To: TWG Chair; GCDAMP Science Advisors File

From: L. D. Garrett, SA Coordinator

Subject: EC Preliminary Review Comments on GCMRC Science Plan

Date: 5/19/2014

These comments to the TWG and GCMRC were recommended by Dr. Smith and are offered by the executive coordinator as preliminary input to TWG discussions of the Draft 2015-17 GCMRC Tri-Annual Budget and Work Plan Prospectus. They are intended to assist the BAHG and TWG in their assessment of projects to propose for the 2015-17 programs. They do not represent a technical review by the SAs and should not be construed as a formal review of the technical adequacy of the Plan or its many proposed projects.

The Science Advisors have been informed that a formal review of a final complete Tri-Annual Budget and Work Plan will be requested on approximately June 6, 2014. That review will be provided to the TWG and GCMRC on approximately June 23 and reported on by the SAs at the June 24-25 TWG meeting.

Following are comments by the executive coordinator that might hopefully be of use to the BAHG and TWG in their deliberations on the set of projects proposed for the 2015-17 period. Because these preliminary comments represent only limited assessment of in incomplete plan, most are of a general nature with specific technical comment not appropriate until a completed plan is available. Comments of a general nature on the entire plan are presented first, followed by specific comments directed at a project level. All comments are presented as bullets.

GENERAL COMMENTS

- The new proposed three year planning process provides a different platform for both science and management planning in the GCDAMP and appears to offer many strengths. For several years the intense annual budget and project planning process appeared to be limiting the TWGs ability to bring focus to several planning needs. These included providing direction on science and management strategies to assure that annual project activities could fulfill specified long term goals and desired future conditions developed by the AMWG and specifying definitive recommendations on what type and level of core monitoring activities are necessary to fulfill these goals and DFCs. Longer term science program activities of the scope and complexity developed by GCMRC and required by the AMWG require effective midterm planning agreements of 3-5 years that allow multi-year commitments for both appropriate observation of trends through monitoring and testing hierarchical nested hypothesis in complex science programs. This approach recommended by the Center seems most appropriate. However, it does not provide a strategic vision from which this plan should be drawn. That strategy depends significantly on the policy direction to be laid out in the EIS/LTEMP. Perhaps TWG and the Center could plan to expand this instrument in 2016 or 2017 to include sections on the AMWG longer term management and science strategy, important adaptive management program activities of the BOR, and clarification of longer term commitments to monitoring programs that are considered critical or core to the program. It would be more effective as a three year plan if it had these components built into it. It would certainly be more practical than production of several separate plans.
- The overall budget for the program seems sufficient in the short term for the primary questions being addressed. Regarding questions of concern, several significant accomplishments regards long term learning have occurred in the past decade along with launches of several new programs with significant associated findings. However, referenced to the final five years of the GCES programs and the first five

years of the GCMRC programs it would appear that GCMRC at best has a stable budget, and yet may be required to address more challenging questions in the next five years. Many national and regional projections of climate change characterize the Southwest and Colorado River Basin to have more change relative to other U.S regions. Those changes reflect increases in temperature, reductions in precipitation, greater variance in weather patterns and potentially more intense weather events. Over a three year plan, it would appear that these projections are of sufficient significance to warrant a proposal for a new multifaceted science thrust in the GCMRC program and the associated required budget. This is a strategic activity and perhaps it is to be addressed in a Strategic Plan. Even if that is the case it would seem that some proposed program activities and necessary funding would at least be evident in 2017 programs for this plan. Since there is currently no other science program on the Colorado River with the capabilities to evaluate over large riverine areas implications of climate change and related changing water quality and quantity, one would assume the activity would occur in GCMRC.

- Collaborative Adaptive Management is a cornerstone to the GCDAMP and it has been effective in its implementation. The GCDAMP has been in existence since 1996 and has demonstrated accomplishment in this new paradigm. It has implemented several complex adaptive management strategies including high flow releases, endangered fish translocation, non-native species control, etc., and modified these strategies through progressive science and monitoring learning processes. However, this primary planning document of the AMP does not present this ongoing interactive management/science process effectively, so that we can know how effectively collaborative adaptive management is working. That is, AMWG and TWG are the critical elements providing stakeholder and management input and guidance to the science process, but these elements are not being evaluated so we can determine the need for change. After seventeen years, perhaps the process itself needs revision as prescribed for other long term AM programs in the U.S. However, that dialogue and assessment is not occurring. Perhaps this is because AM processes and their ongoing success or failure is not presented and reviewed as an important element of the overall program.
- Arguments have been made consistently over the last two decades in multiple reviews that the complexity of the ecosystem under study and the science program itself demands some type of systems model to help guide most appropriate paths for management and science. Along with others, the SAs have proposed this direction in several reviews. Development of a systems model and sub-systems models have occurred and several are being utilized to guide both science and management in this program. The SAs have encouraged that an overall systems model would have to be an open model that at least permitted evaluation of potential impacts that are exogenous to the currently defined CRE for the GCDAMP, especially policy decisions. System models are very expensive and this is a program for which the AMWG/TWG would have to provide clear guidance of specific needs for its effective development. Should the stakeholders support development of a system model, the AMWG should define specifically what it must accomplish. Given future climate implications to the Colorado River resources would it be best for AMWG to collaborate on a basin wide system model that would have greater focus on refined assessment of policy and management actions in the system and how they might affect critical habitat requirements, water availability for desired recreation and water development, energy production, etc. That is, the model would have greater focus on learning regarding impacts of management actions on general aquatic and riparian habitat needs and recreation needs rather than trying to refine the model to predict the specific impacts of marginal habitat changes on biotic species of concern. The science program and associated sub-models could be tasked with this learning need.
- Moving administration of Science Advisors program to another agency. When notified, the SA Executive Coordinator supported the move of the Science Advisors Program to the BOR for administration. Concerns by USGS over even perceived conflict of their administering the budget of a program that reviewed and critiqued their programs seemed reasonable. It is reasonable that any agency in the AMP

could administer the SA contract in an objective manner. However, it is critical that the AMWG/TWG continue to clarify that the SA Program attempt to provide to AMWG/TWG/Asst. Sec./GCMRC the range of review and service support specified in the SA Operating Procedures even if the level of budget support must be reduced due to budget constraints. And, that these review inputs are provided in an independent manner so as to prevent potential bias from any individual party in the AMP. Based on past requirements and what one would expect as future requirements the proposed budget of $70-$80 K would seem to require AMWG to review the SA Operating Procedure and permit significant reductions in service/review activities by the successful contract bidder. Concern also exists that due to this program transfer and time requirements for contracting, the AMWG will not have access to an independent science group for an undetermined amount of time in FY 2015.

- Moving administration of the Lake Powell Program. In TWG budget reviews that the Lake Powell program administration is proposed to be moved to another agency. The SAs have proposed in past reviews that whether it is moved or stays in the AMP the general activities of this program should be retained. It also has been proposed in past SA reviews, that this program needs to have an AMWG or agency review regarding how it can best contribute to specified AMP or agency goals, DFCs, critical questions, etc. For example are the types of data collected and the intensity of sampling necessary to respond to agency needs. Should the work continue on the biological data. Could an assessment be made of existing samples to determine if the data offers potential for learning beyond what would be expected given existing knowledge from other western reservoirs. Certainly, the modeling capabilities cooperatively developed by BOR and GCMRC (CE-QUAL- W2) seem important current needs for agencies and would seem important to a Basin wide management policy modeling approach should it ever be pursued.
- In evaluating budgets, in many projects, especially shorter term studies, it is difficult to determine what activities and budgets are required for each of the three budget years. From the information provided the reviewer must assume that the amount proposed for 2015 is needed for 2016 and 2017. However in small project planning usually the trend in cost requirement looks more like a bell shaped curve. We assume these differential requirements will be clarified in the final plan.

COMMENTS ON SPECIFIC PROJECT AREAS

- The monitoring of water quality and sediment transport in **Project 2** are basic to evaluating changing riparian and aquatic habitats in several other projects. Integration with other programs is demonstrated in collaborative work of these project scientists with other projects conducting interpretation of findings to biotic and cultural resources. Other major accomplishments are web based efforts to continually create improved public real time access to data. Three questions always exist with costly monitoring programs. The first relates to stakeholder level of need for information as regards type and degree of specificity. The plan reviews in the last decade would indicate the program is responding to information desired and using several direct and indirect methods to provide the information to stakeholders and managers. The second question relates to methodologies used for data development. Again, reviews would indicate that ongoing assessments of improved methods are evaluated and implemented as proven more effective. What has not been accomplished by the AMWG/TWG in the last five years is a reassessment of their explicit information needs when cast against changing overall program goals, needs, objectives and critical questions. This process by AMWG/TWG needs to be performed to assure that only necessary information is being required of the GCMRC to assure needed flexibility in science and management programs.
- Although **Project 3** has significant focus on the impacts of HFEs and intervening flows on riverine sediment abundance, movement and storage, it also has focus on sandbar development and maintenance in the system, and modeling of sandbars in the system. It continues to address through both monitoring and research one of the most critical questions of the AMP, i.e., can appropriately managed high flow

events and other required flows through time provide general stability to the number, location and size of sandbars in the system. The program also provides critically needed inputs to understand flow regime impacts to riparian and aquatic habitats. Extensive funding is proposed for 2015/16 to evaluate differing data recovery methods and data quality to assess sediment and sandbar conditions. It is difficult to determine from the write-up if duplicated effort exists. Most of this project effort, approximately $1.2 mil. is directed at providing definitive assessments of the status of sediment and sandbar resources through multiple approaches. Objective 3 proposes to utilize some of these data to develop and refine a model to predict sandbar development and variance in the system and how that variance is linked to operations management, including normal operations as well as event flows such as HFEs. Development and testing is to occur through the 2015-17 period at approximately $100 K per year. It is not made clear how this modeling effort will integrate in the overall program with Argonne sandbar modeling efforts in the LTEMP. The two modeling approaches use different methods but are addressing the same questions. Although costly, this project is addressing one of the most critical problems in the AMP. If in fact duplication exists by design it could be useful in moving more quickly to more effective monitoring methods and improved modeling in the three year period. In total over $4.0 mil. may be expended in this effort over three year period. The SAs will fully evaluate this science and monitoring direction in its review.

- **Project 4** presents two investigations that are proposed to collectively comprise a single research and monitoring project. It is difficult to connect directly the science effort in 4.1 and 4.2 to expressed stakeholder needs for mitigating impacts from dam operations to archeological sites. Research has been ongoing for multiple years to evaluate the relationship of fluvial processes below 45K CFS flows and geomorphic processes above 45K CFS flows. Variances related to assessments are high, at least in part to small sample size. It, therefore, seems unwise to launch a monitoring program of these processes in 4.2 at significant costs without stronger empirical support for the original stated hypothesis. The greatest concern with the project is understanding its potential contribution to assisting mitigation strategies for archeological sites effected by dam operations. How many of the total archeological sites that are determined to be impacted by flow operations in the canyon have attributes expressed in this research? Although not disclosed in the project description, we assume knowledge exists of this number and it is a significant % of the total to support the need for this effort. If the entire approach i.e. hypothesis test and monitoring protocols are successful how will they assist resource managers/tribes in implementing mitigation strategies. This information would be important to the SA specialist in fully evaluating this project.
- **Project 5** presents new program thrusts related to EPT absence/low abundance in the Glen Canyon/Marble Canyon reaches; continuation of work on invertebrate drift in the river and primary productivity monitoring in the Glen and Marble Canyon reaches. The monitoring of invertebrate drift and associated budget is in major part a continuation of needed assessments of habitat quality for main-stem native fish and rainbow trout resources. The proposal for sampling work in the upper Colorado River to provide context for ongoing assessments in the CRE would help validate methodologies. These benefits must be weighed against the $141 K cost by stakeholders. The proposed efforts on primary productivity to develop approaches to derive algae production estimates from dissolved oxygen measurements presents opportunities for more efficient assessments of aquatic biology metrics. The new effort on EPT discussed in earlier GCMRC/TWG planning sessions this year follows on scientist and stakeholder discussions of general hypothesis. From the five presented hypothesis, the selected hypothesis recommended for testing is the impacts of hydro-peaking on egg mortality. As noted the flow experiment portion of the research (34 weekend days of low steady flow from May to August) is not required to develop preliminary evaluations of the hypothesis. With the emphasis that was placed on the need to evaluate effects of low flows on biotic communities in the 1996 EIS it is disheartening to have had the 2000 and 2011 low flow

experiments and not have had effective monitoring in place to evaluate aquatic insects. Project elements 5.11-5.17 propose evaluations of conditions in other riverine systems, literature reviews, citizen science assessments and laboratory experiments to develop initial evaluations of the hypothesis. It is difficult to evaluate the proposed $337K budget since allocations across proposed activities are not presented. Clearly a need exists to evaluate elements that could contribute to absence of EPT in the system and flow variance seems a reasonable hypothesis to test. Laboratory testing of water temperature effects also seems reasonable to evaluate even if a selective withdrawal device is not in current management planning. A management action such as translocation might have merit as well, but as noted would be difficult to assess in this system. This project will receive focused review by the SAs to afford constructive input.

- **Project 6** continued main-stem monitoring of HBC populations, RBT and other native and non-native fishes represents maintenance of long term assessments of a resources considered critical to the AMP in understanding native and non-native fish dynamics in the system. The SAs in their review of the 2013/14 plan supported improved methodologies and assessments, many of which are continued in the 2015-17 Plan. An important factor in effective continued AMP science and management activities on both native and non-native fishes is the collaboration of GCMRC with federal and state agencies and tribal resource specialists, which is very evident in these projects. The SAs will evaluate continuation of past programs as well as proposed assessment changes as well as the new project for evaluating brown trout population origins.
- **Project elements 7.1-7.5** represent a very focused and complex assessment of adult and juvenile HBC population variance in the LCR and its confluence with the Colorado River. The multiple projects developed over time are attempting to both evaluate and confirm factors relating to habitat, competition, predation, etc. that contribute to population variance in HBC juvenile and adult fish. This is recognized as a critical element of the AMP. Results from this effort over the past three years have been extensive with abilities for modeling success greatly enhanced as referenced in the recent LTEMP efforts. Continued work on the Asian Tapeworm potential impacts to juvenile fish is important as is the CO2 effort. The CO2 effort and other water quality issues in the LCR could be exasperated over the next two decades if projected dry warming trends persist. The recent more rapid advances in modeling seems to be associated somewhat with focused information needs of the LTEMP/EIS process. In the review the SAs will want to look at opportunities here and in other areas which may be on the cusp of converting longer term science findings into useable management tools such as models and management guidelines.
- **Project 8** emphasizes AM processes related to implementing management actions, monitoring and revise actions to accelerate the learning process. These non-native fish control and native fish translocation management activities are being effective in accelerating the learning process in the management environment and should be duplicated in other science areas as possible. The SAs saw the continuation of the proposed CAM activities in the 2013-14 plan as central to managers more rapid success using the collaboration and support of GCMRC scientists. The new projects on invasive species and genetic monitoring will be evaluated in the SA review, but no budget is proposed. The PEP scheduled for 2016 is most important but no budget is recommended. This is a most critical PEP and should be considered for 2016.
- **Project 9** incorporates the ongoing monitoring efforts to evaluate status and trends of this critical resource for the AMP. It also proposes multiple new studies to evaluate and define key drivers that can impart change in RBT population size, movement, survival, reproduction, size and condition. All of these factors are hypothesized to have some effect on individuals and populations, and previous evaluations of varied scope have occurred in the program. Some assessments are extensions or add on analysis to evaluations approved in the 2013-14 plan. The key evaluations by the SAs in their review will relate to expected effectiveness of these efforts.

- **Project 10** will evaluate select shore line sites at flows below 8000 cfs in Glen and Marble Canyon to provide to ecologists evaluating food base definitive information of channel geometry and bed grain size. The project has been discussed by GCMRC at two TWG meetings and results from stakeholder requests for assessments. The discussions have revealed both the needs for and procedures required for the project.
- **Project 11** is a continuation of the new vegetation monitoring and assessment programs supported by the SAs with proposed revisions in the 2013-14 plan. River corridor vegetation dynamics associated with dam operations can effect physical, biotic and cultural resources of concern to the AMP. The SAs will evaluate the revisions and new proposals in its review.
- **Project 12** would seem to reflect interest of tribal members in understanding dam management impacts to plant resources of specific importance to tribal members. Although the methods proposed include a mix of qualitative and semi-quantitative approaches it would seem possible to include the project in the vegetation assessment program (project 11). The SAs cultural resource specialist will evaluate these aspects in the SA review.
- **Project 13** presents proposed socio-economic research programs provided through the leadership of GCMRCs newly placed economist. The proposed studies for 2015 for this project emanated in the SEAHG proposed and approved recommendations to the AMWG in 2011/12. Project 13.1, originally proposed by the SEAHG for 2012/13, was proposed for initiation by GCMRC in 2014 with carryover socio-economic funds from 2013-14 ($241K). This assessment of expenditures on recreational fishing and boating in the CRE will be accomplished from surveys originally proposed by NPS. Inclusion of regional economic specialists in the analysis will assist the project. Project 13.2 represents a proposed SEAHG project for initiation in 2012/13 on tribal resource values in the CRE. It was presented to the TWG by the SEAHG as a proposed program currently not being planned by any agency or group of the AMP. The approaches proposed by GCMRC are similar to general methods proposed by SEAHG. The Choice Experimental Method is a recommended approach for these type of assessments. Project 13.3 is a project proposed and approved in the SEAHG recommendations to assist in improved decision analysis by the TWG and AMWG. The proposal has been discussed by the TWG and GCMRC. SA specialists will provide specific review input on these proposals in review of the final work plan.
- **Project 14** overviews administrative costs for the Center which generally tracks from costs in the 2013-14 programs supported by the SAs.