A REVIEW OF THE GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM EFFECTIVENESS

BY
GCD AMP SCIENCE ADVISORS

JANUARY 2007

EXECUTIVE SUMMARY

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In 2005, the Science Advisors were asked to conduct a review of the general effectiveness of the Glen Canyon Dam Adaptive Management Program. The developed review represents an overview critique of the ongoing AMP experiment in managing a dynamic ecological and social system to a level of improved resource conditions. As such, the review does not evaluate all of the detail and complexity of the AMP, but rather focuses on selected structural, process and outcome elements. The focus of this review is on several major aspects of the program including; organizational effectiveness, program resources, operational effectiveness, science and management planning and implementation, and effectiveness in obtaining outcomes.

REVIEW CONSTRAINTS AND PROCEDURES

Constraints

The GCD AMP SA Review was implemented in 2005 but not completed until the end of 2006. Two factors caused these delays.

1. Each SA can budget 14-20 days per year for review and advisory service. Six other reviews were already scheduled to be completed in 2005 and 2006, constraining the time for this review.
2. Further, in mid 2005 and through all of 2006 the Executive Secretary and SAs were requested to provide facilitation and direction of the SPG process and reviews of additional GCMRC science plans. This new task required significant commitment during the period from the SA program.

Procedures

In its original design the AMP review was to obtain two sets of information to conduct the AMP effectiveness assessment as follows:

1. Evaluation of issues, opportunities, concerns, mission and goals, roles, procedures, AMP processes, accomplishments, etc. contained in a wide array of documents by AMP entities, i.e., strategic plans, science plans, briefing reports, meeting agendas, notes and reports, etc.
2. Evaluation of interviews with AMWG, TWG, GCMRC, and SA members designed to solicit individual member perceptions of various issues, opportunities and concerns challenging the AMP.

The final review assessment did not include interview perspectives of AMP members on key issues for two reasons.

1. SA review of the SPG report and GCMRC strategic and operational plans revealed a proposed 2007 AMP initiative to conduct workshop(s) with AMP members to address potentially similar issues that would be addressed in the SA interviews. The SAs felt the interactive AMP workshop environment would produce much better outcomes than phone interviews.
2. The SAs time and budget limitations in 2006 required the assessment to be more focused on evaluation of written AMP documents.

The SAs utilized several sets of information from the AMP to scope and conduct the review process. Most of the planning documents used in the assessment have been formally reviewed by the SAs.

1. Review of science and management plans and technical and science reports, etc., of GCD AMP groups
2. Review of meeting reports, briefing papers, e-mail exchanges, memoranda's, meeting agendas and notes, etc.
3. SA Executive Secretary memoranda and briefings to SAs on direct involvement with AMWG, TWG, GCMRC and Ad Hoc groups on various programs, i.e. SPG Project.

Scoping isolated several areas for review, and one or more general issues in each area, as follows.

Areas of Inquiry	General Issues
Organizational Effectiveness	Mission, Goals, and Objectives; Entity Roles and Responsibilities
GCD AMP Processes	Adaptive Management, Collaboration
Science and Management Planning and Implementation Organization	Planning functions, Program Implementation
Program Resources	Budget Suitability, Budget Process
Operational Effectiveness	Operational Effectiveness
Outcomes	Effectiveness of Outcomes and Actions

Two sets of information were developed in the review of each area as follows:

Findings: Observations on how AMP addresses issues. Assessment of information to identify, as possible, AMP direction, process used, actions, success etc. on an issue.

Recommendations for Improvement: Recommendations from SAs conditioned by potential AMP capacity to respond. In developing assessments of findings and recommendations, the SAs focused on those areas of perceived greatest importance to

the AMP and actions that could likely be performed by the AMP in a 3-5 year program period with current capabilities.

CONTEXT FOR REVIEW RECOMMENDATIONS

A summary of findings and recommendations are provided in this executive summary. These are Science Advisor assessments of effectiveness of the AMP in the areas and on the issues identified, based on documents produced by the AMP. The approach identifies areas of perceived strengths and weaknesses and proposes recommendations for improvement. It does not produce a scorecard of passes or failures.

The context in which "Recommendations for Improvement" are made in this review are constrained to the mission, goals and operation procedures of the AMP as prescribed in the 2002 AMP Strategic Plan, developed by the Adaptive Management work Group (AMWG). The AMP Strategic plan explicitly defines missions, goals and adaptive management procedures of the organization that respond to the mandates of the Grand Canyon Protection Act of 1992 and the Glen Canyon Dam EIS of 1996.

> "The Secretary shall operate Glen Canyon Dam in accordance with the additional criteria and operating plans specified in section 1804 and exercise other authorities under existing law in such a manner as to protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established, including, but not limited to natural and cultural resources and visitor use" (GCPA 1992).

In its mission of evaluating alternative flow and non-flow options for GCD operations, the GCD AMP is committed to implement an Adaptive Management (AM) process which has basic tenants as follows:

1. Resource area of concern is the Colorado River Ecosystem defined for the AMP
2. Conceptual models are deeded for planning and assessments
3. Questions are formulated as testable hypothesis to guide inquiry
4. Experiments test hypothesis to answer questions and provide management guidance
5. Monitoring and evaluation reveal accuracy or completeness of knowledge and improve knowledge
6. Management is revised and new tests initiate new cycles of learning

FINDINGS OF THE REVIEW

ORGANIZATIONAL EFFECTIVENESS

Mission and Goals

Findings:

- The mission and goals are generally clear and understood in the AMP as demonstrated by continuity from the 1996 GCD EIS through various planning documents and reports of the AMP up to 2007.
- The objectives are specified as prominently as the goals in the AMWG Strategic Plan. However, in review of other plans, program documents and reports, they appear to serve limited purpose in either program planning or implementation.
- Information needs (INs) have received greater attention in planning and programming science. They are specified into primarily research (RINs) and core monitoring (CMINs), and some have been sequenced, a proxy for priority. However, in recent documents and meeting summaries, INs are referenced as being overly extensive, difficult to work with in focusing science priorities, and in responding to the AM protocol of using key questions.
- Science and management questions to guide the AM process have only recently (2005/2006) received attention, and primarily in science planning.

Recommendations for Improvement:

- Gaining focus on critical elements of various goals and development of improved priority setting are recommended improvements.
- Objectives are not being used in planning and programming and should be dropped.
- The AMP should reformulate and focus its INs into sets of science and management questions that can clearly guide short and long term science and management efforts.
- Identifying specific research and management programs to obtain defined outcomes in more explicit time frames could improve science and management outcomes.
- Secretary Designee/AMWG/TWG/GCMRC/SA workshop(s) to establish priority goals and management and science focus areas for the next 3-5 year program period would improve organization effectiveness.

Roles and Responsibilities

Findings:

- Persons involved in the AMP generally have significant knowledge of programs and are skilled professionals. However, skills are not necessarily always matched with responsibilities.
- Roles and responsibilities of formal groups such as Secretary Designee, AMWG, TWG, SAs, GCMRC are defined but in need of additional operational specificity. Others such as the BAHG and CRAHG are ambiguous and/or evolving.
- In spite of documented roles for key entities, agreement does not appear to exist among members regarding the relationships between AMWG and GCMRC in terms of budget and programming authority; explicit responsibilities of the TWG relative to the AMWG; joint relationships and

responsibilities of TWG and GCMRC; and operational responsibilities of the Science Advisers to GCMRC, AMWG, and TWG.

- Some stakeholders either do not understand or do not support or accept the common purpose (s) of AMP, or the processes (AM and collaboration) used to attain the common purpose(s).

Recommendations for Improvement:

- Secretary Designee AMWG/TWG/GCMRC/SAs workshop(s) on mission and goals and roles and responsibilities to gain understanding and acceptance of purpose and roles. Develop guidance document on common purpose; roles; mission and goals. Develop support for 3-5 year common theme and focus for goals and incorporate in strategic plans.
- The Secretary Designee can best serve the AMP by assuring: Reestablishment of the AMP common purpose and processes for obtaining the AMP mission; reestablishment of roles of key entities and monitoring their effective implementation; effective and timely progress on priority goals and focused programs of the AMP.
- The AMWG can best serve the AMP mission by acting as a corporate board to insure that needs of the AMP to satisfy purpose and mission are met, including formulating effective recommendations to the Secretary; setting effective AMP strategies and operations policy; requiring progressive science and management program recommendations; assuring that budgets and other resource needs are met and utilized effectively. The AMWG should require that all TWG/GCMRC proposed program options include technical, managerial, scientific and budget evaluations.
- The TWG has a most critical role to evaluate and recommend program alternatives to the AMWG that are fully evaluated for technical, managerial, scientific and budget effectiveness. Its recommendation to AMWG, where appropriate, should be formal documents. Proposals involving science should be a collaborative effort with GCMRC.
- GCMRC forms the basis for the AM process, i.e., management direction designed using a science basis. It must work in close collaboration with the TWG to insure AMWG recommendations accurately represent the current status of scientific and technical knowledge. A primary goal is to insure highest quality science.
- The SAs have a unique role of ongoing independent advisory input and review of science proposals, plans and findings. It must continue to insure independent scientific critique, to insure the highest quality science.

GCD AMP PROCESSES

Adaptive Management

Findings:

- The GCD AMP program is a national exemplar of adaptive management of complex resource systems. Over a 10 year application, the program has identified key uncertainties through an integrated adaptive assessment process. Those assessments have focused primarily on key resource issues of sediment, threatened species and cultural resources. The assessments have resulted in the development and implementation of management experiments that help better understand these issues and others such as water quality. This is in contrast to less effective adaptive management programs around the country, some of which do not understand and apply the concepts and ideas of adaptive management, while others flounder due to lack of direction and cohesiveness.
- The GCD AMP program has developed a system of adaptive governance. Adaptive management has failed in many applications because of the social and governance context, described by some as adaptive governance. Adaptive governance provides the framework to allow for adaptive management to exist. This involves the leadership, trust and flexibility needed to manage adaptively.
- However, the past two years of AMWG and TWG meeting agendas, Secretary Designee memoranda, AMP discussion topics, conflicts among members, litigation, the SPG Report, etc. reveal potential weaknesses in agreement on common purpose, process, focus, and trust.
- A recent decision by the Secretary to appoint and involve the Assistant Secretary as Secretary Designee's, and the Designee's efforts to improve the effectiveness of the GCD AMP is critical timely direction to the AMP.

Recommendations for Improvement:

- Compare GCD AMP program with other ongoing regional scale adaptive management experiments to develop lessons learned and extend successes in management. One candidate program for comparison would be the Adaptive Waterfowl Harvest Program of FWS.
- Reevaluate program purpose and processes and develop a program that examines and fosters more effective social learning to attain mission and goals. This would include identification of national repositories of knowledge and understanding mechanisms for merging multiple modes of inquiry and analysis including adaptive management, environmental management, FACA, etc., and development of novel approaches to resolve chronic resource issues in shorter time periods.
- Implement at the earliest possible dates a series of workshops to address AM issues, opportunities and concerns that have been identified by various AMP entities, i.e. AMWG 2004, Roles Committee 2005, Science Planning Group 2006, etc. A well designed series of workshops over 2-3 years appears necessary. The workshop(s) would need to be strongly supported and led by the Secretary Designee and AMWG.

Collaboration

Findings:

- The AM process as originally developed in 1995-1997 did not specify collaboration, although cooperation of agencies and stakeholders was expected to make AM a more effective process.
- New more structured approaches to cooperative program efforts of various entities now defined as "collaboration", is being attempted at several levels in the AMP, i.e. AMWG, TWG and GCMRC, BAHG, SPG etc. However, exactly where and how collaboration should be used in each entity and for what explicit outcome is not clear.
- The AMP is having successes in using various elements of collaboration, although all tenants of the process are not employed effectively.
- Some members do not feel the time investments in collaboration are effective in improving final outcomes.

Recommendations for Improvement:

- Collaboration can be a positive tool to make adaptive management more efficient and effective and can and should be implemented in various AMP entities as appropriate.
- Workshop(s) should be utilized to gain increased understanding by AMP entities of AM and collaboration utility, and provide guidance on how best to utilize these methodologies to gain maximum effectiveness. The workshop should provide clarity as to where and how best to utilize collaboration in the differing AMP entities to gain specifically targeted outcomes for each entity. Efficiency and cost effectiveness issues should be addressed.

SCIENCE AND MANAGEMENT PROGRAM PLANNING AND IMPLEMENTATION

Findings:

- Documents indicate that GCMRC seemed to have difficulty gaining acceptance for its annual plans of work, and budgets in the late 1990s and early 2000s. Further, it also seemed to have difficulties in developing its long term science plans.
- The GCMRC has used both independent and collaborative processes for developing science planning approaches and proposed experiments.
- Current TWG and GCMRC leadership supports collaboration of GCMRC, TWG and SAs as needed approaches to developing effective science and management programs. This was demonstrated in 2006 by GCMRC and TWG jointly supporting the SPG process and continuing CRAHG and BAHG processes. The MRP includes specification for continued future GCMRC/TWG/AMWG interaction on science and management planning.

Further, AMP entities are proposing an AMP Effectiveness Workshop to improve program planning and implementation.

- In spite of the existing collaboration and program advances, reviews of e-mails and meeting minutes for AMP entities such as TWG, CRAHG, SPG, BAHG, etc., reveal frustration with program planning and implementation processes. Symptoms of at least some dissatisfaction by some stakeholders are evidenced in apathy, criticism of frequent meetings, condemnation of the AM process, increased support for voting to resolve issues, block voting, criticism that the process does not support certain members, threats of lawsuit, etc.
- Both GCMRC and TWG appear to express some caution regarding use of greater collaboration than was expended by SPG and BAHG in past science and budget planning processes.
- Just as GCMRC appears to have been criticized in the early 2000s over productivity, the TWG seems now to be bearing significant criticism. Yet TWG and GCMRC working together on the SPG, CRAHG, BAHG, etc, seemingly contributed to significant outcomes in 2006.
- Some members, in apparent dissatisfaction with the speed at which the AMP process progresses, seem to desire to truncate AM processes and implement management actions with limited scientific knowledge, i.e. approaches on experimental options.
- Management actions do not seem to fully support the AM process, by failing to pursue important science/management cycles to adequate closure, i.e., BHBF, Lake Powell water quality, etc.
- Scientists and managers (GCMRC/SAs/TWG) often fail to operate in integrative planning approaches that use efficient and effective methods.
- Strained relationships appear to exist between TWG and GCMRC and possibly among AMWG/TWG/GCMRC. These feelings and other sources of conflict reduce interactions and possibly AMP effectiveness.
- Issues of management that seem critical to both science and managers do not seem to be addressed and/or resolved at an appropriate level to permit either scientists or managers to do effective planning. For example, entity roles and role playing; desired future resource conditions; defining priority goals; defining criteria for management actions, etc., all require greater resolution.

Recommendation for Improvement:

- A priority need exists for retreats of the AMP entities that would be dedicated to establishing more effective approaches for science and management planning and actions.
- Confirmation of the AMP goals, especially areas of critical focus.
- Establish improved specification of priorities and how the various AMP entities can best contribute to the goals in more integrated approaches.
- Develop more effective and efficient collaborative AM processes, or other processes for scientist/manager resolves on key AMP issues.

- Develop 5 year program resolve or significant advances on critical science program efforts including; LTEP, HBC, Lake Powell monitoring, CMP, CRP, BHBFs, AMP funding priorities, external funding opportunities.
- Develop 5 year program resolve on critical management program efforts including priority science/management programs of non-native fish control, RIP, translocation; TCD implementation; criteria for management actions; and desired future resource conditions.

PROGRAM RESOURCES

Findings:

- The current budget seems sufficiently large to support core programs, but is a limiting factor on most program needs.
- Past investments in technology for data gathering and processing are realizing savings, but new investments are curtailed.
- Budget flexibility is limited in terms of re-allocation of extant resources to address new challenges, expand existing programs and fund new initiatives. Cost increases now have significant impacts.
- New funding is unavailable to address key resource issues. These include items such as temperature control devices, and endangered species recovery among others.
- A future budgeting process and plan although referenced in the MRP for developing long term budget needs, is not adequately developed.

Recommendations for Improvement:

- Develop improved methods for establishing priorities on explicit programs and projects.
- Develop and implement well designed two year budget plans to extend positive outcomes of annual budget planning process,
- Develop strategies for creating flexibility in budget to allow for shifting priorities, and funding new pilot programs i.e., like the experimental fund.
- Develop strategies for supplementing budget to fund critical needs, such as TCD, recovery programs, Lake Powell, CRP, etc.

OPERATIONAL EFFECTIVENESS

Findings:

- The AMP has had operational effectiveness.
- Between1996-2002 the GCD AMP developed necessary charters entities, protocols, strategic plans, etc. for implementing the AMP and annually programming and funding required activities.
- The AMP has completed two major experimental flow events and several minor events with effective analysis and assessments.
- The AMP has formulated program proposals, completed NEPA requirements, implemented and evaluated multiple, short and long term science programs, conservation practices and management activities; i.e. extensive MLFF

assessments; HBC translocation; assessments of experimental options; evaluation of fish removals; etc.

- Weakness seems to exist in the AMP relating to agreed common purpose; processes used to obtain these outcomes, especially interdependent activities; and operational procedures to resolve issues.
- The operational procedures for TWG to structure recommended alternatives to AMWG is not clearly articulated. For example, often only one alternative is proposed as a recommendation rather than several options with complete assessments of each. Most often complete assessments, i.e., technical, science, management, budget information seems lacking.
- There do not seem to be integrated operational procedures with schedules for developing and advancing critical recommendations on programs and budget from, for example, BAHG or SPG through GCMRC, TWG, AMWG, Secretary Designee to the Secretary.
- 2-5 year operational and strategic budget planning approaches are not currently effective to accommodate program challenges.
- Objective processes for establishing priorities for long term (5yr) management and science programs does not exist, i.e. based on criteria and repeatable methods.
- An objective science and management process for determining multi-resource program and budget tradeoffs for decision-making does not exist.
- An objective operational procedure for science and management planning that effectively moves from manager's priority goals to management and science questions, to science and management solutions for specific focus areas in specified time frames does not exist.
- An objective model process for evaluating the AMP research and management area (CRE) as an ecosystem, at least conceptually, to be used in science/management planning and assessments, although partially complete, is not being utilized effectively.
- Moving the new interdisciplinary science process (MRP) into project applications is needed.
- GCMRC operational procedures for science review obtains effective input, but how the input is used needs to be more clear.

Recommendations for Improvements:

- A workshop (s) is necessary to evaluate current science and management operational methods to assure more efficient and effective recommendations to the Secretary.
- Specify AMP group(s) and charge(s) to complete more objective and effective management and science planning and decision processes for the above operational weaknesses in the period FY 2007-2009, and incorporate in operations.
- The AMP might consider expanding the AWP to include schedules, programs and activities of all AMP entities and their interdependences in advancing recommendations.

EFFECTIVENESS OF OUTCOMES ON KEY RESOURCE ISSUES

Findings:

- The AM process of the AMP, as utilized, has accomplished significant outcomes.
- However, the 2005 Status of Colorado River Ecosystem (SCORE Report) presents mixed results toward resolving known resource issues. Through an integrated set of accomplished adaptive management actions and research, much more is known about sediment storage and movement, water temperature and other aspects of the physical resources than biotic and cultural resources.
- The improved understanding of physical resources gained in one decade are now being used in research and management applications in the CRE, including BHBFs.
- Large uncertainties still remain regarding the recovery of HBC populations as referenced in the 2006 Knowledge Assessment. In the 2005 SCORE report, the HBC populations were defined to be ~~in peril~~ of this. Yet, analysis from 2006 indicates that HBC are at higher levels than determined in the SCORE Report. It is not clear whether natural warming, predator removal, or other factors are resulting in the assumed stable population. Both science (MRP, LTEP) and management plans are drafted to address the diverse issues.
- The Lees Ferry sport fishery has experienced cycles of both decline and partial recovery over the decade. Although some resource impacts of some management actions are known, knowledge of how all of the multiple factors interact is not known. Significant uncertainty still seems to exist.
- Much uncertainty still exists about relative and direct impacts of changing habitat, food base, predation, competition, pathogens etc. on both higher trophic fish; i.e., like HBC and trout.
- Significant uncertainties exist regarding cultural resources, although a new collaborative science direction is proposed for 2007 (i.e. GCMRC/CRAHG).
- Recent completion of strategic and operational plans by AMP entities outline aggressive science and management direction to address defined uncertainties, i.e., GCMRC/HBCG/CRAHG/BAHG/SPG.

Recommendations for Improvement:

- The greatest opportunities for improvement in SCIENCE AND MANAGEMENT outcomes in the near term from the GCD AMP appear to exist in pursuing proposals resulting from the AMWG workshop (2004) the established Roles Report (2006); recommendations of TWG and GCMRC from the Science Planning Group (2006); and proposals documented in GCMRC strategic and operational science plans (2006).
- For science, the review of final assessments by GCMRC of differing experimental science options for the long term, supports completing analysis

of resource impacts of the MLFF, with associated predator control, natural warming and translocation activities. This proposal was evaluated by GCMRC and the SPG as a potential option. It has significant merit from a science and learning perspective. Since the EIS on new experimental options is expected to require two to three years to derive a record of decision, this proposal should be given strong consideration for the 2-3 year transition period. The proposed effort would maximize opportunities for analysis of data to understand potential impacts of warming water, predation control and translocation on the endangered HBC resource under the MLFF regime. Also, given recent sediment inputs and status of science, a BHBF could enhance opportunities to understand both sediment storage and conservation in this same three year period and provide new knowledge for cultural resource management and protection. In addition evaluation of Lake Powell long term data would provide critical insight into system water quality issues that may be long term with changing basin hydrology.

- In management, outcomes could improve by using AMP workshops and actions of Secretary Designee, AMWG, TWG, GCMRC and SAs to address priority issues relating to; support for the AMP common purpose and AM process; resolving longer term budget plans and needs; improved operational specification of different entity roles; processes to improve priority setting and decision making; defining desired future resource conditions and management actions, etc.