January 2, 2007

Dr. Michael Healey
Lead Scientist, California Bay-Delta Authority
CALFED-CBDA
650 Capitol Mall, 5th Floor
Sacramento, CA 95814

RE: Review of Resource Agencies Action Matrix for 2007

Dear Dr. Healey:

The EWA Technical Panel attended the annual program review on November 28-30, 2006. As in past years, the panel was charged with the preparation of a report that provides, "… a comprehensive evaluation of the EWA to determine the biological benefits of EWA and other environmental water in recovery of at-risk native species and provide recommendations on water allocation priorities…." We were given seven questions to consider when preparing our report. This year the Panel was requested to address an additional task. We were asked to prepare a separate evaluation of the Resource Agencies Action Matrix presented at the program review by Jim White and Kevin Fleming. We were given five questions to consider when preparing that report. The purpose of this letter is to present our findings on the Action Matrix.

The matrix lists six potential experiments, and for each, there are nine cells that give information such as the timing of the action, triggering events, scientific uncertainty, and response variables. The information in each cell is reduced to bullet form, which gives an indication of the thinking that went into the design of a proposed action, but not a complete description of it. On December 11, 2006, the Panel received supplemental information on the matrix, which did provide new insight into the rationale for the proposed actions, but was still considered insufficient for a detailed review by the panel.

We generally agree in concept with the approach described in the matrix and supplemental information such as describing the actions, their rationale, response variables, etc. This approach gives the management actions an improved technical basis. The panel encourages the managers to continue with this approach and, in the future, provide more explanation and scientifically defensible justification for the actions and to quantify as many of the components of the matrix as possible. Our answers to the five questions suggest the kind of additional information that would be useful.

We disagree with the use of the term "experiment" to describe the management actions in the matrix. Labeling the management actions as experiments creates the temptation to over interpret the results and it may suggest that the results have greater

validity than is warranted. The lack of experimental controls (to compare with the treatment) and little or no replication undermines the power and rigor of any conclusions that might be drawn from changes in delta smelt abundance. An experimental approach needs greater attention to the analyses of existing information, hypothesis development, experimental design (including controls), sample sizes and duration (number of years) of the experiment. The latter two should be derived from a power analysis. In our opinion, the proposed actions for 2007 describe new management actions not scientific experiments. Consequently our answers to the five questions must be interpreted with that constraint in mind. We repeat each question followed by our answer:

1. Evaluate the technical assumptions and conceptual models underlying proposed matrix actions including action triggers, signal-to-noise ratios for response variables, measurement of response variables, and additional proposed field sampling.

We divided our answer to this question into comments on the conceptual model and comments on the stated hypotheses.

Comments on the conceptual model

A conceptual model is not specifically stated so we cannot give a definitive answer to this question. The overall working hypothesis in the Draft Supplemental Information implies a conceptual model based on the delta smelt's life cycle in which adult delta smelt migrate upstream in the winter, larvae hatch in the spring and juveniles grow while drifting downstream in the summer and autumn. Growth is determined by food availability, which is assumed to be increased by the flux of plankton from upriver and decreased by competition from the invasive clam *Corbula amurensis*. All delta smelt life stages can be entrained in the pumps. The conceptual model assumes hydrodynamics and salinity affect the spatial-temporal pattern of smelt so that alteration of Delta flows as described in the Action Matrix are assumed to affect survival and reproduction success. However, whether the net impacts of proposed actions on any life stage are significant or whether the total impact of proposed actions on the population will be biologically meaningful or detectable is largely unknown. The Action Matrix also proposed actions to increase plankton influx to the Delta. As noted in the background information (*Resource Agency Pelagic Organism Action Matrix Related to Water Operations*, November 22, 2006) the general conceptual model and hypotheses were developed after the 2006 CalFed Science Conference and reflect recent studies. However, while the inferred conceptual model apparently underlies the proposed actions for 2007, it is insufficiently detailed or developed to be used in analysis of the data or for planning experiments in the future.

The Panel recommends developing a conceptual model of the delta smelt's life history that integrates potential effects of changes in hydrologic flow conditions, water quality, fish behavior and physiology on spatial-temporal scales relevant to the life stages of delta smelt and other pelagic organisms. The Panel suggests that the conceptual model consider delta smelt and other pelagic organisms in a broader context than simply responses to operations proposed in the Action Matrix. Considering the pelagic

organisms' life history strategies and how Delta development and water operations affect those strategies would provide an ecologically based approach to the eventual design of experiments. The current conceptual model only qualitatively addresses the mismatch between the evolved behavioral and physiological patterns and the existing hydraulic and water quality conditions in the Delta. The Panel encourages the continued research and development of an explicit, spatial-temporal life-cycle model as a foundation for designing Delta-wide experiments. A serious information gap that presents a barrier to the formulation of practical hypotheses is that the in-delta spawning migration behavior of delta smelt (timing, selection of spawning sites, etc.) is not well described. Also, there is no field measure of egg production per spawner and no consideration for the effect of food availability on reproductive output in space and time. The latter, in particular, could be important in the case of repeat spawners. We suggest that a model, which reasonably characterizes the spatial temporal life history patterns, will be needed to identify action triggers, and sampling protocols for future experiments. In brief, Delta experiments can most effectively be designed and implemented, if first developed in silico.

Comments on the hypotheses

A focus on the testing of specific hypotheses is a good approach, but more planning should go into the process before actions are taken because so much uncertainty is involved. The hypotheses are in essence predictions of the effects of actions, but they do not characterize the underling mechanisms. There may be ways of objectively evaluating these as being true or false at the end of a defined time period. However, the longer the time period between an action and a predicted response, the lower the likelihood of being able to connect the two as cause and effect. The panel questions whether it is possible to evaluate the responses to actions outlined in the 2007 Action Matrix

For example, consider the May-December hypothesis: "*Higher Delta outflow in summer and fall will expand suitable habitat available to delta smelt, shifting their distribution downstream and so reducing winter entrainment.*" The primary responses are the location of X_2 and the distribution of delta smelt in the FMWT survey. A number of unstated processes link the action to the response variables and many of these are not understood or cannot be controlled. For example, the effect of increasing Delta outflow is contingent on the water year conditions, which will alter the entire hydraulic environment and distribution of smelt prior to, during and after the May-December action. The assumption underlying this prediction is that flow affects smelt distributions. The panel suggests a more relevant question would be to study or explore how flow and water quality properties affect smelt behavior that in turn determines smelt migration. The current Action Matrix and the associated monitoring are not sufficient to address this. However, an understanding of fish response is needed to understand how the population will respond to Delta-scale manipulations.

2. Evaluate response time for detecting effects of proposed actions identified in the matrix.

The Panel believes that a meaningful evaluation of the time required to detect the effect of a proposed action is vitally needed, but was not included in the Action Matrix. Whether the time required to detect responses can be quantified should be determined by an analysis of the existing data. Some understanding of the individual responses of fish to the action and the fish's response to the sampling gear will be required. Also needed is a power analysis to determine the magnitude of response necessary to confidently detect a change in abundance, size distributions, etc. using the proposed sampling methods.

3. Provide input on response variables and the relationship between multiple year responses to single- or multiple-year actions.

A consistent problem in ecology is separating the effects of natural variation from the response to a planned action. Identifying the effects of actions whose responses are measured in later life stages or subsequent generations is especially difficult. Most of the response variables in the Action Matrix are affected by demographic processes as well as seasonal environmental variability. Consequently, detecting interannual responses will be extremely difficult given the level of effort identified. To further complicate the issue the plan has numerous actions, so attribution of a cause is speculative. In essence, it is highly unlikely that the specific effects of single or multiple-year actions can be identified.

4. Provide independent perspective regarding characterization of scientific uncertainty in proposed actions and responses.

The panel encourages the use of uncertainty assessments in designing experimental procedures. However, the Panel has insufficient information to apportion uncertainty in the 2007 actions. Given the limitations of the existing knowledge base, the large scope for variability in the system, and the generally high level of scientific uncertainty expressed in the best professional judgment of agency personnel, it would be unrealistic to expect results that had much predictive value.

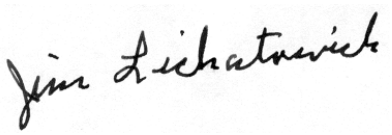
5. Evaluate potential contribution of proposed actions and subsequent measurements to improving estuary-wide knowledge base regarding declining pelagic species.

It appears the responses to the proposed actions will be observed with the existing Delta monitoring programs. Because it is still unresolved as to how past variation in the Delta water quality and hydraulics has affected the delta smelt distribution and population, it seems unlikely that modest changes on top of the natural conditions in 2007 will be informative.

We interpreted question six in our charge as a direct reference to the Action Matrix, so this letter will serve as our review of the Action Matrix as well as the answer to question six in our overall charge.

We appreciate the opportunity to comment on the Action Matrix.

Sincerely,



Jim Lichatowich
For the entire panel

Panel Members: Jim Anderson, Jim Cowan, Ron Kneib, Jim Lichatowich, Steve Monismith, Kenny Rose, Paul Smith, Andy Solow, and Buzz Thompson.