic levels with fish?		1) CMIN 1.1.1 Determine and track the composition and biomass of primary producers below Glen Canyon Dam in conjunction with measurements of flow, nutrients, water temperature, and light regime.
	b. Relational understanding of productivity and operational affects: How is invertebrate flux affected by water quality and dam operations?		2) CMIN 1.2.1 Determine and track the composition and biomass of benthic invertebrates below Glen Canyon Dam in conjunction with measurements of flow, nutrients, water temperature, and light regime. 3) CMIN 1.5.1 Determine and track the composition and bio-mass of drift in the Colorado River in conjunction with measurements of flow, nutrients, water temperature, and light regime.
	c. Linkage between food availability (local and drifting food) and fish abundances: Are trends in the abundance of fish populations or indicators associated with fish, correlated with patterns in food availability and/or quality?		
Riparian	a. Temporal and spatial interactions within the riparian community. How do processes occurring at a variety of spatial scales (i.e., population level to community to landscape scales) interface to influence riparian habitat structure and composition?		1) CMIN 6.1.1 Determine and track the abundance, composition, distribution, and area of the marsh community as measured at 5-year or other appropriate intervals based on life cycles of the species and rates of change for the community. 2) CMIN 6.6.1 Determine and track the composition, abundance, and distribution of seep and spring communities as measured at 5-year or other appropriate intervals based on life cycles of the species and rates of change for the community. 3) CMIN 6.2.1 Determine and track the patch number, patch distribution,

	<p>b. Temporal and spatial interactions between ecosystem components. What is the nature and timing of terrestrial—aquatic linkages, and what is their influence on the recipient habitat?</p>		<p>composition and area of the NHWZ, OHWZ, and sand beach communities as measured at 5-year or other appropriate intervals based on life cycles of the species and rates of change for the community.</p> <p>4) CMIN 6.5.1 Determine and track the distribution and abundance of non-native species in the Colorado River ecosystem as measured at 5-year or other appropriate intervals based on life cycles of the species and rates of change for the community.</p>
	<p>c. Temporal and spatial interactions between ecosystem components. How do terrestrial habitat and cultural resources interface?</p>		
Sediment	<p>Is there a “flow-only” (meaning, without sediment augmentation) operating strategy for Glen Canyon Dam releases that will attain and maintain necessary levels of useable sediment storage in the Colorado River ecosystem (CRE) to achieve desired CRE resource conditions and ecosystem function? Assumption: artificial floods, termed Beach/Habitat-Building Flows, are a required element of the flow-only management strategy.</p>		<p>1) CMIN 8.1.3 Track, as appropriate, the monthly sand and silt/clay -input volumes and grain-size characteristics, by reach, as measured or estimated at the Paria and Little Colorado River stations, other major tributaries like Kanab and Havasu creeks, and “lesser” tributaries?</p> <p>2) CMIN 8.2.1 Track, as appropriate, the biennial or annual sandbar area, volume and grain-size changes within and outside of eddies between 5,000 and 25,000 cfs stage, by reach.</p> <p>3) CMIN 8.1.2 What are the monthly sand and silt/clay –export volumes and grain-size characteristics, by reach, as measured at Lees Ferry, Lower Marble Canyon, Grand Canyon, and Diamond Creek Stations?</p> <p>4) CMIN 8.1.1 Determine and track the biennial sand bar area and fine-sediment volume and grain-size changes within eddies below 5,000 cfs stage, by reach.</p> <p>5) CMIN 8.5.1 Track, as appropriate, the biennial sandbar area, volume and grain-size changes above 25,000 cfs stage, by reach.</p>
Recreation	<p>a. What are the principle drivers of recreational experience quality in the CRE, and how important are flows relative to the other drivers?</p>	<p>CMIN 9.1.1.1 and RINS 9.1.1, 9.1.2, 9.1.3, 9.3.1, 9.4.1</p>	<p>1) CMIN 9.3.1 Determine and track the size, quality, and distribution of camping beaches by reach and stage level in Glen and Grand Canyons.</p> <p>2) CMIN 9.1.1 Determine and track the changes attributable to dam operations in recreational quality, opportunities and use, impacts, serious incidents, and perceptions of users, including the level of satisfaction, in the Colorado River Ecosystem.</p> <p>3) CMIN 9.5.1 Determine and track the</p>

	b. How do dam-controlled flows and other management actions affect recreational experiences, and what is/are the optional flows for maintaining a high quality recreational experience in the CRE?	CMINS 9.1.1, 9.2.2, 9.3.1, 9.2.2 and 9.5.1, EINS 9.1.1 and 9.3.1, RIN 9.5.1	frequency and scheduling of research and monitoring activity in Glen and Grand Canyons. 4) CMIN 9.1.2 Determine and track the frequency and scheduling of river-related use patterns. 5) CMIN 9.2.2 Determine and track accident rates for visitors participating in river-related activities including causes and location (i.e. on-river or off-river), equipment type, operator experience, and other factors of these accidents in the Colorado River ecosystem.
KAS	See riparian question b.		1) CMIN 5.1.1 Determine and track the abundance and distribution of Kanab ambersnail at Vasey's Paradise in the lower zone (below 100,000 cfs) and the upper zone (above 100,000 cfs). 2) CMIN 5.2.1 Determine and track the size and composition of the habitat used by Kanab ambersnail at Vasey's Paradise.
Power	a. What flow regimes best mitigate cultural, sediment and recreation resource impacts, improve fishery resources, maintain or improve riparian habitat and insure acceptable power generation?		1) CMIN 10.1.1 Determine and track the marketable capacity and energy produced through dam operations in relation to the various release scenarios(daily fluctuation limit, upramp and downramp limits, list components, maximum flow limit of 25,000 cfs, minimum flow limit of 5,000 cfs).
Trout	a. Operational affects on recruitment dynamics and dispersal. What is the relationship between GCD flow regimes, and annual volumes, and population dynamics of rainbow trout in the Lees Ferry reach and downstream?		1) CMIN 4.1.1 Determine annual population estimates for age II+ rainbow trout in the Lees Ferry reach. 2) CMIN 4.1.4 Determine annual growth rate, standard condition (Kn), and relative weight of rainbow trout in the Lees Ferry reach. 3) CMIN 4.1.2 Determine annual proportional stock density of rainbow trout in the Lees Ferry reach.
	b. Operational affects on recruitment dynamics in Lees Ferry. What could be the water quality effects (temperature) on RBT/Brown trout in Lees Ferry?		
AMP	What is the status of existing GCMRC/AMP data related to key resources and ecosystem processes (such as water volume/release pattern, water temp/ qualities, sediment volume/flux, vegetation/habitats, terrestrial food resources, etc) with respect to the following: 1)		None identified

	accuracy of existing data, 2) adequacy/precision necessary for modeling and status/trends assessments, and 3) current accessibility/utility of existing databases for analyses and future model development.		
Extirpated Species			None identified