Glen Canyon Dam Adaptive Management Work Group
Agenda Item Information
February 9-10, 2011

Agenda Item

Technical Work Group Chair Report

- Fall Steady Flow Plan
- Core Monitoring Plan
- Annual reporting meeting
- Schedule for the year
- Economics update

Action Requested

Fall Steady Flow Plan:

✓ The following motion is recommended by TWG. However, no motion is officially made unless and until an AMWG member makes the motion in accordance with the AMWG Operating Procedures.

> **Proposed motion**: AMWG approves the plan as described in "Study Plan—Biological Resource Responses to Fall Steady Experimental Flows Released from Glen Canyon Dam, 2009-2012," dated February 2010, with the understanding that GCRMC will prepare a synthesis of results from the various studies identified in the plan and present that to the TWG in January 2013.

Core Monitoring Plan, Annual Reporting Meeting, Schedule for the Year, Economics Update:

✓ Feedback requested from AMWG members.

Previous Action Taken

Economics Update

✓ By AMWG: At its August 2010 meeting, AMWG passed the following motion by consensus: The AMWG supports implementation of studies to further our understanding of the socioeconomics of adaptive management decisions within the GCDAMP; this includes and is not limited to market, non-market, and non-use studies. Thus, the AMWG directs TWG to further develop an economics implementation plan to be provided to AMWG at its next meeting for possible implementation starting in FY 2012. That implementation plan will include the following components:

a. Information needs associated with each study or analysis and the prioritization of those needs,
b. Scope and costs associated with each project and potential funding sources,
c. A description of how the information would be useful to the program, and
d. A more thorough review of the economics panel report.

Fall Steady Flow Plan

✓ By Other: The 2008 Biological Opinion (and its supplement in 2009) on the operation of Glen Canyon Dam identified conservation measures necessary to conserve and protect the

endangered humpback chub (*Gila cypha*). Experimental flows described in that opinion were implemented that included a two-month period of steady discharge during fall (September and October) over five years (2008-2012).

Relevant Science

See below.

Presenter

Shane Capron, Chair, Technical Work Group (Western Area Power Administration)

Background Information

Fall Steady Flow Plan: Review and Approval

The biological opinion on the operation of Glen Canyon Dam (BiOp; USFWS 2009) identifies conservation measures necessary to conserve and protect the endangered humpback chub (*Gila cypha*). Experimental flows described in the BiOp included a two-month period of steady discharge during fall (September and October) for five years (2008-2012). The Near Shoreline Ecology (NSE) project was developed in 2008 to better understand how these experimental flows, through their interaction with physical habitat structure, influence the survival rates of juvenile native and non-native fishes in the Colorado River ecosystem below Glen Canyon Dam. Findings from this study will provide information to better understand how flow and habitat management can be used to cultivate and enhance survival of juvenile native fish, and guide future GCDAMP recommendations for the Department of the Interior to consider as management or experimental actions. The primary focus of this research project was to address two key research questions:

1) Do steadier flows during summer and/or fall increase survival rates of juvenile native and non-native fish?
2) To what extent do physical habitat structures (e.g., sand bars and backwaters), in conjunction with flows during these periods, influence survival rate?

Following a pilot study in fall 2008, four monthly research trips were conducted in 2009 and 2010 (July through October) to compare and contrast differences in fish community response to fluctuating and steady flows, as well as to investigate juvenile survival and habitat preference in the Little Colorado River (LCR) reach of the mainstem. These trips provided the design framework to estimate growth, survival, and abundance by habitat type. This study design is based on a mark-recapture approach that estimates habitat-specific abundance for each trip using closed models, and relaxes the assumption of population closure between sampling trips.

In response to a request from the GCDAMP, and to address the need to learn from the fall steady flow experiment, the GCMRC prepared a science plan that underwent TWG review in September 2009. In response to TWG comments, the GMCRC prepared a revised draft in February 2010 for the March 2010 TWG meeting (see http://www.usbr.gov/uc/rm/amp/twg/mtgs/10nov15/Attach_09a.pdf). After further review, the document was approved by TWG at its November 2010 meeting.

> **TWG MOTION: November 15, 2010 (passed: 18/1/3 abstentions)**
> The TWG has reviewed the following document: "Study Plan—Biological Resource Responses to Fall Steady Experimental Flows Released from Glen Canyon Dam, 2009-

2012." dated February 2010. TWG understands that GCRMC will prepare a synthesis of results from the various studies identified in the plan and present that to the TWG in January 2013. This synthesis should include the following:

a. the scientific linkages between the study results and the Strategic Science Questions (SSQs) and other Information Needs identified in the study plan,
b. analysis of the effects and causal factors including the ability to answer the SSQs as well as a description of the uncertainty of the results including confounding factors (e.g., storm events),
c. a synthesis of all the results evaluating the biological success of the Fall Steady Flow experiment and the overall objectives described in the plan and the 2009 Biological Opinion.

The TWG recommends that AMWG approve the study plan with the understanding that GCRMC will develop a synthesis of results for the January 2013 TWG meeting that responds to the components described above in the TWG motion.

Core Monitoring Plan Update

On December 1, 2009, GCMRC and TWG co-hosted a workshop on the development of a general Core Monitoring Plan (GCMP) for the GCDAMP. The purpose of the meeting was to:

- Achieve understanding of the GCMRC proposed general strategy for long-term core monitoring (measuring trends in "signals" for resources of critical interest to GCDAMP).
- Enhance support for the general Core Monitoring Plan (including timelines, budget, and staffing requirements) and completion of remaining steps for all resource areas.
- Reach a tentative agreement on timeframe and steps for TWG to develop a recommendation to AMWG.

This agenda item is a report to AMWG on the work that has been done to implement the results of that workshop. The workshop report was provided to AMWG in February 2010; please see that Agenda Item Form (http://www.usbr.gov/uc/rm/amp/amwg/mtgs/10feb03/Attach_15a.pdf) for background information and history on the AIF process.

An ad hoc group of the TWG led by the TWG Chair was formed to work with GCMRC to revise the GCMP and help integrate the TWG concerns. The primary goals were to help revise Section 2 of the document, which describes the process of developing the individual core monitoring plans by AMP goal. A number of revisions to the main portion of the document have been completed; TWG will review those in January 2011 and plans to have a final review in March 2011.

The primary change that has been made to the document is the addition of an appendix written by TWG that describes the TWG role in the development of the individual core monitoring plans (by AMP Goal). The appendix describes the management portion of the project, decision-making, and expectations from the TWG for what will be in each individual plan. The Appendix calls for each individual plan to include a trade-off analysis or risk assessment that will include a high, medium, and low funding scenario and describe the trade-offs between each of these. This will allow TWG to consider different levels of implementation. The decision-making process will incorporate a Structured Decision-Making process to develop a series of 10 criteria for TWG to use when making decisions about the level of implementation for each program. The TWG Chair requested and received an initial review on the appendix by the Science Advisors (November 5, 2010). TWG will consider these comments and revise the draft appendix for TWG review in March.

At the AMWG meeting, the TWG Chair will further describe the appendix to the core monitoring plan, the review by the Science Advisors, and next steps.

Annual Reporting Meeting
In January of each year, GCRMC reports on its progress with the TWG. GCMRC provides a written assessment for each project outlining progress, accomplishments and publications, information gained to answer Strategic Science Questions related to the project, and recommendations for the next year(s). The intent is to evaluate progress and to develop recommendations for changes to the projects. In 2011, TWG will develop recommended changes in the FY 2011-2012 biennial workplan for AMWG to consider. The annual reporting meeting is the first step in this process, to insure that TWG has the most current information on progress on each project and project needs. Results of the Annual Reporting Meeting will be further discussed at TWG at its January meeting and direction will be provided to the Budget Ad Hoc Group (BAHG). The BAHG will then develop recommended changes in the FY 2012 budget and workplan to bring to TWG's March meeting.

Schedule for the Year
See Table at the end of this AIF for more detail on the TWG workplan.

Economics 101: GCDAMP family invited, March 7, 2011 in Phoenix
TWG meeting: March 8-9, 2011
AMWG meeting: late spring
TWG meeting: June 2011
AMWG meeting: August/September, 2011
TWG meeting: October 2011

Economics Update
In August 2010, AMWG requested that TWG develop a socioeconomics implementation plan based on consideration of the recommendations from the socioeconomics workshop and expert panel report (GCMRC 2010, http://www.usbr.gov/uc/rm/amp/amwg/mtgs/11feb09/USGS_SE_Rpt.pdf). The AMWG requested TWG provide four items:

(a) Information needs associated with each study or analysis, and the prioritization of those needs,
(b) Scope and costs associated with each project and potential funding sources,
(c) A description of how the information would be useful to the program, and
(d) A more thorough review of the economics panel report.

TWG has continued its review of the document and is developing draft comments on the report in response to (d) above.

TWG has also worked to develop a series of tables that will comprise the main portion of the implementation plan.

- Table 1 is a tabular description of the economic recommendations from the expert panel report, describing TWG's understanding of how the expert panel expected the information to be used. This table incorporates the information needs, or questions, which were developed by the workshop participants.
- The suite of information needs/questions developed by the workshop participants is provided in Table 2.

- Table 3 is the core of the document and describes the draft TWG recommendations for an implementation plan. It includes project description, dates, estimated costs, AMP information needs related to the project, workshop information needs, and a description of how TWG expects the information to be used.

The implementation plan is currently in draft form. TWG expects to complete its work in March and provide a recommendation to AMWG in late spring. TWG is seeking input from AMWG on the draft implementation plan: Tables 1-2 (http://www.usbr.gov/uc/rm/amp/amwg/mtgs/11feb09/Table_1-2.pdf) and Table 3 (http://www.usbr.gov/uc/rm/amp/amwg/mtgs/11feb09/Table_3.pdf).

Technical Work Group (TWG) 1-Year Running Workplan

Updated: January 24, 2011

Econ. 101 March 7; TWG March 8-9	Late June, 2011	October 2011	WORKSHOPS
Economics 101 course	FY 2012 Budget/Workplan Changes	CMP Fish – SDM	Economics 101 (March 7)
SA Annual Report	CMP Fish – Initial	CMP Vegetation – SDM	Geomorphology: late winter
Genetics Mgt Plan presentation (FWS)	CMP Vegetation – Initial		IN workshop foodbase/Powell (March)
Hydrograph 2012	Hydrograph 2012 - Recommendation		KA II January (Questions) March/April (experts) & June/July (review of experts)
SA prospectus decision support	SA prospectus decision support		GCMP workshops for individual plans, criteria development
FY 2012 Budget/Workplan Changes	Economic Implementation Plan		GT Max/Socioeconomics early spring 2011
LSSF synthesis			Nonnative workshop: Jan-Mar
General CMP Final Review			
Economic Implementation Plan			

Final Report of the GCMRC Socioeconomic Research Review Panel

Report of a Workshop held
December 2 & 3, 2009
Phoenix, Arizona

Review Panel:

Joel Hamilton
Professor Emeritus of Agricultural Economics and Statistics
University of Idaho, Moscow, Idaho

Michael Hanemann
Chancellor's Professor of Agricultural and Resource Economics
University of California, Berkeley, California

John Loomis
Professor of Agricultural and Resource Economics
Colorado State University, Fort Collins, Colorado

Lon Peters
Northwest Economic Research, Inc., Portland, Oregon

Grand Canyon Monitoring and Research Center
February 26, 2010

1. Introduction

The Grand Canyon Monitoring and Research Center convened a workshop December 2-3, 2009, in Phoenix to discuss socioeconomic information needs of the Grand Canyon Dam Adaptive Management Program (GCAMP). Attendees included some two dozen members of the Grand Canyon Technical Work Group representing a wide range of stakeholder and management organizations and agencies. Discussion was stimulated by a series of presentations by technical experts with research experience on Grand Canyon issues:

- Dr. John Duffield, University of Montana, Missoula, Economic Values for National Park System Resources within the Colorado River Basin
- Dr. David Harpman, Bureau of Reclamation, Denver, Integrative Recreation Economics Tool
- Dr. Yeon-Su Kim, Northern Arizona University, Flagstaff, Assessing Impacts of the LSSF Experiment on Regional Recreation Economics
- Mr. David Marcus, independent consultant, Berkeley, Glen Canyon Dam Releases – Economic Considerations
- Mr. Clayton Palmer, Western Area Power Administration, Salt Lake City, The Alchemy of Power Economics: Converting Watts to Dollars
- Dr. Thomas Veselka, Argonne National Laboratories, Chicago, Estimating Colorado River Storage Project Power Economics with the GTMax Model
- Dr. Michael Welsh, Christensen and Associates, Madison, GCES Nonuse Value Study

Four of us, designated as independent panelists were also invited to participate in the workshop:

- Dr. Michael Hanemann, University of California, Berkeley
- Dr. Joel Hamilton, University of Idaho (Emeritus), Moscow
- Dr. John Loomis, Colorado State University, Fort Collins
- Dr. Lon Peters, Northwest Economic Research Inc., Portland

Our role as an independent panel was to recommend potential approaches, methodologies, and anticipated timeframes to address the identified socioeconomic needs of the GCDAMP. This document presents our findings and recommendations from the workshop.

2. Impressions from Two Days in Phoenix

The first part of the two-day workshop consisted of presentations by seven technical experts who had experience with socioeconomic investigations of topics related to the Grand Canyon and Glen Canyon Dam. Each presentation was followed by vigorous discussion among all workshop attendees. At the conclusion of the presentations, the workshop participants were assembled into four small groups to brainstorm about the socioeconomic information needs of the GCAMP. These brainstorming results were compiled into a list, and participants were asked to rate the importance of each item, and to specify whether they should be addressed in phase I or phase II of a research program. In the section which follows we separately address our impressions from the presentations and discussions and from the small groups.

a. Inferences from the Presentations and Discussions

Physical and biological issues in the river corridor have been the main theme of GCAMP information gathering and research efforts in the past. While these investigations have been needed and useful (and have provided much information that is a prerequisite for economic analysis), the result has been that funding for actual socioeconomic research has been very limited. The need for more socioeconomic information to help inform tradeoff analysis by the GCAMP has been apparent for some time. This need has been highlighted by several studies including a 1999 National Research Council report, but to date there has been little follow up by GCAMP to fill this information need.

A significant gap in socioeconomic information available to the GCAMP is the lack of up to date market, non-market and nonuse values for Grand Canyon resources. Some of the benefits of Grand Canyon and Glen Canyon resources are defined in or by markets, such as guided tours and hydropower production. However, because other uses such as fishing and white water recreation are not priced in a market, the use of non-market evaluation techniques is necessary to estimate what value these users place on their Grand Canyon experiences. In his workshop presentation David Harpman talked about his "Integrative Recreation Economics Tool" that computerizes the integration of biological and economic information to allow the user friendly estimation of consumers' surplus from recreation use. Of course, use of Harpman's tool requires up to date information on Grand Canyon River recreation use as input – information that is not now being collected in a systematic and comprehensive way for this reach of the Colorado River.

The presentation by Yeon-Su Kim outlined her work on the regional economic impacts of the 2000 steady-flow experiment on the river. Clearly regional employment and income impacts are very important to regional stakeholders even though national economic efficiency impacts are supposed to be the principal basis for making federal resource use decisions (U.S. Water Resources Council,1983). Kim noted that the regional impacts are lessened by the fact that much of the spending by rafters and outfitters immediately leaks out of the region to pay for items not produced locally. In fact several of the larger outfitters are not even based in-state, so their impact on the regional economy is small. Furthermore, many of the rafting-related jobs are seasonal and low paying. The marginal regional economic impact of any river management change would probably be minimal since the number of rafters is strictly controlled and over subscribed. Since the rafter numbers and their costs are quite fixed, we need to find out if there is any change in consumers' surplus if their non-market valuations of their trip were to change as a result of a management shift.

The Grand Canyon is also a national treasure, and people all over the United States attach a value to the continued existence of the canyon, to the possibility that they might want to visit it sometime, and they want to bequeath this treasure to their grandchildren. This nonuse value may in fact be the dominant value that people place on the Grand Canyon. In his presentation to the workshop, Michael Welsh talked about the results from his 1995 study of nonuse values for the Grand Canyon. This work was completed too late to be included in the March 1995 Environmental Impact Statement (EIS) on the operation of Glen Canyon Dam Colorado River Storage Project, although Welsh's work was cited in the final Record of Decision (ROD).

There has been some controversy about estimation and use of nonuse values. However, the National Research Council (NRC) Committee 1996 report on River Resource Management in the Grand Canyon, while acknowledging the controversy about the measurement of nonuse values, states:

> "Although contingent valuation continues to be controversial, there is a growing body of evidence that supports its practical usefulness (Harpman et al., 1995). Contingent valuation is routinely applied with confidence to estimates of use values, and early work on nonuse values is encouraging." (NRC, 1996, page 120)

The NRC Committee notes that "nonuse values have been included in a variety of policy analyses for which changes in the quality or availability of natural resources are an issue." (NRC, 1996, page 119) It goes on to say:

> "Whether nonuse values can be measured with sufficient accuracy to meet high scientific standards is a question still widely discussed among policy analysts and economists. There is, however, a theoretical economic framework sufficient to form a foundation for their use in the GCES. The literature on CVM indicates that accuracy is sufficient to make quantification of nonuse value useful in understanding the balance of values at stake in managing Glen Canyon Dam. This is particularly true given all that can be learned in the nonuse valuation process regarding public views of the resource issues being addressed under GCES. To neglect total values in favor of more narrowly defined use values would be to leave a major gap in the economic studies under GCES and in the Glen Canyon Dam EIS. This would be unjustifiable given that nonuse values can be estimated." (NRC, 1996, page 120)

With regard to the measurement of nonuse value, the NRC Committee found that:

> "The GCES nonuse value studies are one of the most comprehensive efforts to date to measure nonuse values and apply the results to policy decisions. The studies were subject to extensive scrutiny by the interests (agencies, advocacy groups) participating in GCES and also to intensive review by a panel of professional economists with no stake in the outcome of the studies." (NRC, 1996, page 135)

Similarly, the US General Accounting Office Assessment of the Glen Canyon EIS stated that:

> "The Glen Canyon Dam's EIS nonuse value study was carried out in a manner consistent with contingent valuation and survey research guidance developed to produce high-quality contingent valuation studies. Nonuse values were estimated for the level of change associated with each examined alternative compared to the no-action base case. As such, no estimate for the level of nonuse values associated with the No-Action Flow alternative is provided. The study produced results that suggest that there are substantial nonuse values associated with each of the examined alternatives to current operations at the Glen Canyon Dam." (GAO, 1996, page 133)

In short, while there is controversy regarding the use of contingent valuation in general, nonuse value was recognized by the National Research Council Committee as being relevant to decisions

regarding the operation of Glen Canyon Dam. CV is the only method for estimating nonuse values in the Grand Canyon. We do not believe there are grounds for controversy regarding the particular implementation of CV done by Welsh.

Budget constraints, along with a lack of enthusiasm for nonuse values on the part of the Technical Work Group have meant that little subsequent work on nonuse values has been done. Our impression from listening to the discussion at the workshop (and perhaps partly as a result of what people learned at the workshop) is that the TWG is now much more open to a research program that would estimate changes in nonuse values due to the implementation of various of management alternatives in the Grand Canyon and at Glen Canyon Dam.

Apparently the National Park Service (NPS) is prepared to proceed with needed socioeconomic research. John Duffield's presentation was evidence that NPS is willing to independently fund research, including non-market and nonuse approaches, needed to make management decisions.

Hydropower economics was a point of contention at the workshop. We heard presentations by Tom Veselka, Clayton Palmer, and David Marcus. The main points of difference seemed to revolve around the value of Glen Canyon capacity, how changes in the operation of Glen Canyon Dam would affect Colorado River Storage Project (CRSP) electricity costs, and the degree to which actions at Glen Canyon might be mitigated by the fact that CRSP is closely integrated with other hydropower resources markets by the Western Area Power Administration. We comment on these issues below.

b. Lessons from the small groups

Participants met in four small groups at the end of the first day of the workshop to brainstorm about information needs for GCAMP decision making. Each group then reported four or five of their top information needs or research questions to the meeting facilitation team. Further discussion then led to modification, merger or bifurcation of some of the questions, eventually resulting in list of 24 questions. Workshop participants were asked to score the questions one through five for their importance to GCAMP decision making (five being most important). They were also asked to indicate whether the issue should be addressed in phase I or phase II of a research program. Participants voted using radio frequency clickers linked to a computer to preserve anonymity. The results are presented in table 1.

Following the voting, the group discussed both the results and the procedure for voting. Comments included: "the voting was too hurried to give proper time for thinking", "several of the questions were similar which made it hard to vote, and "we had neither the time not information to consider budget realities". Clearly, both the statements of the questions and the rank ordering of their importance should not be accepted as definitive. The phase I – phase II results are especially questionable because people did not have any information on budget realities when they voted.

Table 1: Questions Developed by Small Groups on First Day of Workshop

(All participants, Ranked by Importance Score)

Item		Importance Score	Phase Score
B	How do high flow and other experiments affect recreation (river rafting fishing guides and other associated businesses, including tribes)?	4	1.2
H	Having heard two distinct views, what is the value of hydropower capacity of GCD?	4	1.2
W	Determine impacts on marketed hydropower and recreation values of alternative flow scenarios in real time to support decision making.	4	1.4
Q	What is the total non-use value for natural cultural, and recreational resources along the river?	3.8	1.5
D	What are the points of disagreement on methodologies and assumptions in regard to power analysis?	3.6	1.2
E	What would a consensus interagency methodology for modeling hydropower and recreation (e.g., fishing and rafting) economic outcomes look like?	3.6	1.5
A	What are the attributes of of the river that are important to recreational users?	3.5	1.3
G	What are the use and nonuse costs and benefits of HFE including the marginal costs and benefits of changes in HFE duration and size?	3.5	1.4
O	What is the economic benefit of river recreation to tribes?	3.5	1.5
U	What is the value of clean power generaton at GCD nationally?	3.5	1.5
C	Do we need to determine the value of specialness" of resources such as hydroelectric power generation; visitor satisfaction; value of beaches to support rafting; values of high visibility wildlife e.g. peregrine falcon, big horn sheep; and value of a blue ribbon trout fishery?"	3.4	1.6
L	What is the sociocultural impact of recreational use in the Colorado River on native american values associated with resources and places in the Grand Canyon?	3.4	1.6
M	Can the values of dependable power and water supplies be reflected in future economic analysis?	3.4	1.6
T	What are the non-use values for different resources (including the tribal perspective) so we can include these values in trade-off analysis?	3.4	1.4
I	What is the base case on optimal power generation?	3.2	1.5
N	How much weight should non-use values be given compared to market and non-market use values?	3.2	1.5
R	What are the socioeconomic benefits and costs of hydropower generation from HFE to tribal communities?	3.2	1.6
V	Can we obtain an assessment of alternative economic consequences associated with different flow regimes at GCD from one or more CRSP customers, including indirect impacts?	3.2	1.5
F	Integrate all use and non-use socioeconomic data into a conceptual model.	3.1	1.7
J	What are the requirements for economic information in GCPA, ESA, NHPA, NEPA, CRSPA, etc.?	3.1	1.4
P	What is the socioeconimic impact of mechanical removal of non-native fish and other actions?	3.1	1.4
S	What is the total economic impact to upper basin water users from changes to power generation from base case?	3.1	1.6
X	Can contracting for firm power WAPA be adjusted to be more flexible for current hydrology and operations without affecting the Basin Fund?	3.1	1.7
K	What are the associated costs to hydropower of non-TCD warmer releases?	2.8	1.8

In developing the recommendations which appear in the following section we chose to use this list of questions in the spirit in which they were originally generated – as brainstorming results. We took the list as a starting point to stimulate our thinking, and as a check-list to be sure we did not miss important subject areas. We tried to account for the overlap between several of the statements. We tried to account for the inherent sequential nature of some of these tasks – you need to collect this information before you can do that kind of study. We tried to anticipate likely future agency budget realities.

3. Context for Economic Analysis

Before we discuss recommendations, it is important to first outline some basic concepts of economic analysis that provide important background for our recommendations.

a. The economic measure of value

Federal principles and guidelines state that the federal objective of water and related land resources planning is to contribute to the national economic development, consistent with protecting the environment (U.S. Water Resources Council, 1983) In addition, the principles and guidelines state that contributions to national economic development are increases in the *net* value of the national output of goods and service, *expressed in monetary units*. This is a restatement of the conventional monetary metric of value used in economics. Economists measure welfare in monetary terms by its *income equivalent* – the change in income that is equivalent, in terms of its impact on a person's welfare, to the change in question. The source of the welfare change could be an increase in net income, in which case the change in net income is the direct measure of economic value. If the welfare change is a change in the price, quality, or access to items that are of value to a person (regardless of whether they are marketed goods and services or non-marketed items), the economic value, in monetary terms, of the change in the price, quality or access to those items is the change in the person's income that would have an equivalent impact on his or her welfare.

In general, there are two ways to define an income equivalent, known as the *willingness to pay* (*WTP*) measure of income equivalence and the *willingness to accept* (*WTA*) measure. Suppose the change generates an improvement in the person's welfare. The WTP measure of income equivalence is the maximum amount of money the person would be willing to pay (i.e., the maximum reduction in his net income he would be willing to endure) in order to obtain the change rather than go without it. The WTA measure of income equivalence is the minimum amount of compensation (i.e., the minimum increase in his net income) he would be willing to accept in return for foregoing (giving up) the change. If the change is directly a change in net income, then there is no difference between the WTP and WTA measures of income equivalence – they are both equal to the change in net income. If there is some type of change other than a direct change in net income, then the WTP and WTA measures can be different. Based on existing research, a general presumption is that the WTP measure is likely to be somewhat smaller in absolute value than the WTA measure, but this may not always be true. More importantly, the federal principles and guidelines state that the WTP measure of value is to be used in water and related land resource planning.

When the change involves the price, quality or access to a marketed commodity and the person

whose welfare is being measured is a consumer of the affected item, the WTP and WTA are essentially equivalent to what is known as the change in *consumer's surplus* – the change in consumer's surplus is used as an approximation to both the WTP and WTA measures. When the people whose welfare is affected consist of both producers and consumers, the income equivalent of the aggregate impact on their combined welfare is referred to as change in "*producers plus consumers surplus*" – it is the sum of the change in net income for the producers and the change in consumers surplus (the income equivalent of their change in welfare) for the consumers.

It is important to note that, even for a marketed item, the economic *value* of the item is *not* the same as its price. For example, the total price to fish or raft in the Grand Canyon National Park can be quite high; it can include the cost to travel the Grand Canyon area, the fee paid to a guide or outfitter, as well as various other costs. The total price could be, say, $350. But that does not necessarily measure the value to the individual from fishing or rafting at the Grand Canyon. His value cannot be *less* than the $350 price because – unless he badly miscalculated -- he would not have chosen to make the trip. But his value can certainly be *more* than the $350 price. Suppose that his value for the trip, as measured by WTP, is $500.[1] Then, he would have been willing to pay up to $500 to take the trip. But, since the price of the trip is only $350, he receives a *net benefit* amounting to $150. Suppose, for example, that it became impossible to take the trip to the Grand Canyon due, say, to a change in reservoir operations. He would lose a consumption experience which he values in monetary terms at $500 – that is his *gross* loss of benefit. But he avoids an expenditure of $350, and he is now free to spend that money on something else. His *net* loss is $150, the amount by which his gross loss would have exceeded his cost – that is his consumer's surplus.[2] It is his "profit" as a consumer, and it can be seen as analogous to the profit that a firm makes.[3] Because it relates in this case to the person's enjoyment of a marketed item – namely, commercial rafting at the Grand Canyon– it is said to be a *use value* for the Grand Canyon.

The above illustrates the importance of the emphasis on *net* as opposed to gross benefit -- net benefit equals gross benefit minus cost. There is also an important economic issue associated with the measurement of cost. The economic cost of an item is defined as the economic value of whatever is sacrificed or foregone in order for the item to be provided. This is not limited to the actual outlays required to obtain the item; it also includes what economists call the *opportunity costs* associated with the provision of the item. The opportunity cost is the value of the *best* alternative that is foregone when the item is supplied. In the recreation context, the time spent travelling to the site may have an opportunity cost component, namely the income foregone when time is not spent earning money but is used instead for recreation. The opportunity cost of time is

[1] It might be even higher as measured by WTA, e.g., because a trip was already "purchased" and was now being withheld or taken away.

[2] The numerical values used here are made-up in order to illustrate the concept of consumer's surplus. However, empirical studies of commercial rafting in the Grand Canyon demonstrate that commercial boaters obtain a sizeable amount of consumer surplus even after quite large commercial fees (Bishop, et al, 1987).

[3] Technically, it is the WTP measure of consumer's surplus. There is also a WTA measure of consumer's surplus, when gross value is measured with the WTA measure. In practice, consumer's surplus is often measured as an ordinary demand curve, in which case it approximates both the WTP and WTA measures of net value.

regularly considered in recreation economics studies.

By a similar logic, the fixed capital costs of currently existing power plants do not constitute a net economic cost to society associated with changes in operations. These fixed costs are considered *'sunk' costs* because the decision to build the power plant has already been taken and the plant is already in operation. Existing fixed costs are not an economic cost of the alternative power plants' operations. But capital costs of new power plants, not currently existing but expected to be built in the future to make up for a reduction in hydropower generation at Glen Canyon Dam, *do* count as a real economic cost associated with a change in operations. In economic terminology, payments to cover the fixed capital costs of existing power plants would be considered "*transfer payments*." Transfer payments reflect a redistribution of income from one group in society to another, and do not reflect a real economic cost to society.

Similarly, the gross economic value of an output is not necessarily the actual revenue received from its sale – it is the value to the recipient of the commodity, based on what it would cost to receive a similar flow of service from an alternative source. Thus, if hydropower from Glen Canyon Dam is sold for $0.5/Kwh but the cost to supply electricity from an alternative source using fossil fuel, say, is $0.8/Kwh, which sets the market price in the Western power grid, the value of electric power generated at Glen Canyon Dam is $0.8/Kwh, not $0.5/Kwh. In economic parlance, the difference -- $0.3/Kwh -- is an economic transfer from the owner of Glen Canyon Dam to the contractors who receive power from Glen Canyon Dam. Like other transfer payments, it involves the redistribution of income from one group in society to another, but not a real economic cost to society.

The foregoing discussion, including the distinctive economic treatment of transfer payments, highlights the difference between an economic analysis of costs and revenues and a financial or accounting analysis of costs and revenues. A financial analysis focuses on the actual revenues and costs accruing to a particular agent; an economic analysis focuses on the real economic costs and benefits to society associated with those financial flows. Therefore, a financial analysis includes transfer payments, while an economic analysis of the sort required by the federal principles and guidelines excludes them.

b. Other Measures – Regional versus National, and Other Metrics

It is sometimes desired to analyze the economic effects of a water project not nationally but within a local economic region, for example the region where the project is located. It is sometimes desired to assess the economic effects in terms of metrics other than the income equivalent of the aggregate impact on welfare (i.e., producers plus consumers surplus); the other metrics may include impacts on employment, output, and sometimes tax revenue. It is common to use an input-output model for regional analyses and calculation of these other metrics. Here we add a note of caution about such analyses.

While there may be a strong local interest in regional effects, it should be noted that the federal principles and guidelines stress the national perspective and assert the primacy of national economic development. Moreover, there are some substantive economic issues that arise when a regional analysis is conducted using input-output analysis, even if the metric employed is impact on local income.

First, the conventional input-output models do not account for consumer's surplus. At best, they account for changes in producers' and consumers' incomes, but they do not allow for the welfare effects of any changes in prices, quality or access to commodities, and they do not account for the income equivalent of such welfare changes (i.e., the change in consumers surplus).

Second, when the economic analysis is conducted for a local region there is almost inevitably some economic leakage, defined as the difference between total sales in the region and income (value added) generated in the local region (Loomis and Walsh, 1997).This leakage consists of payments for goods and services imported into the region from outside, and income payments (including interest, rents, profits and taxes) by producers and consumers within the regions to economic actors outside the region. Given such leakage, the impact on income generated within the region is only a fraction of the total sales generated within the region.[4] The change in total regional sales without a correction for leakage is therefore not an economically meaningful welfare metric, although it is commonly computed in regional input-output analyses.

Third, the conventional input-output analyses ignore substitution between economic changes occurring within the local region being considered and economic changes occurring elsewhere in the national economy. An increase in employment in the local area may cause in-migration to the region and a corresponding decrease in employment outside the region. Viewed from a national perspective, what is happening may simply be a relocation of production, employment and income from one region to another, rather than a net increase nationally. This is a transfer, which has no economic significance nationally. Similarly, a change in taxes is simply a transfer, not a real economic change. In fact, if there is full employment in the economy generally, the increase in regional employment projected by an input-output model is unlikely to be realized: it is simply not credible.

In short, if it is desired to produce a regional analysis, the analysis should at least be consistent with sound economic practice. Leakage has to be accounted for. Offsetting economic changes occurring outside the region should be noted. The only meaningful monetary measure of welfare is income and income-equivalent measures of change in welfare. Other monetary metrics that do not measure this, such as changes in regional sales, are not economically meaningful, cannot validly be combined with income equivalent welfare measures, and should be discarded. The number of jobs created may be a metric of interest, but the credibility of such estimates depends on justifying the implied assumptions about existing unemployment.

c. Long and Short Run Analyses

Any analyses should account for differences between the long run (LR) and the short run (SR). For example, the imposition of changes in operations at GCD will change the distribution of electricity generation in the SR, before new power plants can be built or the transmission system reconfigured. That is, in some periods the output of GCD will fall (rise) and the output of other generators will rise (fall). In the LR, changes in GCD operations may cause changes in the

[4] This is less of an issue at the national level, because imports of goods and services from other countries and income payments to persons in other countries are a much smaller fraction of national value added.

quantity and location of newly built generators, as well as investments in transmission. Present value analysis can be used to eliminate differences in cash flows of different operating regimes. One possibility to keep in mind is that any reductions in capacity at GCD will simply *accelerate* the construction of new capacity somewhere in the area covered by the Western Electricity Coordinating Council (the WECC coordinates electricity service and system reliability in all or parts of 14 western states plus parts of Mexico and Canada), which implies that the economic cost of such reductions in capacity is the acceleration of the investment (e.g., moving from 2017 to 2016), not the entire cost of the investment itself.

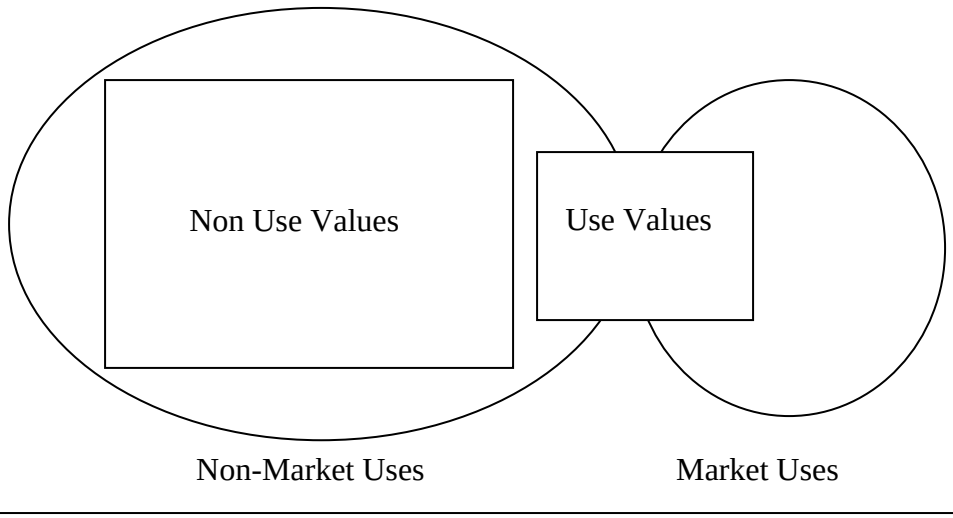
d. Use value, Non-Market Value, Nonuse Value

As noted above, people who visit the Grand Canyon to sightsee or participate in outdoor recreation such as fishing or boating obtain a *use value* from their visit, which can be measured in monetary terms by their WTP measure of net welfare change (their consumers surplus). The unique nature of the Colorado River through the Grand Canyon and the presence of endangered species yield benefits to people who may never set foot in the Grand Canyon. These are *nonuse values* because they occur off-site, usually at homes or households. Nonuse values were also called "passive use values" by the U.S. District Court of Appeals (1989) in upholding the inclusion of option value and existence values in Department of Interior Natural Resource Damage Assessments. Existence values are the benefits individuals receive from the knowledge that the natural environment of the Colorado River and its native and endangered species are protected for themselves and future generations (Krutilla and Fisher, 1975; Hanemann, 1994; Richardson and Loomis, 2009).

Nonuse values are also measured in monetary terms by people's WTP for protection of the unique natural environment and native and endangered species of the Grand Canyon. Nonusers' WTP may be paid in the form of a higher utility bill or higher taxes, as nonuse values are public goods, like national defense. As with other public goods, people generally pay for them through taxes. Regardless of whether people actually pay for their nonuse values, the satisfaction they receive from the knowledge that the Colorado River through the Grand Canyon is protected, along with the native and endangered species, is a real economic benefit to society. There does not need to be an actual payment (a financial cash flow) to generate an economic benefit. The benefits exist independent of whether an agency can capture these as increased tax revenues or increments to utility payments. Figure 1 illustrates the relationship between non-market value (the entire circle) and the primary components: (a) use values (e.g., recreation) and (b) nonuse values.

While the relative proportions of use and nonuse values will vary from resource to resource, Loomis, et al.'s (2005) comparison of use values and nonuse values (see also Welsh, et al., 1995) in the Grand Canyon indicates that the nonuse values dominate use values in the Grand Canyon. In part this is due to the cap on rafting use, but in part due to the public good nature of nonuse values. Everyone in the U.S. (or even the world) can receive the satisfaction from knowing the Colorado River through the Grand Canyon and its native and T&E species are protected, without having to visit.

Figure 1. Market and Non Market Values of the Colorado River & Native & T&E Species in the Grand Canyon



e. Relation Between Data Collection, Surveys, and Economic Analysis

Economic analysis requires data. The data used by economists often comes from a variety of sources. Economists often use data from published sources. For example, the regional economic models presented by Kim during the first day of our workshop relied heavily on published US government sources.

In other cases economic analysis may rely primarily on in-house company or agency information. The analysis that we propose below for the hydropower system will rely significantly on Glen Canyon operating data and on information on the characteristics and operation of the regional power coordinating agencies.

The economic analysis of recreation and of nonuse values requires a different approach. Since the needed data is not available from published sources or agency operating data, it must be obtained using surveys. The only way to measure a rafter's willingness to pay for the rafting experience is to elicit that response with a well designed survey of river users. To estimate the net economic value of the rafting experience, one also needs estimates of what the rafters actually did pay, which can also come from the survey. The estimation of nonuse values also depends heavily on contingent valuation survey approaches. A systematic program of survey data collection must be an integral part of the GCMRC socioeconomic research program.

4. Recommendations for Surveys and Studies

The following are our recommendations for surveys and studies that should be conducted by GCMRC. We begin with a discussion of some of the considerations and constraints that shaped our recommendations.

a. Considerations

Past GCMRC budgets have focused largely on biological and physical issues. While this has provided much useful background information, it has left little of the available resources to support socioeconomic studies. We realize that making major shifts in this research program budget will be difficult and will take time. In making our recommendations we have tried to be sensitive to these budget constraints, personnel constraints, and timing realities.

Of course, the budget, personnel and timing realities will depend on the perceived urgency of the socioeconomic studies. It is our conclusion that the socioeconomic analyses recommended below are important for Grand Canyon policymaking, so we recommend that these studies be initiated as soon as possible, and pursued expeditiously. However we recognize that the policy making context could change in ways that make it more urgent to have the socioeconomic research results sooner. If that happens, and if that urgency is backed up by budget and personnel increases, then the analysis might proceed faster than shown in the timeline below.

A socioeconomic research program will follow a logical sequence. Some things must be done before others. The process generally starts with problem identification, a search for existing data and related work, and discussions of appropriate analytical models. Often information from one stage of analysis serves as input to a subsequent stage. (For example, collection of data on river use and user spending must precede the building of an economic impact model.) Some studies are simply harder to do than others, and might be deferred to give GCMRC more time to acquire experience doing socioeconomic research, and to allow more time to plan such studies. (For example, studies of Grand Canyon nonuse values are inherently more complex than studies of the economic value of river use.)

All work should be peer-reviewed throughout, to enhance credibility and acceptance. Allowance must be made in the research timeline to allow for this peer review.

b. Hydropower

The main effect of any changes in the operation of Glen Canyon Dam will most likely be a change in the timing of hydropower generation during the course of the day, the week and the year, rather than any change in the total Kwh generated at GCD over the course of the year. But, because electric power has a different economic value at different times of the day, the week, and the year, this can translate into an economic cost. To assess the economic cost it is necessary to look at the real economic value of the power generated at GCD rather than the contract prices at which much of the power is sold. As indicated in section 3a, the GCD contract prices may involve economic transfers and therefore understate the economic value of this resource.

GCD and the CRSP system are embedded in the larger western power grid (the WECC). Similarly, the utilities to which CRSP sells power are embedded in the WECC. Therefore, in principle, the market by reference to which the economic value of GCD power is determined is not the CRSP system but the WECC. At any point in time, it is the marginal price of electricity in the WECC that determines the economic value of power generated at GCD.

As indicated in section 3a, the capital costs of existing power plants, whether in CRSP or the

WECC generally, do not constitute a net economic cost to society of changes in operations. They are sunk costs, and they do not count as an economic cost of the existing power plants' operations. As a general statement, there currently exists excess capacity in the WECC. But, to the extent that, at some point in the future, reductions in power generation at GCD require an increment in generating capacity somewhere in the WECC system, the marginal cost of this extra capacity *would* count as a real economic cost. It would not necessarily be the cost of additional capacity in CRSP – it would be the cost of additional capacity anywhere in the WECC system to which WAPA and/or WAPA contractors have access. Moreover, it would be determined by the capital cost associated with the cheapest alternative source of additional capacity, which could be based on non-fossil fuel, and could take the form of investments in the promotion of energy conservation (a.k.a., "negawatts").

We were told at the meeting in Phoenix that the existing power contracts for GCD expire in 2024. This creates the possibility that, when new contracts are negotiated for post-2024, it would be possible (and desirable) for WAPA to seek contract modifications that take into account the power generation impacts of any modification in GCD operations. The opportunity for contract adaptation should be factored into the economic assessment of the economic costs of changes in GCD operations for the period after 2024.

The first step is to establish a "base case" against which various scenarios for hydroelectric operations can be compared. The base case, and all scenarios, must be developed in sufficient detail that existing modeling tools can be used to estimate economic effects. Given the nature of markets in the western U.S., such detail should include, at a monthly level, peak (hourly) output, and peak and off-peak energy output. More sophisticated analyses may require even more detail, e.g., hourly or even within-hour energy production in the base case and relevant scenarios. Although the development of a "base case" is likely to be contentious, we recommend that current operations be considered the "base case", but that operations in some historical period, defined by a lack of environmental constraints, also be modeled, so that arguments about cumulative changes in equity can be considered.

Once a base case is established, alternative scenarios for future operations must be clearly defined at the same level of detail (e.g., peak demand and peak and off-peak energy). Given the alternatives, existing models used by WAPA to optimize the operation of the integrated system of generation resources should be used to determine if all consequences of changed operations can be managed within the WAPA marketing area, or if electrical (and thus economic) "spill-over" effects will alter generation patterns, market prices or transmission bottlenecks elsewhere in the WECC system. If the effects of changed operations at Glen Canyon can be managed by WAPA without economically significant changes in the rest of the western U.S., then the economic consequences of such operations will be limited to WAPA's customers, and the modeling effort limited. However, at this point there is no way to know if such changes will spill over into the rest of the WECC system beyond WAPA without actually checking this using a model of the WAPA system and checking changes at flowgates where WAPA interconnects with the rest of the WECC.

We have focused so far on requirements for the analysis of the economic impacts of changes in GCD operation The analysis should also incorporate an assessment of the financial effects on individual WAPA contractors. As explained in section 3a, the analysis of financial effects tracks

flows of funds, e.g., changes in WAPA's overall revenue requirement or transfers between WAPA customers. Financial effects are important to those who are actually paying the bills, but economic effects are important from a national policy perspective.

We recommend that WAPA's existing power flow models be used to analyze the expected effects of changes in generation at Glen Canyon Dam, including effects on (a) generation (federal or non-federal) within the WAPA system, (b) loadings on transmission lines, (c) ability to meet reliability criteria, and (d) spot market prices at the Palo Verde Hub. These effects should be estimated for a near-term year (e.g., 2012) and a long-term year (e.g., 2020), because in the long-run more changes can typically be made via investments that could mitigate any short-term effects.

If WAPA's power flow models demonstrate changes in flows at the border of WAPA's system, or at interconnection points with other systems, then a more extensive modeling effort will be required, to check for changes in the above four indicators (generation, transmission, reliability, and hub prices) throughout the WECC. Again, a near-term year and a long-term year should be modeled.

Any economic effects should be identified with specific parties, both inside WAPA and elsewhere in the WECC system. Candidates for such identification include the following: WAPA's customers, end-users of WAPA's customers, other end-users in the WECC, other producers inside the WAPA marketing area, and producers outside the WAPA marketing area but inside WECC.

The power modeling effort can be spread out over time, initially focusing on the WAPA marketing area using existing models, while soliciting qualification statements from entities (vendors) that maintain power flow models of the entire WECC. If the existing models show effects outside the WAPA marketing area, additional analysis for the entire WECC should be performed.

Because western power markets probably do not meet the definition of "perfect competition", some effort should be taken to account for market imperfections. It is at least theoretically possible that changes in operations at Glen Canyon Dam will provide opportunities for some suppliers to exercise market power, at least in the short run. (Entry in the long run *may* eliminate such concerns: additional generation and transmission resources may be built.)

To the extent that repeated analyses of power market impacts are required as part of the future decision-making during the extended experimentation contemplated under the Adaptive Management Plan, it may well be possible to ease the calculations by developing a simplified response-surface model, embodied in a spreadsheet, linking changes within the CRSP service area to impacts on prices and capacity requirements within WECC.

In addition to the economic and financial analyses discussed above, economic impacts will also be of interest to policy makers. Thus, input-output models such as IMPLAN could be used to estimate changes in employment, income, and government tax revenues, due to changes in operations at Glen Canyon Dam. The relevant geographical area would be the CRSP service area. However, the limitations inherent in such models should be noted, and leakage must be accounted for.

Finally, changes in generation patterns may result in changes in emissions of carbon dioxide and other sources of environmental consequence. Again, commercially available models are capable of estimating emission changes. Any solicitation of vendor qualifications should include the ability to model power flows, economic consequences, and environmental effects.

USGS should first seek access to a model of the WECC system and may wish to issue an RFQ for providers of such access to obtain preliminary estimates of the expected cost of estimating the net economic effects of changes in operations at GCD.[5] It would appear that this task could be accomplished during the current fiscal year (FY10) if staff is available to formulate (scope) the problem, and to seek and evaluate responses. These estimates could then be used to establish a budget for FY11, for actual modeling work within the WAPA marketing area based on an RFP and bids from qualified firms. During FY11, information generated by the WAPA modeling effort would then be used to develop budgets for FY12 and beyond, once a determination is made about the potential geographical scope of economic effects. Table 2 summarizes these modeling suggestions.

Table 2

Date	Task(s)	Responsible Parties
FY2010	Define GCD operational base case and change cases	GCMRC, with cooperation from WAPA
	Solicit firms for WECC analysis (RFQ for engineering, financial, and economic analyses)	GCMRC, with cooperation from WAPA
FY2011	Model WAPA's system with changes in GCD operations; check flowgates between WAPA and rest of WECC; establish framework for economic and financial analyses	Consultant, with cooperation from WAPA
FY2012	Conduct economic and financial analyses, for WAPA and its customers and, if necessary, WECC	Consultant, WAPA, GCMRC

c. Recreation

As noted above, studies of the economics of recreation are generally based on data from surveys of recreation users. Table 3 provides a taxonomy of the different users of the Grand Canyon, the providers of recreation and the economic impact areas (i.e., counties and reservations) that merit detailed economic study. Several of these groups have not been studied in decades, despite the regional and national prominence of fishing and rafting in Glen and Grand Canyons. Each row can be thought of as one survey that captures multiple values. Repeating surveys over time creates consistency of data collection over time, and allows for tests of responses to specific events (e.g., experimental releases, extreme weather events). In each case, the first step is to find out what related survey data already exists or may be collected in the near future (perhaps by state or other federal agencies)

[5] It may be possible to utilize a non-proprietary model of the WECC system such as the SWITCH model recently developed at UC Berkeley.

Table 3: Economic Effects of Resource Use Proposed for Near-Term Studies

	Users		Providers	County/Reservation Incomes
	Values	Attitudes		
Glen Canyon Anglers (FY11)	Benefits	Preferences	Outfitters	Impacts
Day Use Rafters (FY11)	Benefits	Preferences	Outfitters	Impacts
WW Rafters (FY12)	Benefits	Preferences	Outfitters	Impacts
Diamond Creek to Mead (FY12)	Benefits	Preferences	Enterprise	Impacts

Implementation and Economies of Scale in Recreation Surveys

For each type of recreational user in each location a single survey will be able to provide information on visitor preferences, visitor benefits (i.e., net WTP or consumer surplus) and expenditures. This expenditure data can be used in the IMPLAN regional input-output model to estimate the positive economic impacts to the surrounding counties and Indian Reservations in terms of direct and indirect personal income and employment generated. The indirect effects capture the multiplier effects from subsequent rounds of spending in the surrounding region. Separate interviews with the guides and the tribes will be needed to obtain their expenditures associated with the guiding, access fees, food, and other costs. We recommend that the economic impact analysis use two impact areas. For consistency with past research, it would be appropriate to use the counties surrounding the Grand Canyon. However, since many outfitters have their base of operation in Nevada or Salt Lake City, it would be appropriate to show results using a broader multi-state economic impact area.

FISCAL YEAR 2011

We recommend that the Glen Canyon angler and rafting surveys begin in FY 2011, as this is a small geographic area with a well defined user group. The angler surveys could be done by partnering with Arizona Fishing and Game (AZFG). An efficient division of labor would be for joint design of the survey, AZFG implementation of the angler survey (as state agencies are not subject to federal review by OMB), and data analysis and report writing by USGS/NPS, NAU or contractors. The Glen Canyon rafter survey may be able to be done in conjunction with the planned river recreation surveys by John Duffield (Bioeconomics) as part of the NPS assessment of benefits of river recreation in the Colorado River watershed. The GCMRC surveys should build upon Bishop, et al.'s past surveys (1987) and Duffield's (2009) to maintain consistency in questions over time.

FISCAL YEAR 2012

In FY 2012 we recommend that whitewater boaters (private and commercial) be surveyed in the Grand Canyon. For comparability of data and comprehensiveness of analysis, we recommend that the survey collect information on preferences, economic benefits to the boaters themselves, and their expenditures. Interviews with the outfitters will be needed to obtain the outfitters' expenditures for commercial trips. The data from private boaters, commercial passengers and outfitters can then be analyzed to estimate use values of whitewater boaters (i.e., consumer

surplus), and the economic impacts to surrounding counties (and states) of the income and employment associated with whitewater rafting. Since several commercial outfitters are located outside of the surrounding counties we recommend that the economic impact analysis also be performed using surrounding states such as Nevada and Utah to more completely reflect the personal income and employment supported by whitewater rafting. This would be consistent with the west wide service area used in the hydropower analysis. The GCMRC surveys should build upon Bishop, et al.'s past surveys and Duffield's to maintain consistency in questions over time.

In addition, surveys should be initiated in the Diamond Creek to Lake Mead stretch of the Colorado River. This segment has been experiencing increased use, both as the last days of a Grand Canyon trip, but also as separate day and short overnight trips. The Hualapai Tribe uses this stretch for their guided trips as well, yet little is known about the recreation benefits to the visitors or the regional economic impact of these trips. Discussions with Hualapai Tribe and other outfitters to obtain information to perform a regional economic impact analysis should be a high priority in FY12.

Maintaining a Monitoring Cycle and Special Use Surveys Related to Experiments
Since the Grand Canyon Protection Act specifically mentions recreation as one resource to be monitored, GCMRC, NPS and AZGF, should periodically resurvey all users groups and river segments specified in Table 1 on a rotating cycle. Thus, once the first pass of surveys is completed in FY 2013, in FY 2014 it will be time to repeat the Glen Canyon anglers and day use boaters survey. Likewise in FY 2015 it will be appropriate to repeat the Grand Canyon whitewater boater and Diamond Creek-Mead surveys.

In some cases, these surveys will serve as a baseline and allow measurement of effects of experimentation in Glen and Grand Canyon. However, if large experiments are planned, it would be important to do pre-experiment visitor surveys and post experiment visitor surveys to assess the economic effects of these experiments on visitor benefits and the regional economy.

These proposed recreation use surveys address Questions B, W (part), A, O, L, G (part), C, and R identified at the December Socioeconomic meeting.

d. Tribal

Native Americans account for a significant portion of the total population most directly affected by GCD operations, namely residents of northeast Arizona.[6] About 85% of the most directly affected Indian population live on Indian Tribal reservations in that region of Arizona (NRC, 1996, page 138). The Tribes have a variety of interests in any change in the operations of GCD. They claim some degree of sovereignty over portions of the river and its associated environment. They were the original inhabitants of this region and have strong religious and cultural attachments to the landscape and its fauna and flora. As the National Research Council noted:

> "In terms of cultural and historic traditions and beliefs and practices, the Native American peoples are the population at risk relative to dam operations." (NRC, 1996, page 140)

[6] In 1990, they accounted for 49% of the population of Coconino, Apache and Navajo counties, as cited by National Research Council (1996, p. 138).

In addition, in some cases (especially the Hualapai Tribe) they derive significant income from river-based recreational and other enterprises. However, while the Native American Tribes were belatedly included in the group of Grand Canyon Environmental Studies (GCES) cooperators convened by the BOR, their distinctive interests and the impact of dam operations on them received very little attention in the GCES studies. The NRC 1996 report criticized GCES for having been slow to incorporate the Tribes in the group of GCES cooperators. It clearly implied that it felt the Tribes had received inadequate consideration in the GCES process. Clearly, a socioeconomic research program for the GCMRC needs to recognize not only the **economic** impacts but also the **social** impacts on the Tribes that result from changes in dam operations. The Tribal social impacts may suggest both opportunities and constraints that should be considered as changes in river operations are contemplated.

The most effective way to accomplish this is to design and implement a survey of the Tribal populations. Information to be covered in this survey should include:

- Attitudinal questions
- Impacts of flow regimes

Tribal representatives should be invited to participate in the development and testing of the survey instrument. To the extent that they may already have information on issues covered by the survey from their own sources, that information should be consulted in the design of the survey. For example, the survey could be a mail or phone survey of residents of the Tribe reservation, and Tribe members living off the reservation, using contact lists provided by the Tribes.

The tribal survey will address issues O, L and R raised at the December 2009 Socio-Economics workshop.

e. Nonuse Surveys

Nonuse values were recognized by the National Research Council Committee on River Resource Management in the Grand Canyon as "an acknowledged dimension of comprehensive environmental studies." The Committee went on to comment that "nonuse value seems particularly relevant in the case of the Grand Canyon because of the high aesthetic and intangible values attached to the region nationally and internationally and by Native American Tribes." It noted: "Even so, and perhaps for this very reason, the BOR long resisted inclusion of nonuse values but in 1995 acceded to them as an addendum to the EIS." This is the study by Welsh, et al. 1995. Referring to the information in this study, the Committee stated "the information itself is clearly warranted as a component of GCES." [7] (NRC, 1996, page 28)

It is now almost 15 years since that study was conducted. Much has changed including the management scenarios in the Grand Canyon and the demographics of the U.S. population, especially in the Four Corners Region. As recommended by the National Research Council in its report "Downstream", these nonuse values are quite important to understanding the public

[7] The Committee also stated that "GCES has illustrated the need for the inclusion of nonuse value studies in similar projects" (NRC, 1996, page 6-7).

benefits of alternative management strategies in the Grand Canyon.

We recommend that in the upcoming fiscal year (2011) that the 1994 nonuse value study be reviewed and a determination made of what changes need to be made to the questionnaire. In conjunction with this it may be beneficial to hold a one day workshop on the conceptual basis for and methods for conducting nonuse value surveys in order to prepare TWG and GCMRC staff for this effort. The effort will require an interdisciplinary effort with hydrologists, fish biologists and anthropologists to obtain data on key environmental variables such as beaches, game, native and endangered fish, and the status of cultural resources in the Grand Canyon. The linkages between flow and other management actions and these resources need to be identified so that survey scenarios can be developed that better match current management options under consideration by AMWG, TWG, and GCMRC. By tying flow-related changes to the environment to the nonuse value survey, the incremental or **marginal** nonuse values can be estimated that are most useful for evaluating potential management actions in the Grand Canyon.

The study and survey revision steps should be in consultation with the National Park Service's nonuse value study that John Duffield is currently leading. Initial focus groups to refine the revised survey should occur in Fiscal Year 2011. Formal pre-tests and piloting of the survey and OMB clearance would be a priority in Fiscal Year 2012. Full implementation of the study should be scheduled and budgeted for Fiscal Year 2013. This survey should be repeated at least every decade or when major changes to the operation of Glen Canyon dam or major experiments are being considered so as to provide public input on the consequences to nonuse values of different management alternatives.

The non use value surveys will address issues: T, Q, G (part), C (part), and N raised at the December Socio-Economics review team meeting.

5. Implementation

a. Staffing and Agency Costs

- Staffing. We have mentioned staffing at various points in this report. As the GCMRC shifts to greater emphasis on socioeconomic studies, GCMRC staff with resource economics expertise will be required to conceptualize the required studies, to initiate RFPs and help secure study funding, and to provide study oversight. Resource economics staff will also be needed to help interpret study results and to outline the implications of these results for agency policy. Additional resource economics staff will be required to do this effectively. This assumes that most of the socioeconomic research will be conducted by outside consultants. If some of the studies were to be conducted in-house, the requirement for additional staff would be much greater.

- Agency costs. In addition to the staffing needs noted above, there will be other additional agency costs. These will include costs for outside consultants, costs for conducting surveys, and perhaps other data acquisition costs. The GCMRC also needs to plan for the additional operating costs that will be needed if the added resource economics staff is to be effective.

b. Collaboration

As noted above, the fishing surveys should be undertaken in collaboration with Arizona Fish and Game. The recreation use surveys should be undertaken in cooperation with the NPS effort lead by Duffield, et al. Other possibilities for collaboration, especially for data collection, should be investigated. Possibilities include collaboration with river guide organizations and the tribes.

c. Budgeting

The following is our suggestion for a budget timeline with our rough estimates of costs. We have tried to recognize budget realities, personnel limitations, and logical project sequencing. Depending on the perceived urgency of the socioeconomic analysis, and fund availability, it might be possible to accelerate the timeline.

Fiscal Year 2010

- Initiate RFQs for power models (consultants, perhaps NAU or other qualified entity). No additional budget will be required if this is done by existing staff. However, it might be worthwhile for GCMRC to consider enlisting some additional socio-economic expertise, perhaps from David Harpman or another similarly qualified expert, when developing the RFQs, in which case some additional funding may be required to support this activity in FY10

Fiscal Year 2011

- Initiate recreation surveys of Glen Canyon anglers and day-use rafters $50,000 - $100,000
- Identify tribes for specific surveys of preferences and attitudes $5,000
- Offer "Nonuse Values 101" to educate staff on topic $15,000 (plus participation of David Harpman)
- Power modeling. Cost depends on whether there is a non-proprietary model of WECC and, if not, the cost of access to a proprietary model.

Fiscal Year 2012

- Conduct power flow studies that show the financial and economic consequences of Glen Canyon management alternatives on WAPA, WAPA customers and the Upper Basin Fund. $50,000
- Recreation surveys continue, now covering white water users including Diamond Creek to Mead rafters $100,000 - $150,000
- Prepare surveys of tribal preferences and attitudes $20,000
- Conduct focus groups and piloting of Non Use Value survey, and initiate OMB clearance. ($200,000).
- Power modeling. Cost to be determined.

Fiscal Year 2013

- Expand power flow studies to include the financial and economic consequences of Glen

Canyon management alternatives for the entire WECC. $100,000
- Recreation surveys continue, repeating the coverage of Glen Canyon and day-use $150,000
- Add tribal surveys. $60,000
- Conduct full nonuse value survey. $500,000

Fiscal Year 2014

- Develop "real-time decision-making spreadsheet" ($50,000 - $100,000)
- Recreation surveys continue, repeating coverage of white water users $150,000

d. Policy and legal analyses

The basic question is: How will the market, non-market use and nonuse values be integrated into policy analysis? We recommend that DOI Office of Policy Analysis and/or DOE and/or WAPA develop a policy position paper on how the dollar values of market, non market and nonuse values will be used in the different decision making processes such as NEPA analysis, adaptive management and in any benefit-cost analysis.

Resolving these questions of how market, non-market use and nonuse values should be integrated into Grand Canyon policy formulation would address questions X, J, F raised at the December Socio-Economics workshop.

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INCLUDES TWG COMMENTS: 1/3/2011

Table 1. Socioeconomic Projects identified in the February 26, 2010 "Final Report of the GCMRC Socioeconomic Research Review Panel."

Proposed Study/Activity	Questions Addressed	Proposed Use by AMP (Expert Panel Perspective)	TWG Comments
Socioeconomic research overall and its application to GCDAMP decision-making. Cost: TBD	J, F	How will the market, non-market use and nonuse values be integrated into policy analysis? The Panel recommended that the DOI Office of Policy Analysis and/or DOE and/or WAPA develop a policy position paper on how the dollar values of market, non-market and non-use values will be used in the different decision making processes such as NEPA analysis, adaptive management and in any benefit-cost analysis. Resolving these questions of how market, non-market use and nonuse values should be integrated into Grand Canyon policy formulation would address questions J and F raised at the December Socioeconomics workshop.	CREDA: At the end of the report the question is raised – how will the results of all this economic work be used in the GCDAMP decision making process? CREDA suggests that this should be one of the very first questions to be answered. DOI must not wait until it sees the answers before it decides how or if economic impacts will affect its decisions.
FY2010			
Staffing. Cost: TBD		As GCMRC shifts to greater emphasis on socioeconomic studies, GCMRC staff with resource economics expertise will be required to conceptualize the required studies, to initiate RFPs and help secure study funding, and to provide study oversight. Resource economics staff will also be needed to help interpret study results and to outline the implications of these results for agency policy. Additional resource economics staff will be required to do this effectively. This assumes that most of the socioeconomic research will be conducted by outside consultants. If some of the studies were to be conducted in-house, the requirement for additional staff would be much greater.	Norm: include staffing proposal by expert panel (done).

Proposed Study/Activity	Questions Addressed	Proposed Use by AMP (Expert Panel Perspective)	TWG Comments
Define GCD operational base case and change cases. Cost: TBD		This task addresses the fundamental need to define a base case (i.e., a "standard") against which proposed changes in GCD operations can be evaluated in the future. The panel recommended that TWG select an operational scenario that reflects current (MLFF) operations. Base case needs to define monthly volumes, hourly (or even within hourly) outputs, amount of peak and off-peak power production, etc. The panel also recommended studies related to the financial effects of changes to GCD operation and distributive effects.	CREDA: The panel may have recommended MLFF as the base, but they acknowledged controversy. CREDA recommends pre-ROD conditions be the base; the Argonne post-ROD work could "fill in" this gap, with the new work as additive. Jerry: Selecting the operational scenario will be crucial-there are great variations in dam operations within the MLFF . Current 8.23 maf seems to be the current scenario compared to late 1990 averages of 11 maf.
Solicit firms for WECC analysis and conduct initial power modeling using currently available models. Cost: TBD WECC = Western Electrical Coordinating Council (i.e., western grid).		The expert panel recommended that GCMRC analyze how different types of CRSP operations may or may not "spill over" into the WECC. They viewed the analysis of potential "spill- over effects" between the CRSP and WECC, using an appropriate model, as a necessary first step to properly evaluate power value and potential replacement costs associated with future changes in GCD operations. The Panel recommend that WAPA's existing power flow models be used to analyze the expected effects of changes in generation at Glen Canyon Dam, including effects on (a) generation (federal or non-federal) within the WAPA system, (b) loadings on transmission lines, (c) ability to meet reliability criteria, and (d) spot market prices at the Palo Verde Hub. These effects should be estimated for a near-term year (e.g., 2012) and a long-term year (e.g., 2020), because in the long-run more changes can typically be made via investments that could mitigate any short-term effects. If WAPA's power flow models demonstrate changes in flows at the border of WAPA's system, or at interconnection points with other systems, then a more extensive modeling effort will be required, to check for changes in the above four indicators (generation, transmission,	CREDA: Should clarify that the capacity impacts are Glen Canyon generating capacity. This is the relevant metric – not sure what "system" means. The marginal price of electricity in the WECC is not an appropriate measure to develop trade-off analysis for operational decisions. Basically, there is no "marginal price" WECC-wide. Generation and markets are regional, constrained by physical transmission constraints. The WECC as a whole is not a "market". Capacity can't be purchased at the PV hub, and is not necessarily "always available". PV prices do not reflect the cost of capacity. It is inappropriate to state that the "value" of GCD power should be compared to the WECC as a "market", because

Proposed Study/Activity	Questions Addressed	Proposed Use by AMP (Expert Panel Perspective)	TWG Comments
		reliability, and hub prices) throughout the WECC. If needed in a second step, the panel recommended that GCMRC solicit outside consultants to perform the broader WECC analyses using models that are most appropriate for this purpose. The panel also suggested that GCMRC enlist additional expertise to develop the RFQs for the power modeling work.	operationally the WECC is NOT the market. Jerry: workshop and evaluation of the GT Max model included in HYD 10.R2.11-12 to determine the suitability of this model for this purpose
FY2011			
Non Use Values 101 educational workshop. Cost: $15,000	C, G, N, Q, T	The panel recommended that GCMRC host a Non Use Values 101 class to help TWG & AMWG understand the relevance and value of this type of study for informing future AMP decision making. This workshop would provide AMP stakeholders with a basic introduction to the concepts and rationales underlying non-use value studies, clarify terminology, and provide an overview of how this analysis is conducted and how the resulting data could be to interpreted and applied to inform AMP decisions.	CREDA strongly supports the recommendations of the socio econ ad hoc group regarding the econ training. (see paper by Shane Capron) Jerry: A more basic course which outlines differences b/w market ,non market ,and non use studies is needed. Additional more in depth webinars /conference calls could be added as needed.
Power Modeling: initiate base case analysis. Cost: TBD	I, W, S	This task would define the parameters of an MLFF base case scenario and then analyze its economic implications. The base case will provide the foundation against which economic projections of alternative GCD operations would be compared in the future. Determine what “changes” to this base case will be analyzed. 1) Model WAPA’s system with changes in GCD ops, 2) Check flow gates between WAPA and rest of WECC under different operational scenarios, 3) Establish framework for economic and financial analyses.	CREDA: See above comments re selection of pre ROD conditions as the base case.

Proposed Study/Activity	Questions Addressed	Proposed Use by AMP (Expert Panel Perspective)	TWG Comments
Recreation: initiate recreation surveys of Glen Canyon anglers and day-use rafters. Cost: =$50,000 - $100,000	B, W, A, O, L, G, C,R	The panel proposed that GCMRC undertake socioeconomic studies focused on recreational values that include both market and non-market *use* values for specific river reaches. The panel maintained that it is the *benefits* to recreational value in a broad sense, rather than just regional income (as reflected in a typical market analysis) that are important for the AMP to measure. They proposed that the first study focus on angling and rafting use of the Glen Canyon reach.	WAPA: The panel proposed studying recreation expenditures (market) as well as the non-market aspect of recreation. This recommendation included several suggestions on how to avoid an incorrect recreation market analysis. While the panel suggested that economics of scale could be had by gathering recreational data on both market and non market aspects at the same time, this is really a program decision. We imagine it's the case that market data are easier to gather and can be analyzed easily. Dave Garrett calls recreation expenditure analysis the "low hanging fruit". On the other hand, data on recreational consumer surplus (preferences) will require a proper survey design and additional input from stakeholder groups. We suggest that the expenditure data be gathered and analyzed while the nonmarket survey instrument is being developed Jerry: -- reviews by the NRC, recreation PEP, and the expert panel review have been critical on the lack of understanding by the program related to user values --previous studies are dated Richards(1985) Bishop(1987)

Proposed Study/Activity	Questions Addressed	Proposed Use by AMP (Expert Panel Perspective)	TWG Comments
Review 1994 Non Use Value Survey and update the questionnaire. Cost: $0	T, Q, G, C, N	The panel maintained that a new non-use value study is needed to properly assess resource values associated with Grand Canyon, and potential impacts to those values from dam ops. The focus would on values that are important to tribes and the American public that are not dependent on human use or consumption for their value. Preparing for this study will take considerable time; therefore the panel recommended that GCMRC and TWG start planning now for a future non-use value study, taking into account changes that have occurred in the canyon and to dam operations since 1995. Initiating Step #1 – discussion and review of old questionnaire – could be done at no additional cost to the AMP.	CREDA: Regarding recreation surveys, how are the views of people who are not interested in fishing/rafting accounted for? Regarding non-use surveys, as asked by the Hualapai representative at the workshop, how can any willingness-to-pay survey be designed so as to eliminate all of the biases of the respondent (economic, cultural, spiritual, etc.)? Should a non-use value for non carbon emitting hydro electric generation be identified?
Identify tribes for specific surveys of preferences and attitudes. Cost: $5,000	O, L, R, B	The expert panel heard from the Tribes that there is a need to integrate tribal values in AMP decision making. Tribal surveys should start to address this need by more clearly defining what those values are and by determining how best to measure them and how changes in GCD operations may affect tribal values. The panel recommended that GCMRC start to plan for future tribal surveys in Phase I and implement them in Phase II.	WAPA: While the panel recommended the gathering of information regarding Native American attitudes, it's unclear to us how this fits into the gathering and analyzing of economic information and how it might inform decision makers regarding changing the operation of GCD. We'd like to separate the sociological analysis from the economic analysis and consider the panelists recommendations as they relate to gathering data on Native American attitudes and the GCD AMP program.
FY2012			

Proposed Study/Activity	Questions Addressed	Proposed Use by AMP (Expert Panel Perspective)	TWG Comments
Conduct power flow studies that show the financial and economic consequences of GCD management alternatives on WAPA, WAPA customers and the Upper Basin Fund. Cost: TBD	I, W, S	This task would evaluate economic outcomes from alternative GCD operations in relation to the base case. TWG/AMWG/or DOI first need to define what "change cases" they want to analyze before this can be initiated.	
Recreation surveys continue, now covering white water users including Diamond Creek to Mead rafters. Cost: $100-150,000	B, W, A, O, L, G, C, R	Same rationale as for Glen Canyon recreational analysis, except that the focus of this study would be on the recreational uses downstream of Lees Ferry. Like the previous study, the proposed analyses would address both market and non-market values, so that the costs or benefits to recreation could be fully evaluated.	CREDA: How are the specific reaches determined? Through the DFC process? Jerry: --reviews by the NRC, recreation PEP, and the expert panel have been critical of the lack of understanding by the program related to recreation values --there is a need to understand the effects of different flow regimes on trip attributes and resource conditions that effect the quality of river experiences --non river recreation use in the CRE is not understood
Prepare surveys of tribal preferences and attitudes. Cost: $40,000	O, L, R, B	A socioeconomic research program for GCMRC needs to recognize not only the economic impacts but also the social impacts on the Tribes that result from changes in dam operations. The Tribal social impacts may suggest both opportunities and constraints that should be considered as changes in river operations are contemplated. Information to be covered in this survey should include attitudinal questions and impacts of flow regimes. Tribal representatives should be invited to participate in the development and testing of the survey.	

Proposed Study/Activity	Questions Addressed	Proposed Use by AMP (Expert Panel Perspective)	TWG Comments
Conduct focus groups and piloting of Non-Use Value survey, and initiate OMB clearance. Cost: $200,000	T, Q, G, C, N	The panel recommended that GCMRC start to plan for a future non-use value study during Phase I, to be ready for actual implementation in Phase II. These FY12 tasks would be part of the preparatory phase preceding implementation of the actual survey.	
FY2013			
If needed: expand power flow studies to include the financial and economic consequences of Glen Canyon management alternatives for the entire WECC. Cost: TBD	M, U, V, W	The panel believed there was a need to more fully analyze how proposed changes in GCD opertations may affect the larger western electrical grid, thus influencing power market values. The need to evaluate the impacts on the WECC would be assessed in step 1 under power modeling in FY 2011 and 2012. During FY2011, information generated by the WAPA modeling effort would be used to develop budgets for FY2012 and beyond, once a determination is made about the potential geographical scope of economic effects and whether the expanded WECC-level analysis is deemed necessary to influence GCDAMP decision-making.	CREDA: See comments above re "the market". Trade-off analysis most likely would not extend to the WECC.
Conduct tribal surveys. Cost: $60,000	O, L, R, B	A socioeconomic research program for GCMRC needs to recognize not only the economic impacts but also the social impacts on the Tribes that result from changes in dam operations.	
Conduct full non-use value survey. Cost: $500,000	T, Q, G, C, N	It is now almost 15 years since the Welsh et al. (1995) study was conducted. Much has changed including the management scenarios in the Grand Canyon and the demographics of the U.S. population, especially in the Four Corners Region. As recommended by the National Research Council in its report "Downstream", these nonuse values are quite important to understanding the public benefits of alternative management strategies in the Grand Canyon. By tying flow-related changes to the environment to the non-use value survey, the incremental or marginal nonuse values can be estimated that are most useful for evaluating potential management actions in the Grand Canyon.	
Recreation surveys continue, repeating the coverage of Glen Canyon and day-use. Cost: $150,000	B, W, A, O, L, G, C, R	The panel recommends that socioeconomic surveys be repeated every 2-3 years as a monitoring tool to assess how changes in GCD operations affect recreational values.	CREDA: How long does it take to synthesize data from the surveys, and will results from each survey be available prior to the next one being started?
FY2014			

Proposed Study/Activity	Questions Addressed	Proposed Use by AMP (Expert Panel Perspective)	TWG Comments
Develop "real-time decision-making spreadsheet." Cost: $50,000 - $100,000		To the extent that repeated analyses of power market impacts are required as part of the future decision-making it may well be possible to ease the calculations by developing a simplified response-surface model, embodied in a spreadsheet, linking changes within the CRSP service area to impacts on prices and capacity requirements within WECC.	
Recreation surveys continue, repeating coverage of white water users. Cost: $150,000	B, W, A, O, L, G, C, R	The panel recommends that socioeconomic surveys be repeated every 2-3 years as a monitoring tool to assess how changes in GCD operations affect recreational values.	

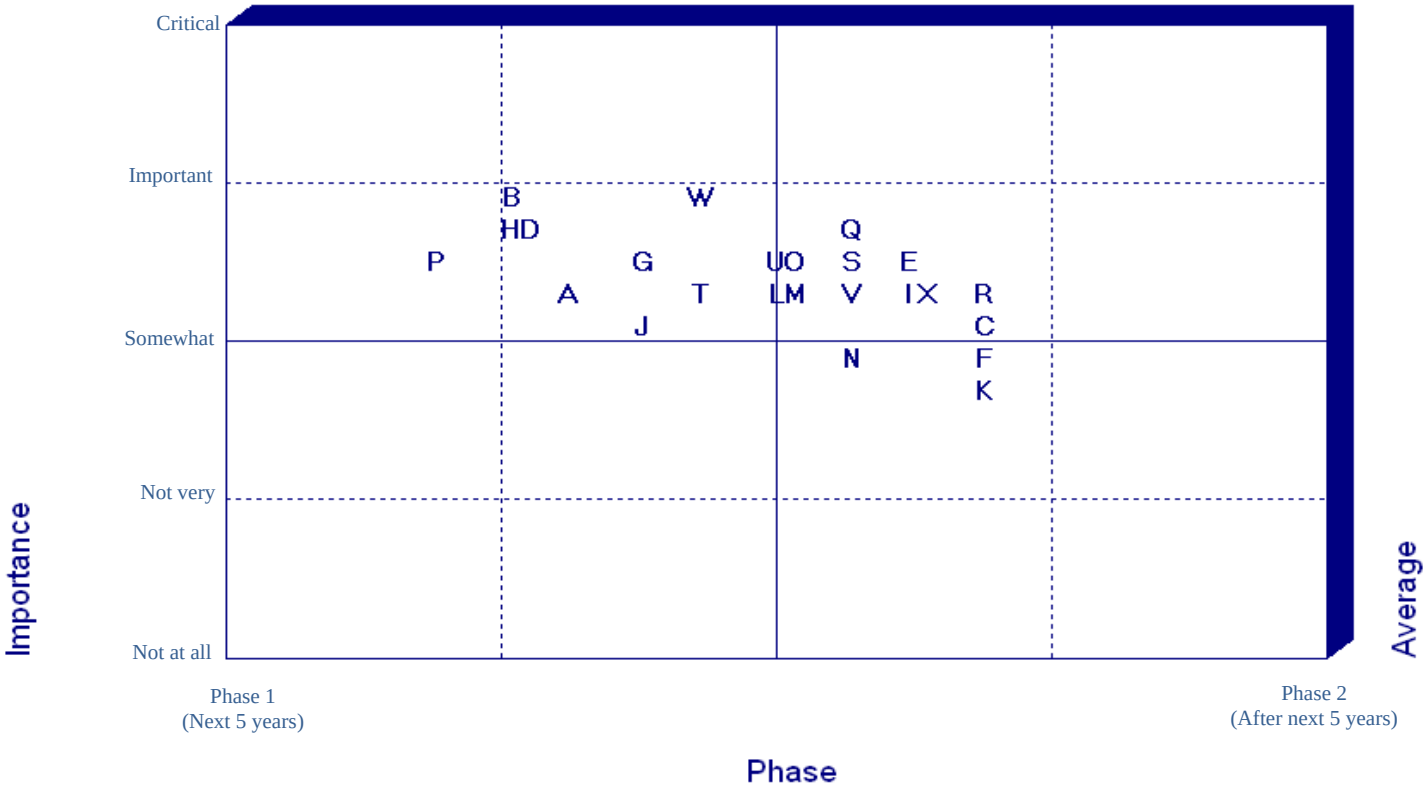
Table 2. Polling results from a TWG December 2009 Socioeconomics workshop. Workshop participants developed the following list of questions that they felt needed to be resolved in order to inform AMP decision making in the future. These questions were subsequently evaluated by the TWG members in terms of their perceived importance and the most appropriate time frame for addressing them (Phase 1 or Phase 2). The results of this exercise informed the expert panel's recommended list of socioeconomic activities to be pursued by the AMP over the next few years.

Importance and Timing of Socioeconomic Questions to Inform Decisionmaking for the AMP

All Workshop Participants and Official TWG Members

Socioeconomic Questions	All Participants			Official TWG Members		
	Average Importance Rating	Phase 1	Phase 2	Average Importance Rating	Phase 1	Phase 2
	28 participants			16 participants		
B-How do high flow and other experiments affect recreation (river rafting fishing guides and other associated businesses, including tribes)?	4.0	79%	21%	3.9	75%	25%
H-Having heard two distinct views, what is the value of hydropower capacity of GCD?	4.0	79%	21%	3.8	75%	25%
W-Determine impacts on marketed hydropower and recreation values of alternative flow scenarios in real time to support decision making.	4.0	64%	36%	4.0	56%	44%
Q-What is the total non-use value for natural cultural, and recreational resources along the river?	3.8	50%	50%	3.8	44%	56%
D-What are the points of disagreement on methodologies and assumptions in regard to power analysis?	3.6	75%	25%	3.7	75%	25%
E-What would a consensus interagency methodology for modeling hydropower and recreation (e.g., fishing and rafting) economic outcomes look like?	3.6	46%	54%	3.6	38%	63%
A-What are the attributes of the river that are important to recreational users	3.5	71%	29%	3.3	69%	31%
G-What are the use and nonuse costs and benefits of HFE including the marginal costs and benefits of changes in HFE duration and size?	3.5	61%	39%	3.4	63%	38%
O-What is the economic benefit of river recreation to tribes?	3.5	54%	46%	3.4	50%	50%
U-What is the value of clean power generation at GCD nationally?	3.5	46%	54%	3.6	50%	50%
C-Do we need to determine the value of specialness" of resources such as hydroelectric power generation; visitor satisfaction; value of beaches to support rafting; values of high visibility wildlife e.g. peregrine falcon, big horn sheep; and value of a blue ribbon trout fishery?"	3.4	39%	61%	3.1	31%	69%
L-What is the sociocultural impact of recreational use in the Colorado River on Native American values associated with resources and places in the Grand Canyon?	3.4	43%	57%	3.4	50%	50%
M-Can the values of dependable power and water supplies be reflected in future economic analysis?	3.4	39%	61%	3.5	50%	50%
T-What are the non-use values for different resources (including the tribal perspective) so we can include these values in trade-off analysis?	3.4	57%	43%	3.2	56%	44%
I-What is the base case on optimal power generation?	3.2	50%	50%	3.3	38%	63%
N-How much weight should non-use values be given compared to market and non-market use values?	3.2	46%	54%	2.9	44%	56%
R-What are the socioeconomic benefits and costs of hydropower generation from HFE to tribal communities?	3.2	36%	64%	3.3	31%	69%
V-Can we obtain an assessment of alternative economic consequences associated with different flow regimes at GCD from one or more CRSP customers, including indirect impacts?	3.2	54%	46%	3.4	44%	56%
F-Integrate all use and non-use socioeconomic data into a conceptual model.	3.1	29%	71%	2.9	31%	69%
J-What are the requirements for economic information in GCPA, ESA, NHPA, NEPA, CRSPA, etc.?	3.1	57%	43%	3.1	63%	38%
P-What is the socioeconomic impact of mechanical removal of non-native fish and other actions?	3.1	61%	39%	3.4	81%	19%
S-What is the total economic impact to upper basin water users from changes to power generation from base case?	3.1	39%	61%	3.4	44%	56%
X-Can contracting for firm power WAPA be adjusted to be more flexible for current hydrology and operations without affecting the Basin Fund?	3.1	32%	68%	3.2	38%	63%
K-What are the associated costs to hydropower of non-TCD warmer releases?	2.8	21%	79%	2.6	31%	69%

Scatter Diagram
Importance and Timing of Socioeconomic Questions
Official TWG Members – December 2, 2009



Draft: 1-10-2010

Table 3. Proposed Socioeconomic Plan for FY2011-2014, as recommended by the TWG Socioeconomic Ad Hoc Group.

ROW #	Proposed Study/Activity	AMP Info Needs	TWG Questions to be addressed	Proposed Use by AMP (SEAGH Perspective)
1	Socioeconomic research overall and its application to GCDAMP decision-making. Cost: TBD	N/A	Resolving questions of how market, non-market, use and non-use values should be integrated into Grand Canyon policy formulation would address questions J and F.	How will the market, non-market use and nonuse values be integrated into policy analysis? Policy should be developed in a collaborative effort between the AMWG, DOI and DOE/WAPA on how the dollar values of market, non-market and non-use values will be used in the different decision making processes such as NEPA analysis, adaptive management and in any benefit-cost analysis.
2	Staffing. Cost: TBD Time: FY 2012 and beyond	N/A	N/A	As GCMRC shifts to greater emphasis on socioeconomic studies, GCMRC staff with resource economics expertise will be required to conceptualize the required studies, to initiate RFPs and help secure study funding, and to provide study oversight. Resource economics staff, or outside consultants, may be needed to help interpret study results and to outline the implications of these results for agency policy. Additional resource economics staff or contractors may be required to do this effectively. This assumes that most of the socioeconomic research will be conducted by outside consultants. If some of the studies were to be conducted in-house, the requirement for additional staff would be much greater.
	FY 2011			

ROW #	Proposed Study/Activity	AMP Info Needs	TWG Questions to be addressed	Proposed Use by AMP (SEAGH Perspective)
3	Economics 101 educational workshop. Cost: TBD Time: FY 2011	**IN 12.1** Develop information that can be used by the TWG, in collaboration with GCMRC, to establish current and target levels for all resources within the AMP as called for in the AMP strategic plan. **IN 12.2** Determine what information is necessary and sufficient to make recommendations at an acceptable level of risk. **RIN 12.1.1** What is the economic value of the recreational use of the Colorado River ecosystem downstream from Glen Canyon Dam? **RIN 12.1.2** What are the use (e.g., hydropower, trout fishing, rafting) and non-use (e.g., option, vicarious, quasi-option, bequest and existence) values of the Colorado River ecosystem	C. Do we need to determine the value of "specialness" of resources, such as, hydroelectric power generation; visitor satisfaction; value of beaches to support rafting; values of high visibility wildlife e.g., peregrine falcon, big horn sheep; and value of a blue ribbon trout fishery? D. What are points of disagreement on methodologies and assumptions in regard to power analysis? E. What would a consensus interagency methodology for modeling hydropower and recreation (e.g., fishing & rafting) economic outcomes look like? J. What are the requirements for economic information in GCPA, ESA, NHPA, NEPA, CRSPA,? M. Can the values of dependable power and water supplies be reflected in future economic analysis? N. How much weight should non-use values be given compared to market and non-market use values? T. What are the non-use values for different resources (including the tribal perspective) so we can include these values in trade-off analysis?	The panel recommended that GCMRC host a Non Use Values 101 workshop to help TWG & AMWG understand the relevance and value of this type of study for informing future decision making. However, the TWG felt that a more general workshop/training was needed initially to provide AMP stakeholders with a basic introduction to the concepts and rationales underlying socioeconomic studies in general, to clarify terminology, and to provide an overview of how various types of analyses (market, non-market, non-use studies) are conducted and how the resulting data could be to interpreted and applied to inform AMP decisions. This workshop is currently scheduled for March 7, 2011 in Phoenix. This educational workshop is not intended to cover non-use economics in-depth, that will be covered during the non-use workshop now scheduled for FY 2012. Western may provide support for the Economics 101 workshop and to help GCRMC to identify presenters specifically to address power system economics. CREDA will also provide professional opinion to GCRMC on potential power system experts.

ROW #	Proposed Study/Activity	AMP Info Needs	TWG Questions to be addressed	Proposed Use by AMP (SEAGH Perspective)
4	Define GCD operational base case and change cases. Cost: TBD Time: FY 2011 Policy	**IN 10.1** Determine and track the impacts to power users from implementation of Record of Decision dam operations and segregate those effects from other causes such as changes in the power market. **RIN 10.1.1**. What would be the effects on the Colorado River ecosystem and marketable capacity and energy of increasing the daily fluctuation limit? **RIN 10.1.2.** What would be the effects on the Colorado River ecosystem and marketable capacity and energy of increasing the upramp and downramp limit? **RIN 10.1.3** What would be the effects on the Colorado River ecosystem and marketable capacity and energy of raising the maximum power plant flow limit above 25,000 cfs? **RIN 10.1.4** What would be the effects on the Colorado River ecosystem and marketable capacity and energy of lowering the minimum flow limit below 5,000 cfs? **RIN 10.1.5** How do power-marketing contract provisions affect Glen Canyon Dam releases?	I. What is the base case on optimal power generation? W. (partly) Determine impacts on marketed hydropower and recreation values of alternative flow scenarios in real time to support decision making. S. (partly) What is the total economic impact to upper basin water users from changes to power generation from base case?	This task addresses the fundamental need to define a base case (i.e., a "standard") against which proposed changes in GCD operations can be evaluated in the future. The panel recommended that TWG select an operational scenario that reflects current (MLFF) operations. The base case needs to define monthly volumes, hourly (or even within hourly) outputs, amount of peak and off-peak power production, etc. There is disagreement of what the base case should reflect; pre-rod conditions or MLFF. We recommend developing a base cast that captures current MLFF operations. The TWG also believes there would be value in using this base case in the future to assess change relative to pre-rod operation such that the change from various operations could be assessed to show how moving from one scenario to the other either results in net benefits or costs. This step, defining the base cases and the change cases to be analyzed in the future is essential to further analyses. **TWG – we need to discuss this further as the ad hoc group did not reach consensus on this approach. We have disagreement over the base case, pre-rod or MLFF or potentially both.**

ROW #	Proposed Study/Activity	AMP Info Needs	TWG Questions to be addressed	Proposed Use by AMP (SEAGH Perspective)
5	Peer review of the WAPA GTMax power model. Cost: $30,000 Time: FY 2011	**SSQ 3-4.** What are the projected hydropower costs associated with the various alternative flow regimes being discussed for future experimental science (as defined in the next phase experimental design)? **IN 10.1.** Determine and track the impacts to power users from implementation of ROD dam operations and segregate those effects from other causes such as changes in the power market. **CMIN 10.1.1** (as redefined by SPG). 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, etc.).		**Workplan: HYD 10.R2.11-12 p. 150** WAPA will provide the GCMRC with a full description of the GTMax model including equations. GCMRC will organize and host a workshop involving technical staff from WAPA, a representative from National Argonne Laboratories, and a small group of independent hydropower modeling experts. During this workshop, the functions, assumptions, and data needed to run the GTMax model and possibly other models will be described in detail and demonstrated through hands-on involvement of all subject experts. GCDAMP stakeholders will be invited to observe the workshop, but the focus of this workshop will be on providing an opportunity for independent experts to become thoroughly familiar with and be able to independently assess GTMax and other relevant models in terms of their potential suitability for use as an electrical power system economic forecasting tool and post hoc assessment tool in the AMP.

ROW #	Proposed Study/Activity	AMP Info Needs	TWG Questions to be addressed	Proposed Use by AMP (SEAGH Perspective)
6	Power modeling: conduct the base case analysis and initial power modeling using currently available models and test "spill over" effects with the WECC. Cost: TBD Time: FY 2011 WECC = Western Electrical Coordinating Council (i.e., western grid).	**IN 10.1** Determine and track the impacts to power users from implementation of Record of Decision dam operations and segregate those effects from other causes such as changes in the power market. **RIN 10.1.1**. What would be the effects on the Colorado River ecosystem and marketable capacity and energy of increasing the daily fluctuation limit? **RIN 10.1.2.** What would be the effects on the Colorado River ecosystem and marketable capacity and energy of increasing the upramp and downramp limit? **RIN 10.1.3** What would be the effects on the Colorado River ecosystem and marketable capacity and energy of raising the maximum power plant flow limit above 25,000 cfs? **RIN 10.1.4** What would be the effects on the Colorado River ecosystem and marketable capacity and energy of lowering the minimum flow limit below 5,000 cfs? **RIN 10.1.5** How do power-marketing contract provisions affect Glen Canyon Dam releases? **CMIN 10.1.1** (as redefined by SPG). 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, etc.).	I. What is the base case on optimal power generation? W. (partly) Determine impacts on marketed hydropower and recreation values of alternative flow scenarios in real time to support decision making. S. (partly) What is the total economic impact to upper basin water users from changes to power generation from base case?	**Workplan: HYD 10.R2.11-12 p. 150** Implement the report recommendation to complete the base case study for hydroelectric operations in FY 2011. The detailed description of the base case study will be prepared by GCMRC, with input from WAPA and appropriate experts, based on the description in the Socioeconomic Panel's report, and input from the GTMax workshop results, and any additional specifications by the TWG/AMWG. This base case study will also include an analysis of "spill over" with the WECC. The base case and spill over analysis will be completed by WAPA and a report prepared at no cost to the AMP. The report will be submitted by WAPA to GCMRC for peer review. GCMRC will oversee the peer review process and use the Science Advisors as needed. WAPA will incorporate changes into the report based on comments received from the peer review process. If WAPA's power flow models demonstrate changes in flows at the border of WAPA's system, or at interconnection points with other systems, then a more extensive modeling effort may be required, to check for changes in four indicators throughout the WECC (generation, transmission, reliability, and hub prices). If needed in a second step, the panel recommended that GCMRC solicit outside consultants to perform the broader WECC analyses using models that are most appropriate for this purpose. The panel also suggested that GCMRC enlist additional expertise to develop the RFQs for the power modeling work.
	FY2012			

ROW #	Proposed Study/Activity	AMP Info Needs	TWG Questions to be addressed	Proposed Use by AMP (SEAGH Perspective)
7	Non-use values workshop to incorporate review of the 1994 Non Use Value Survey and update the questionnaire. Cost: $0 Time: FY 2012	**RIN 12.1.2** What are the use (e.g., hydropower, trout fishing, rafting) and non-use (e.g., option, vicarious, quasi-option, bequest and existence) values of the Colorado River ecosystem **RIN 12.1.3** How does use (e.g., hydropower, trout fishing, rafting) and non-use (e.g., option, vicarious, quasi-option, bequest and existence) values change in response to an experiment performed under the Record of Decision, unanticipated event, or other management action?	T, Q, G, C, N	A new non-use value study is needed to properly assess resource values associated with Grand Canyon, and potential impacts to those values from dam operations. The focus would be on values that are important to tribes and the broader American public that are not dependent on human use or consumption for their value. Data on tribal values may be gathered as part of this study depending on the outcome of preliminary investigations. Preparing for this study will take considerable time; therefore the panel recommended that GCMRC and TWG start planning early for a future non-use value study, taking into account changes that have occurred in the canyon and to dam operations since 1995. Initiating Step #1 – discussion and review of old questionnaire – could be done at no additional cost to the AMP. However, TWG is recommending that this be accomplished in a workshop format to include a more detailed review of non-use economics.
8	Scoping activity: identify tribes for specific surveys of preferences and attitudes and determine if separate tribal studies are needed. Cost: $5,000 Time: FY 2012	**RIN 11.2.1** What are traditionally important resources and locations for each tribe and other groups? **RIN 11.2.2** What is the baseline measure for resource integrity?	B. How do high flow and other experiments affect recreation (river rafting fishing guides and other associated businesses, including tribes)? O. What is the economic benefit of river recreation to tribes? L. What is the sociocultural impact of recreational use in the Colorado? R. What are the socioeconomic benefits and costs of hydropower generation from HFE to tribal communities? T. What are the non-use values for different resources (including the tribal perspective) so we can include these values in trade-off analysis?	There is a need to better integrate tribal values in AMP decision making. This task is intended as a scoping activity to determine how tribal values should be assessed and then integrated into AMP decision making. Future activities per the panel's recommendations are provided below but they are placeholders if scoping finds that a separate process is needed to specifically address tribal preferences and values. This scoping process should fully include the tribes and any similar processes they may be involved in (such as the surveys currently being conducted by the Hopi Tribe as part of their monitoring project).
9	Recreation Use Analysis: Part A (Market):	**CMIN 9.1.1** Determine and track the changes attributable to dam operations in recreational quality, opportunities and use, impacts, serious incidents, and	A. What are the attributes of the river that are important to recreational users? B. How do high flow and other experiments affect recreation (river rafting fishing guides	The panel proposed that GCMRC undertake socioeconomic studies focused on recreational values that include both market and non-market *use* values for specific river reaches. While the

ROW #	Proposed Study/Activity	AMP Info Needs	TWG Questions to be addressed	Proposed Use by AMP (SEAGH Perspective)
	initiate recreation expenditure analysis of Glen Canyon anglers, day-use rafters, and Grand Canyon and Marble Canyon white water users including Diamond Creek to Mead rafters. Part B (Non-Market): initiate development of survey instrument for recreation non-market use analysis and obtain OMB clearances. Cost: $150,000 - $200,000 Time: FY 2012-2013	perceptions of users, including the level of satisfaction, in the Colorado River Ecosystem. **CMIN 9.1.4** Determine and track the economic benefits of river related recreational opportunities. **RIN 12.1.1** What is the economic value of the recreational use of the Colorado River ecosystem downstream from Glen Canyon Dam?	and other associated businesses, including tribes)? C. Do we need to determine the value of "specialness" of resources, such as, hydroelectric power generation; visitor satisfaction; value of beaches to support rafting; values of high visibility wildlife and value of a blue ribbon trout fishery? G. (partly) What are the use and nonuse costs and benefits of HFE including the marginal costs and benefits of changes in HFE duration and size? L. What is the sociocultural impact of recreational use in the Colorado River on Native American values associated with resources and places in the Grand Canyon? O. What is the economic benefit of river recreation to tribes? W. (partly) Determine impacts on marketed hydropower and recreation values of alternative flow scenarios in real time to support decision making.	panel suggested that economics of scale could be had by gathering recreational data on both market and non market aspects at the same time, this is really a program decision. Market data are easier to gather and can be analyzed easily. Data on recreational consumer surplus (preferences) will require a proper survey design and additional input from stakeholder groups. The expenditure data be gathered and analyzed while the nonmarket survey instrument is being developed The regional economic effects of GCD experiments and other DOI actions will be analyzed. This analysis would be devoted to the impact on the regional economy as a result of changes in expenditures resulting from these actions. The groups of interest for this study would be Glen Canyon day use rafters and anglers and Grand Canyon Whitewater rafting of commercial and private boaters from Lees Ferry to Diamond Creek or Lake Mead and the Hualapai white water recreational enterprise that services Diamond Creek to Lake Mead. This expenditure data can be used in the IMPLAN regional input-output model to estimate the positive economic impacts to the surrounding counties and Indian Reservations in terms of direct and indirect personal income and employment generated. Indirect effects would capture the multiplier effects from subsequent rounds of spending in the surrounding region. Separate interviews with the guides and the tribes will be needed to obtain their expenditures associated with the guiding, access fees, food, and other costs. We recommend that the economic impact analysis use two impact areas. For consistency with past research, it would be appropriate to use the counties surrounding the Grand Canyon. However, since many outfitters have their base

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				of operation in Nevada or Salt Lake City, it would be appropriate to show results using a broader multi-state economic impact area (Report page 16)
10	Power modeling: conduct change case analyses, and power flow studies that show the financial and economic consequences of GCD management alternatives on WAPA and WAPA customers. Cost: TBD Time: FY 2012	**RINS 10.1.1-10.1.5**	I. What is the base case on optimal power generation? W. (partly) Determine impacts on marketed hydropower and recreation values of alternative flow scenarios in real time to support decision making. S. (partly) What is the total economic impact to upper basin water users from changes to power generation from base case?	This task would evaluate economic outcomes from alternative GCD operations in relation to the base case. TWG/AMWG/or DOI first need to define what "change cases" they want to analyze before this can be initiated (see task above).

ROW #	Proposed Study/Activity	AMP Info Needs	TWG Questions to be addressed	Proposed Use by AMP (SEAGH Perspective)
11	[Contingent upon power modeling in FY 2011] WECC power analysis: GCMRC to solicit firms for future WECC analysis and work with WAPA to establish framework for future economic and financial analyses if deemed necessary by power modeling completed in FY 2011. Cost: TBD WECC = Western Electrical Coordinating Council (i.e., western grid).	**IN 10.1** Determine and track the impacts to power users from implementation of Record of Decision dam operations and segregate those effects from other causes such as changes in the power market. **RIN 10.1.1**. What would be the effects on the Colorado River ecosystem and marketable capacity and energy of increasing the daily fluctuation limit? **RIN 10.1.2.** What would be the effects on the Colorado River ecosystem and marketable capacity and energy of increasing the upramp and downramp limit? **RIN 10.1.3** What would be the effects on the Colorado River ecosystem and marketable capacity and energy of raising the maximum power plant flow limit above 25,000 cfs? **RIN 10.1.4** What would be the effects on the Colorado River ecosystem and marketable capacity and energy of lowering the minimum flow limit below 5,000 cfs? **RIN 10.1.5** How do power-marketing contract provisions affect Glen Canyon Dam releases?	I. What is the base case on optimal power generation? W. (partly) Determine impacts on marketed hydropower and recreation values of alternative flow scenarios in real time to support decision making. S. (partly) What is the total economic impact to upper basin water users from changes to power generation from base case?	This project is contingent upon the power modeling done by WAPA in FY 2011 to determine "spill over" effects to the WECC. The panel believed there was a need to more fully analyze how proposed changes in GCD operations may affect the larger western electrical grid, thus influencing power market values. The need to evaluate the impacts on the WECC would be assessed in step 1 under power modeling in FY 2011 and 2012. During FY2011, information generated by the WAPA modeling effort would be used to develop budgets for FY2012 and beyond, once a determination is made about the potential geographical scope of economic effects and whether the expanded WECC-level analysis is deemed necessary to influence GCDAMP decision-making. If determined that WAPA's models are not sufficient to capture "spill over" effects, GCMRC should solicit outside consultants to perform the WECC analyses using models that are appropriate for this purpose. If these tasks are needed, GCMRC should enlist additional expertise to develop the RFQs for the power modeling work (see staffing).
	FY2013			

ROW #	Proposed Study/Activity	AMP Info Needs	TWG Questions to be addressed	Proposed Use by AMP (SEAGH Perspective)
12	Recreation Use Analysis Continues: Part B (Non-Market): initiate recreation surveys of Glen Canyon anglers, day-use rafters, and Grand Canyon and Marble Canyon white water users including Diamond Creek to Mead rafters. Cost: =$150,000 - $200,000 Time: FY 2013-2014	**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. **CMIN 9.1.4** Determine and track the economic benefits of river related recreational opportunities. **RIN 12.1.1** What is the economic value of the recreational use of the Colorado River ecosystem downstream from Glen Canyon Dam?	A. What are the attributes of the river that are important to recreational users? B. How do high flow and other experiments affect recreation (river rafting fishing guides and other associated businesses, including tribes)? C. Do we need to determine the value of "specialness" of resources, such as, hydroelectric power generation; visitor satisfaction; value of beaches to support rafting; values of high visibility wildlife and value of a blue ribbon trout fishery? G. (partly) What are the use and nonuse costs and benefits of HFE including the marginal costs and benefits of changes in HFE duration and size? L. What is the sociocultural impact of recreational use in the Colorado River on Native American values associated with resources and places in the Grand Canyon? O. What is the economic benefit of river recreation to tribes? W. (partly) Determine impacts on marketed hydropower and recreation values of alternative flow scenarios in real time to support decision making.	GCMRC should undertake socioeconomic studies focused on recreational values that include both market and non-market *use* values for specific river reaches. In FY 2013, work would focus on the second phase of this project implementing the non-market use values surveys. This recommendation combines areas from Glen Canyon down to Mead in order to maximize efficiency in developing surveys. The intent of the non-market use work is to determine the broader value of the resource to recreation users beyond the simple expenditure analysis under the market use analysis (above). This broader analysis of "willingness to pay" for changes in resource conditions would help the AMP in determining economic consequences of actions by including overall changes in benefits. For example, changes in operations might increase the value of power but might have a negative consequence on the overall benefits to recreational visitors or other user groups. This analysis would put dollar amounts on those changes in benefits and allow an economic analysis to be performed on GCDAMP decisions.

ROW #	Proposed Study/Activity	AMP Info Needs	TWG Questions to be addressed	Proposed Use by AMP (SEAGH Perspective)
13	[Contingent on scoping results FY 2012] Prepare surveys of tribal preferences and social values. The analysis could include consideration of both use and non-use values and include sociology and socioeconomics. Cost: $40,000 Time: FY 2013	**RIN 11.2.1** What are traditionally important resources and locations for each tribe and other groups? **RIN 11.2.2** What is the baseline measure for resource integrity?	B. How do high flow and other experiments affect recreation (river rafting fishing guides and other associated businesses, including tribes)? O. What is the economic benefit of river recreation to tribes? L. What is the sociocultural impact of recreational use in the Colorado? R. What are the socioeconomic benefits and costs of hydropower generation from HFE to tribal communities? T. What are the non-use values for different resources (including the tribal perspective) so we can include these values in trade-off analysis?	This activity is dependent on the outcome of the scoping exercise in FY 2012. Although it is important to consider tribal values in AMP decision making it is unclear whether these values require separate analyses or whether these values could be adequately considered during the use and non-use tasks described elsewhere in this plan. It is important that this research program incorporates tribal values so that decisions can incorporate those values in a meaningful way. A socioeconomic research program needs to recognize not only the economic impacts but also the social impacts on the tribes that result from changes in dam operations. Socioeconomic impacts to Tribes may suggest both opportunities and constraints that should be considered as changes in river operations are contemplated. Information to be covered in this survey could include attitudinal questions about preferences and impacts of flow regimes. Tribal representatives would be invited to participate in the development and testing of the survey.
14	Initiate OMB clearance to conduct surveys with focus groups in FY 2014 in order to develop a non-use values survey in FY 2015. Cost: $20,000			
	FY2014			

ROW #	Proposed Study/Activity	AMP Info Needs	TWG Questions to be addressed	Proposed Use by AMP (SEAGH Perspective)
15	[Contingent on scoping results FY 2012] Conduct tribal surveys for preferences and social values potentially affected by GCD operations. Cost: $100,000 Time: FY 2014-2015		O, L, R, B, T	A socioeconomic research program for GCMRC needs to recognize not only the socioeconomic impacts but also the social impacts on the Tribes that result from changes in dam operations.
16	Conduct focus groups and piloting of Non-Use Value survey, and initiate OMB clearance for full survey implementation. Cost: $200,000		T, Q, G, C, N	The panel recommended that GCMRC start to plan for a future non-use value study to be ready for actual implementation. These FY2014 tasks are part of the preparatory phase preceding implementation of the actual survey.
17	Develop "real-time decision-making spreadsheet" for power impacts and benefits. Cost: $50,000 - $100,000			To the extent that repeated analyses of power market impacts are required as part of the future decision-making it may well be possible to ease the calculations by developing a simplified response-surface model, embodied in a spreadsheet, linking changes within the CRSP service area to impacts on prices and capacity requirements within WECC. The GTMax Lite model may be applicable to develop this, but only after adequate testing is done in tasks above.
	FY2015			

ROW #	Proposed Study/Activity	AMP Info Needs	TWG Questions to be addressed	Proposed Use by AMP (SEAGH Perspective)
18	Conduct full non-use value survey. Cost: $500,000 Time: FY 2015-2016		T, Q, G, C, N	By 2015, it will have been 20 years since the Welsh et al. (1995) study was conducted. Much has changed including the management scenarios in the Grand Canyon and the demographics of the U.S. population, especially in the Four Corners Region. As recommended by the National Research Council in its report "Downstream", these nonuse values are quite important to understanding the public benefits of alternative management strategies in the Grand Canyon. By tying flow-related changes to the environment to the non-use value survey, the incremental or marginal nonuse values can be estimated that are most useful for evaluating potential management actions in the Grand Canyon.
19	Implement Core Monitoring Plan for Socioeconomics. Cost: TBD		B, W, A, O, L, G, C, R	The panel recommends that socioeconomic surveys be repeated every 2-3 years as a monitoring tool to assess how changes in GCD operations affect recreational values. This should be integrated into the Core Monitoring Plan. A placeholder for socioeconomics should be kept in the initial General Core Monitoring Plan.