***Response to IWQP PEP Recommendations:***

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## I. Introduction:

The Integrated Water Quality Program (IWQP) Protocol Evaluation Panel (PEP) met in Flagstaff and on Lake Powell and the Lees Ferry reach from November 27 – December 3, 2000. The PEP spent time in the field and received technical presentations on the IWQP. A presentation was made to the TWG by the Chairman of the IWQP PEP, Jim Ruane on February 13, 2001. The PEP provided GCMRC with their final report on February 23, 2001.

In this document, the PEP's findings and recommendations have been summarized in a table. Page numbers are provided so the reader can locate the complete PEP finding and recommendation in the PEP final report. GCMRC's response to each paraphrased finding and recommendation is incorporated in the same table. The table is organized according to the PEP's categories of 1) technical, 2) programmatic, and 3) institutional issues. Implementation of many of the recommendations is dependent on further analysis and review of existing data, development of a revised IWQP 5-yer plan, and discussions with TWG/AMWG.

Few recommendations could be adopted or rejected entirely. Many recommendations will have resource impacts in terms of funding levels, contracted assistance or cooperative agreements.

The greatest repeated themes for high prioritization were:

- Develop appropriate models for up- & downstream, collecting appropriate data to calibrate & validate models. Start with physical components and work toward biological modeling. Obtain appropriate assistance and consider convening an expert panel for modeling efforts.
- Use the models to revise the 5-year IWQP and guide AMP decision-making
- Drive integration efforts with focused testable hypothesis
- Shift efforts from uplake to downstream as models are developed and provide predictability

Following discussion with the TWG, GCMRC will develop its draft FY 2003-2008 IWQP plan based on the PEP recommendations and GCMRC's proposed responses. The changes suggested by the PEP report will require modifications to the IWQP while allowing adequate replication to ensure a smooth transition without compromising the Lake Powell long-term data set. Some of the changes will take several years to accomplish, consistent with the phased approach recommended by the PEP.

**II. Technical Findings and Recommendations**

| Issue | Findings and Recommendations | GCMRC Response |
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| **Data Collection** | | |
| **Inflow sampling (pp. 14-15)** | • Reactivate USGS water-quality sampling stations at Green, Cisco, and Bluff. Analyze samples for TP, TN, TOC, TDS and SS. Compare data from these stations with "inflow" data obtained on the Lake to provide best estimates of inputs to the model. | Concur. GCMRC will initiate as soon as possible with the USGS collection of these data at the recommended gage sites. Collection of inflow parameters at sampling stations on the Lake will also continue. After two years of concurrent data collection a comparison / evaluation of the measurements will be made to determine which sampling locations provide the best data and parameter estimates. Following this evaluation final inflow sampling sites to be incorporated into the long-term monitoring program will be made. |
| | • In addition to continuous streamflow measurements, continuous measurements of water temperature & specific conductance should be collected and telemetered to GCMRC. | • Disagree. The data is required but non-telemetered data is sufficient for current needs. A monitoring plan specific to TCD implementation and testing may require telemetered data. |
| **Develop a long-term reservoir monitoring program (pp. 26-27)** | IWQP should develop a long-term monitoring plan that can be maintained every year for about 20 years.<br>Untouchable elements<br>• Monthly forebay, dam, tailwater samples<br>• Downstream & inflow samples for model calibration<br>• IN's driven research & monitoring<br>• Meteorological data up & downstream<br>• Essential parameters: TP, TN, Chl, TOC/POC, temperature, conductivity, DO, pH, turbidity<br>Lower priorities:<br>• Up-lake quarterly sites<br>• Side-arms of the reservoir<br>• Major ion collections<br>• Plankton collections | • Concur<br>• As suggested, these alterations will proceed as driven by a calibrated model<br>• Those changes required to drive modeling efforts will be given higher priority for adoption.<br>• Some to the lower priorities may be traded off prior to model conclusions to allow progress for higher priorities, as IWQP judgment allows. |
| **Chlorophyll profiling (pp. 15-16, 20, 26)** | • The lack of complete chlorophyll profiles and TOC (total organic carbon) measurements is a major shortcoming in the current program. These measurements are needed for model calibrations, | • Concur.<br>• Vertical resolution of lab samples has been enhanced and will be evaluated.<br>Instrument detection sensitivity and longevity of an in-situ chlorophyll |

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| | upstream-downstream linkages and to evaluate long-term changes in productivity and trophic status. In situ chlorophyll should be measured in conjunction with profiles and existing lab samples should be maintained or increased. | profiling program system would need to be evaluated prior to implementation. |
| **TOC analysis (pp. 14-15, 18, 24)** | • (See above) TOC should be taken in conjunction with regular chemical sampling from the inflows to below the dam to establish a carbon budget for the reservoir & tailwaters. | Concur<br>• TOC sampling has been added to match current DOC sampling of inflows and forebay-tailwaters since 1998. As these and previous DOC values are evaluated, a more extensive lake-wide sampling of TOC replacing DOC may be phased in. |
| **Seabird profiling (pp. 16-17, 21)** | Use of a Seabird SBE-19 or SBE-25 should be vigorously pursued to replace current Hydrolab profiling. It is more appropriate for a lake of Powell's size, enabling increased lake-wide and vertical measurement resolution while significantly reducing station time. It can also be fitted with a fluorometer for chlorophyll profiling. Station time could be reduced from 30-90 minutes to 15 minutes or less. | • Evaluation required prior to adoption<br>This instrumentation could be evaluated on a test basis prior to commitment. As chlorophyll values are generally low in Lake Powell, a Seabird or any automated profiler must provide suitable detection sensitivity. It could greatly reduce time on station and even trip length if capable of the vertical accuracy needed to suit our program and integrate with the existing database. A long-term commitment to the program would be necessary to overcome investment costs.<br>The current Hydrolab system provides adequate profiles though it lacks chlorophyll capability. |
| **Plankton sampling (pp. 15-16, 21, 26)** | • Phytoplankton & zooplankton collections help explain lake structure, trophic interactions and identify the presence of undesirable taxa, but current efforts could be reduced to evaluate effects of dam operations. Forebay collections could be reduced from monthly to quarterly, uplake stations reduced to one mid-lake and one up-lake site on the main channel.<br>• Data should be formatted for a peer-reviewed publication on trophic dynamics. | • Concur in part<br>Most of the plankton samples have been analyzed and tabulated. Preliminary analyses and statistics have been performed but not extensively integrated. Major changes in the program should await some of this basic integration. This should be accomplished by 2002.<br>Based on the variation seen between stations to date, it is questionable that 3 lake stations would meaningfully describe lake trends. Similarly, quarterly sampling at the forebay station may not adequately describe annual trends, particularly in light of TCD operational concerns. However, reducing the number of tows taken at each station and reducing the number of stations can reduce sample volume without overly compromising the usefulness of the program, and that can be instigated as data analysis is completed.<br>Data is being integrated with fisheries and water quality studies. |

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| **Meteorological data (pp. 16-17, 22, 26)** | • The absence of meteorological data is considered a major shortcoming of the existing data set for the purpose of providing key input to the reservoir model.<br>• A full on-water forebay station should include air temperature, wind speed & direction, incident radiation, precipitation, and relative humidity. In addition, several uplake stations should include wind speed & direction stations. | • Concur<br>We strongly support this effort and would seek cooperative agreements with GCNRA, USBOR-UCR to purchase and maintain these stations, as required by the CE-QUAL model, at several locations on Lake Powell. |
| **Wahweap sampling (pp. 15-17, 20)** | • The monthly Wahweap forebay station be considered differently that other lake stations as it represents the upper boundary conditions for reservoir release water quality and provides forecasting of potential water quality problems.<br>• This station should be placed in the "White Category".<br>• Review the vertical chemical sampling resolution to ensure it is sufficient.<br>• Design and calibrate a "smart model" to integrate and predict riverine water quality based on the forebay and operating conditions of the dam. Installing a permanent thermistor chain in the forebay would provide calibration for temperature. | Concur in part<br>• The forebay station is sampled on a monthly basis instead of quarterly and tailwater sampling is coordinated with forebay sampling. However, it also represents reservoir conditions in the deepest and most downstream location of the reservoir and must be comparable with other reservoir stations. Furthermore, upstream reservoir stations can also provide valuable predictive capability for water quality patterns moving through the reservoir.<br>• Increased vertical resolution is implemented already and being evaluated for differences. Differences may not be manifested under current conditions, which are unusually mixed and somewhat dilute.<br>• A thermistor chain has been implemented for a 1 year period.<br>This effort should be integrated with model development to assure relevance of the data collection and to calibrate a thermal "smart model" when available. |
| | • A telemetered programmable in-situ multi-parameter station profiling station should be considered, particularly as part of the TCD program.<br>• Telemetry to GCMRC & Glen Canyon Dam would provide needed feedback during TCD operation. | • TCD priority<br>A programmable station would be of greatest use during special releases or TCD operation. This is not likely for implementation except as part of TCD monitoring and operation.<br>At the present time, the addition of such a station is not necessary to meet the long-term monitoring objectives. |
| **Station selection and sample timing & frequency (p. 21)** | • The quarterly sampling trips should be scheduled to represent lake processes–maximum inflow, minimum temperatures, maximum summer temperatures, etc.<br>• Lake process driven: | • Previous efforts to replicate seasonally driven trips frustrated by crew availability and timing conflicts<br>• Closer evaluation of significant lake processes and annual timing of event will be assessed to determine timing and width of sampling windows. |

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| **Draft tube measurements (pp. 17-18, 27)** | • GCMRC should consider accessing current monitoring of selected draft tubes for differences between withdrawal zones of the 8 penstocks due to their location and orientation on the dam face. This could answer questions of release quality in the tailwater and might provide an informational backdrop for future operational responses due to the proposed temperature control device. | • Concur<br>This assessment should proceed in a step-wise fashion to be efficient. Evaluating for significant differences in draft tubes is ongoing, however, current mixed and diluted conditions above the dam do not offer a favorable scenario for detecting these differences beyond detection limits of instruments, and the experiment may need to be repeated in the future when such stratification does exist. Assessment should be restricted to preliminary physical evaluation with Hydrolab or YSI instruments and strongly indicated before any chemical sampling is instigated. |
| **Tailwater measurements (pp. 15-17, 20, 26, 32-33)** | The Panel believes that the current location of the continuous monitor in the GCD tailwater (in an eddy along the wing wall below the jet-tubes) is not representative of the water released from the dam. The heterogeneity of the river below the dam should be assessed under available release scenarios from the 3 release structures as well as the 8 powerplant draft tubes.<br>• Installation of an in-channel monitor may be required and should be sampled monthly for water quality. | • Agree with need to access heterogeneity of flows.<br>• Preliminary evaluation of the current site could proceed in a progressive fashion, again, with physical parameters used to indicate the heterogeneity of the site, first identifying differences between eddy vs. steady current sites, then evaluating downstream mixing of any differences found in the draft tube evaluations.<br>• If releases from Glen Canyon Dam include operation of river outlet works or spillways, monitors could be placed in each release structure and augmented with stations downstream of the zone of mixing.<br>• Assessment should be restricted to preliminary physical evaluation with Hydrolab or YSI instruments and indicated before additional chemical sampling is instigated. |
| | • Tests should be conducted to see if draft tube data are representative of actual river flows downstream. | • The IWQP believes that the most representative sampling location, for an upper boundary condition of water quality released downstream, is within the powerplant draft tubes. The station immediately below the dam experiences significant dissolved oxygen artifacts of re-aeration from atmospheric exposure and powerplant operations, such as when generating units are condensing, or placed on spinning reserve. For this reason, locations for continuous monitors have been established at the draft tubes of the individual generating units. |
| | • Improve spatial resolution | • The value of added spatial sampling should first be evaluated with short-term experiments to determine the heterogeneity of the outflows. |

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| **Tailwater productivity studies (pp. 18, 33)** | • Tailwater productivity is of such fundamental importance that we suggest that the IWQP devise a sampling program that addresses the specific issue of the biological functioning of the system between Glen Canyon Dam and Lee's Ferry.<br>• As emphasis shifts from descriptions of reservoir processes, effort can be re-invested downstream through special studies to address information needs identified by the TWG and in support of the water quality-ecosystem model. An understanding of the relationship between operational change and organic production will be essential for addressing management issues associated with downstream biological resources since this reach is important for food base production downstream. Such a study would involve establishing material budgets based on upstream (afterbay) and downstream (Lee's Ferry) water quality data. The objective would be to monitor the productivity and respiration of the system using the water quality model. The study would establish linkages between operational impacts (e.g., flow and stage, nutrient supply, physical perturbation, light regime) and primary/secondary production. Other similar studies addressing knowledge requirements of the water quality-ecosystem model should be designed.<br>• Conduct respiration & productivity analysis<br>• Utilize model<br>• Integrate with other studies | • Existing data & greater integration may provide some of these answers and will be pursued.<br>• These studies and integration with the ecosystem model will receive higher priority, particularly as upstream efforts are reduced. |

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| **Downstream measurements and Model calibration (pp. 15-16, 23, 33)** | • The temperature data collected by continuous monitors at selected locations through out the downstream reach are invaluable data for calibrating a water quality model for the Colorado River.<br>• While the logistics of sample collection are difficult, every effort should be made to increase the sampling efforts in this reach of the system, as needed to calibrate a water quality model or to address hypotheses posed by fisheries managers and investigators. Coordination & integration with other efforts should be explored. Such sampling be linked to operational seasons that reflect climatic changes, reservoir and release water quality, and operations-related changes in hydrology. Sampling and special, focused studies should be linked to the needs of the water quality-ecosystem model.<br>• Continuous physical (DO, conductivity, and pH) monitoring along with periodic chemical sampling such as that used for the tailwater is not likely to be needed in the downstream reach. If physical data are needed for water quality modeling, monitors can be deployed for short periods (7-10 days). Automatic water samplers (e.g., ISCO samplers) can be used to track water quality through the downstream system. | • Without specific information needs specified, a general sample collection program is not indicated. If needed, ISCO automated samplers may become a part of specific research program in the future.<br>• Short-term DO-pH-conductivity deployments to calibrate models could be an extremely useful project for evaluating in-stream metabolism and addresses existing downstream information needs. IWQP strongly supports instituting small-scale tests, initially tested in upper reaches, progressing downstream as successful results are indicated. |
| **Energetics & Community succession (pp. 23, 33)** | • The present research paradigm of collecting assorted water quality variables at a few scattered points within the GC cannot meet the INs of the AMG.<br>• Institute in response to ecological needs<br>• As necessary for calibrating models<br>• The community has been going through succession and cause is unknown but could be important. | Integration and collaboration with existing studies should be pursued to determine linkages and provide a basis for further research. |

| | Water Sample preservation and analytical procedures | |
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| **Major ion sampling (pp. 20, 26)** | • The collection of major ion samples should be considered of lower priority. Sufficient information on these samples has been collected. | • Adoption conditional on evaluation of existing data<br>• IWQP recommends elimination of Ca, Na, Cl, SO4, $CO_3$, $HCO_3$<br>Many elements of the current major ion sampling plan have been measured since the filling of Lake Powell; this includes calcium, magnesium, potassium, sodium, chloride, sulfate, and carbonate species. Regression analyses of these elements indicate that conductivity closely tracks these elements as they make up the major portion of the dissolved component. The existing 35 year history is adequate to evaluate these components and their collection should be suspended. The history of silica and iron is shorter (3-5 years) and could be biologically important, therefore, we should extend their collection until they can be better evaluated for significance to the biotic system. In terms of serving clients, there have been no inquiries for any of the parameters recommended for suspension in at least 10 years. |
| **Nutrient sampling (pp. 14, 19-21)** | • Levels of the nitrogen and phosphorus in Lake Powell are within the oligotrophic to mesotrophic range. These moderate concentrations are easily measured by contract chemistry labs prepared for low level analyses and rigorous QA/QC protocols. Some of the variation in phosphorus values in Lake Powell over the recent past call to question some of the reported measurements from this lake. Specific persulfate oxidation techniques for TP and TN measurements were suggested, as well as special field procedures for remote collections that did not require chemical preservation.<br>• TN rather than TKN analysis was suggested as a more reliable measurement of nitrogen.<br>• Dissolved constituent analysis should be reduced to forebay & inflow samples.<br>• No preservative for monthly samples if possible | • Adopted in part<br>Extensive efforts have been made in the past to find a lab that met our analysis needs and fit within budgetary constraints. This effort was frustrated by issues such as high salinity values that many fresh-water labs were unequipped to deal with. We will pursue this effort with contacts from the PEP members. Procurement of TN over TKN analyses is recognized as superior and will also be pursued. However, nitrate-nitrite analysis has provided some of the most consistent nitrogen series results over time, and discontinuing this N-species would be ill-advised. Nor should ortho-phosphate be discarded as we are still gathering meaningful trends even though there are still significant numbers of samples below detection limits. Ammonia may be negotiable pending search results with other labs.<br>• We will pursue Dr. Jones' offer to evaluate TN/TP methods |

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| | • Detection limits may be superior with other labs | |
| **Preservation techniques (pp. 20-21)** | • Monthly nutrients samples from the forebay might be left unpreserved and shipped express to reduce transport time.<br>• Chlorophyll samples should be filtered out of direct light and the filters should be desiccated in the field with granular silica gel. | • Adopted in part<br>• Monthly forebay-tailwater samples are processed quickly, but express shipment from Page takes 2 days. Results from monthly samples need to correspond to lake-wide quarterly samples, therefore inconsistent preservation techniques could be problematic, but should be evaluated.<br>• Shaded filtration and the silica-gel desiccation method have been adopted and will be evaluated. |
| **QA-QC analysis (pp. 19-20, 34)** | • We strongly encourage that no less than 15% of all samples be duplicates (two laboratory samples from a particular lake site), replicates (replicate laboratory samples from a particular lake sample), spikes (standard additions to lake samples) and blind samples (known concentrations sent to the lab as blind samples).<br>• peer reviewed products | Our program meets or exceeds the 15% quality control samples for the chemical suites outlined in the document.<br>Biological samples are duplicated at a level of approximately 10-15%. |

## III. Programmatic Findings and Recommendations:

| Issue | Findings and Recommendations | GCMRC Responses |
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| **Adequacy of IWQP for MOs and INs (pp. 29 –30)** | • The IWQP appears to be collecting data in response to the current INs. Integration of information across program elements to support future decision-making should be initiated. GCMRC should have input into the activities of other agencies to better logistically and financially support the activities of the GCMRC. GCMRC should obtain feedback and guidance from the TWG and AMWG on how modeling and other integration approaches could best be structured to address their information needs.<br>• Documents should be prepared that explain the program to the public. | • The IWQP will seek to integrate its efforts with other GCMRC program areas through determining the water quality information needs of these other programs and by preparing brief quarterly and annual reports for providing data to other programs and the TWG. The IWQP is already working more closely with BOR and will continue strengthening this relationship to ensure that BOR activities support and complement IWQP efforts. The IWQP will explore with the TWG the creation of an Ad hoc water quality group similar to the Ad hoc sediment group to foster interaction between the IWQP and the TWG.<br>• The IWQP will be included in AMP and GCMRC public outreach efforts. |
| **Downstream Data Needs (pp. 31-32)** | • The Panel considers that the evaluation of the effects of dam operations on downstream resources can best be understood and data needs best identified within a modeling framework. The panel recommends that program management consider a five-year program time frame formally starting in 2002 (the interval between program reviews), but actually getting underway during 2001. The primary goals would be the collection of a full model data set, the calibration and validation of a reservoir model, and the transition to a mode of operation in which model results can supplant much of the present upstream data collection. The program should progress from a reservoir data collection / summarization phase, to a reservoir simulation phase, to a downstream data collection / summarization phase, and finally to a downstream simulative / assessment / predictive phase. | • The IWQP concurs with this recommendation and views the convening of the PEP as the first step in developing a revised long-term monitoring plan for the IWQP. The proposed phase and time frames will be incorporated into a revised long-term (5-year) IWQP plan. |

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| **Importance of Reservoir Ecosystem (pg. 32)** | • The Panel considers an understanding of the reservoir ecosystem to be important to the overall goal of the AMWG. The Panel recommends that the program focus on consolidating their understanding of reservoir processes using the CE-QUAL-W2 model in coordination with BOR. A well developed model could lead to identification of reservoir processes important to downstream resources, consolidation of information needs, and a reduction of the reservoir program to the minimum necessary to obtain boundary conditions and validate model output. | • The IWQP concurs with the guidance of using a modeling framework as a means of organizing current understanding. Efforts to consolidate existing data will be increased. The IWQP will work with BOR by providing data to their modeling efforts. As the model is developed and validated, the monitoring program will be revised to focus more effort on downstream resources. The revised IWQP plan will describe a time frame for achieving the Panel's recommendations while addressing relevant MOs and INs. |
| **Downstream sampling (pp. 32- 33)** | • The Panel believes that the present sampling program for downstream reaches is inadequate. The Panel recommends that the IWQP develop an overarching rationale for downstream data collection. Downstream data should be collected to support a model of the river and to support specific experiments targeted at addressing specific knowledge gaps. The IWQP should devise a sampling program that addresses the specific issues of the biological functioning of the Lees Ferry reach. | • The IWQP will utilize the report from the aquatic foodbase and fish PEP as well as the revised INs to determine the appropriate focus on downstream resources. As noted above, IWQP efforts to integrate with other studies conducted downstream will partially address this recommendation. The level and extent of the ability to address downstream needs will be driven by the development of the reservoir model and the ability of the IWQP to shift more attention to the downstream resources, and the revised INs. |
| **Contracting vs. In-house (pg. 33)** | • IWQP senior staff should move to more of an integrating and interpreting role within the program. Then their more routine tasks, such as collection of monitoring data, could be back-filled by contracts or by staff from sister agencies. The current level of quality field work needs to be maintained under any new arrangement. | • The IWQP will explore the potential of contracting out basic data collection as a means of freeing up the staff time for analysis and synthesis. This review will be based on an evaluation of cost-effectiveness and consistent quality. Under any future scenario it is anticipated that IWQP staff will maintain some field presence to ensure the quality and compatibility of future data collection with past efforts. |
| **Program Management (pg. 34)** | • Program management could be improved for efficient and scientific execution of the program. Program management should emphasize program linkage / integration, formulation of hypotheses consistent with AMP MOs and INs, and integration | • This recommendation will be addressed once the new Biology Program manager is in place and decisions are made about the overall organization and structure of the biology program including the IWQP. Since the IWQP performs most of its work in-house it has not experienced problems with access to data. |

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| | and technology transfer within GCMRC.<br>• GCMRC contractors should be required to release all the data they collect or GCMRC should collect the data. All data collected by GCMRC should be available for anyone to evaluate on their own. | |
| **Integration of Interagency Data and Peer-reviewed Publications (pg. 34)** | • Integration of information and interagency data must be among the program's highest priorities. GCMRC should incorporate peer review as part of a QA/QC procedure for their end products. | • An emphasis on synthesis of existing IWQP data and integrating with data from other studies will be addressed in the revised IWQP plan. For FY 2002, GCMRC is placing a major emphasis on completing an integrated Oracle data base that will include the IWQP data. Working with BOR to develop the CE-QUAL-W2 model should also contribute to increased integration. Attention will be given to symposia presentations and publishing in peer-reviewed journals. |
| **Prioritization of Future Efforts (pg. 35)** | • The establishment of testable hypotheses about the system and the expected impacts of operational changes at Glen Canyon Dam, and the application of models to the water resource issues of the AMP is key to GCMRC meeting its mission for the AMP. | • Model development will be addressed in the revised long-term IWQP plan. The rationale for proposed future monitoring efforts will be driven by hypotheses and revised INs. |

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| **Additional Findings and Recommend-ations (pp. 35 – 36)** | The IWQP personnel are technically capable, conscientious, energetic, and experienced. They have professional products on the results of their monitoring using state-of-the-art data analyses.<br>• The staff desires to develop and/or apply tools (e.g., models) and collect data needed to assist AMP in making management decisions.<br>• The staff desires to determine linkage between Lake Powell inflows and effects on water quality in the forebay and downstream from Glen Canyon Dam.<br>• The Panel recommends that GCMRC hire someone with an academic background in water quality modeling. This individual should be capable of providing direction on model selection criteria and approaches as well as providing a foundation of operating principles and philosophies for establishing a premier modeling organization within the GCMRC.<br>• The panel agrees with the following NRC report findings:<br>1.Clear articulation of the core adaptive management experiment is needed to guide science and monitoring and to focus discussions among stakeholders.<br>2.Scientific basis for trade-off analysis and decision support systems.<br>3.Development and implementation of a detailed, long-term monitoring program should be a high priority for the Center. | • The GCMRC appreciates the recognition of the professional quality of the IWQP staff.<br>• The recommendation to hire a modeler will be discussed with the new biology program manager. Other options such as a detail of BOR or other USGS water quality modeling staff or obtaining an NRC post-doc will also be considered.<br>• Efforts by the AMWG / TWG to develop a Vision, Mission, Goals and Objectives as well as the Narrative of Desired Future Resource Conditions are good efforts to define the core adaptive management experiment. Together with the work of the experimental flows group the IWQP should have adequate guidance.<br>• GCMRC has made a proposal to the USGS for support in developing a Decisions Support System. This is probably something to be considered in out-years following model development and completion of the integrated database.<br>• The IWQP is working to revise and maintain a high-quality long-term monitoring program. Convening the PEP panel was the first step in this process. Developing a revised plan for review by the TWG and the Science Advisors is the next step. |

## IV. Institutional Findings and Recommendations:

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| **Comments on INs and the Role of the GCMRC (pp. 37–38)** | • GCMRC should consider the cost, feasibility, cost-effectiveness, level of significance in decision-making, "critical path" considerations, and potential for success in developing plans for addressing the INs. All planning by GCMRC needs to give major consideration to the original goal in the ROD for selecting a preferred alternative.<br>• The IWQP's position within the AMP calls for it to play a servant-leader role. GCMRC needs to play a major leadership role within the AMP. The IWQP should broaden the scope of their present activities so that they are in a better position to offer assistance to the AMWG and TWG regarding their decision-making.<br>•The Panel recommends that the GCMRC promote the concept of "cost of science" to the AMP. From a total "cost of science" standpoint, it is more defensible to understand upstream limnological processes and downstream riverine processes to the level that they can be simulated using models. It is less defensible to have a surface understanding of these processes and then use "operational experiments" to select optimum dam operations. The benefits foregone if science is not conducted in an efficient and timely fashion is not presently given the priority it deserves within the AMP. | • The current effort by GCMRC to develop INs recognizes many of the comments made by the IWQP PEP, including the "cost of science" concept.<br>• The IWQP will increase its efforts to develop quarterly and annual reports and provide these to the AMWG and the TWG in a timely manner. These reports will serve as a vehicle for providing advice. In addition, IWQP staff will participate in future TWG Ad hoc groups as needed.<br>• The IWQP will work independently and with BOR on model development. The IWQP cautions that model development can be costly and encourages the experimental flows group and the TWG to examine the benefits to learning through a series of future experiments as compared to initiating them through triggering criteria that provides little lead time to organize rigorous scientific data collection. |
| **Forebay Monitoring (pg. 38)** | •The forebay (Wahweap) station should be considered as belonging in the "White category". The forebay profile represents in many ways the best approximation to the upper boundary condition of the downstream river. Another main reason is that potential water quality problems for the downstream | • The existing IWQP monitoring plan has been developed utilizing the white, gray, and black categories developed by the TWG. During the development of those categories the IWQP presented information on the relative importance of the forebay. The IWQP concurs with the Panel's recommendation. At the same time, the current structure appears to be working and could be continued. If it is, it should be |

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| | can be forecasted and therefore possibly avoided using data only from the forebay. Additionally, IN 5.4 is in the "white category" and calls for a very wide range of information on the lake that can only be addressed if data are collected on the lake. | done with recognition of the importance of the forebay station and the higher level of data collection that is recommended to be conducted at this station. |
| **Modeling Approach with BOR (pp. 38–39)** | •The GCMRC needs a model for Lake Powell, and it is only prudent that they use the model that the BOR is applying to Lake Powell. The Panel recommends that the two organizations use the CE-QUAL-W2 model, but that each organization apply the model based on their respective organizational objectives (some objectives are suggested for the IWQP). It is recommended that they exchange inputs, runs, findings, etc., to save time and money to meet their respective objectives as well as to review the basis for each other's findings. | •GCMRC concurs with this recommendation and will continue to coordinate with BOR on model development. |
| **Agreement with NRC Downstream Report (pg. 39)** | The panel agrees with the following NRC findings:<br>1. The Center should work with the TWG to develop a revised set of MOs and INs. These should be linked with testable hypotheses and situated within an internally consistent understanding of the ecosystem.<br>2. Decisions about geographic linkages with adjacent areas and larger scales should be made on a case-by-case basis, considering ecosystem processes, management alternatives, funding sources, and stakeholder interests. | • GCMRC's current effort to develop INs is consistent with the NRC's recommendation.<br>• GCMRC also concurs with the NRC's recommendation regarding geographic scope. This position has been reiterated in the Loveless guidance document and generally has been used to determine what work is done within the AMP. |