Responses to Les Grober's questions (from Resh, Meyer, Canuel, Atwater, collated by Collier)

1) Do you concur with the scientific report determination that changes in the flow regime of the San Joaquin River basin are impairing fish and wildlife beneficial uses?

Yes, the DISB concurs. The Report uses the best available science in support of its determination that changes in the flow regime of the San Joaquin River basin impair fish and wildlife beneficial uses. The external scientific reviewers also came to this conclusion. They are respected and experienced scientists with extensive expertise in salmonid biology, and they provided a thorough review of the report. Generally, more flow, coupled with a more natural spatial and temporal pattern of flow, is needed in order to protect those beneficial uses.

However, as has been emphasized repeatedly there is no single variable that can be "fixed" to solve the overall ecological problems of the Delta region. For example the recent NAS report concluded "that only a synthetic, integrated, analytical approach to understanding the effects of suites of environmental factors on the ecosystem and its components is likely to provide important and useful insights that can lead to enhancement of the Delta ecosystem and its species."

2) Does the Scientific Report demonstrate:

a. the relationship between flows and SJR basin fall-run Chinook salmon survival and abundance?

Yes, the report demonstrates the relationship between flows and SJR basin Chinook salmon survival and abundance based on the available scientific literature. More specifically, the report demonstrates that flows during the February through June period are of particular significance in determining salmon survival and abundance. While correlation does not necessarily equal causation, available information indicates that increased flows would be expected to increase the abundance of fall-run Chinook.

b. the importance of unaltered hydrographic conditions in supporting ecosystem processes for Chinook salmon, Central Valley steelhead, and other native species?

Yes. The document provides a thorough review of the relevant scientific literature showing the importance of a more natural flow regime to support ecosystem processes for native species including Chinook salmon and Central Valley steelhead. These findings are not unique to the San Joaquin River basin; similar conclusions have been reached for rivers throughout the nation. The report acknowledges that there are many factors contributing to the population reductions of native fishes, and correctly points out that flows are particularly critical and a "master variable" with considerable impact on many of the other factors influencing ecosystem conditions.

It should also be noted that maintaining a river for one particular native species may sometimes-to-often protect overall river health to some degree because maintenance of this native species could necessitate an intact community of organisms at lower trophic levels on which this species feeds (e.g. benthic macroinvertebrates) as well as high

quality habitat and good water quality (e.g. Norris and Thoms 1999). However, the consensus among the vast majority of international studies is that flow management is best addressed for the entire ecosystem rather than focusing on target species (e.g. Arthington 1998, King *et al.* 2000). Flow requirements have the potential to benefit many aspects of the ecosystem in addition to the target species and thus these programs would do better to expand their objectives. Compared to some international approaches, neither California nor any other US states appear to have embraced an overarching holistic methodology to environmental water management that is analogous to the approaches developed in South Africa, such as BBM or DRIFT (e.g. King *et al.* 2000) or Australia, such as the Benchmarking Method or the Holistic Method (e.g. Arthington 1998).

3) Does the approach used to develop San Joaquin River flow objectives and the associated program of implementation provide for the reasonable protection of fish and wildlife beneficial uses?

In general, the appropriate approach has been used, but could be improved upon. Whether the flows implemented will be adequate for protection of fish and wildlife beneficial uses depends on what percentage of unimpaired flow is selected for implementation (see also response to question 4). Adaptive management will be very important, because the percent of mean flows criterion may not represent the full range of variability in flows that is necessary for sustaining species and ecosystems processes. As a result, the proposed approach, if implemented without a robust adaptive management plan, may not be successful in meeting the goal of salmon survival.

One aspect of the approach that deserves further attention is the recommendation to allocate tributary flows on a proportional basis. Although there is some logic behind that recommendation, the data on extent of wetted surface as a function of flow suggests that fish habitat on the Tuolumne and Merced may increase more rapidly as a function of flow than on the Stanislaus. Hence it may be that greater return could be gained by providing flows to the tributaries in which a greater area of available habitat is generated per volume of flow. That approach deserves further consideration, and activities in other priority tributaries such as the American, Consumnes, Deer Creek, and Mill Creek, should probably be considered as well.

The DISB also feels strongly that climate change needs to be incorporated. The February 2012 report treats 21st-century warming as beyond the current scope of setting flow objectives. It seemingly writes off its effects as “difficult to predict” (p. 3-42). It bases the proposed flow criteria on the range of meteorological and hydrologic conditions since 1922 (p. 5-1).

A broader outlook is recommended by the authors of “Sustainable water and environmental management in the California Bay-Delta,” a new report from the National Research Council (http://www.nap.edu/catalog.php?record_id=13394). Reviewing climate-change projections for California, they find that the 21st-century is likely to bring “a larger fraction of winter precipitation occurring as rain in tributary watersheds in Sierra-Nevada, reduction in snow pack and correspondingly the amount of water supply

during late spring and summer, reduction in water storage opportunities with a corresponding reduction in the ability to mitigate floods and meet minimum flow targets, challenges in managing the cold water pools of the upstream reservoirs, and increased probability of water temperatures exceeding lethal limits for delta smelt, salmon, and other species." The report adds, "Many of these changes are already being observed" (p. 155). Finally, critical flows should be considered since there may be future years when a percent of mean flows criteria does not meet the minimal needs of either fish or ecosystem processes

4) Does use of a percent of unimpaired flow provide an appropriate method for implementing the narrative San Joaquin River flow objective in a way that reasonably protects fish and wildlife beneficial uses, given the other factors that the State Water Board must consider when determining a reasonable level of protection for beneficial uses?

Use of the percent of unimpaired flow approach is generally an appropriate method given the current extent of scientific knowledge on flow requirements for fish and wildlife, but will likely need improvement as adaptive management is implemented. The approach should initially provide a seasonality and variation in flows more like the natural flow regime, and therefore be beneficial to fish and wildlife. However, the decision as to what percentage to use will determine whether there is a reasonable level of protection for fish and wildlife beneficial use. In defense of the range of percentages considered (20-60%), the Water Board staff posits that even the lower percentage will increase flows during this period in dry years, but that is not a particularly convincing argument. A very small improvement in flow conditions is an improvement, but not one that will necessarily result in measurable improvement in salmonid abundance and survival. The potential flows during different year types for different percent unimpaired flow (or the flows if that percentage had been applied over the past decade or more) should be compared with the flows recommended by DFG to double smolt production (Table 3.15), the AFRP modeling results (Table 3.16), the TBI/NRDC logit analysis results (Table 3.17), and the Water Board's own determination that 60% of flows would be protective of fish and wildlife beneficial uses. Tables 3.18 through 3.23 provide further estimates of recommended flows at different locations. Percentages of unimpaired flow resulting in flows outside the range of those recommended by the several methods used imply that the flows would be less protective of the fish and wildlife beneficial uses. That analysis of the extent of loss of protection of fish and wildlife beneficial use provides needed information to be factored into the balancing of different beneficial uses.

Worldwide, research is indicating that the percent of impaired flow is not the best criterion to use, but should be used together with other criteria. Variability in flow and minimal critical flows (see response to 3, above) should be given further consideration. In particular, the State Water Board should consider the combined importance of higher and more variable flows in spring. In addition to flow itself, variables such as the rate of change in flow have been shown to provide important cues to fish and other wildlife and should be given further consideration. Beyond percent of unimpaired flow, consideration of where the flow derives from should also be given further consideration. The proposed

plan does not identify areas where investment (e.g., restoring the hydrograph) would have the greatest benefits to fish and ecosystem processes. Adherence to flow regime, alone, assumes equal benefit everywhere but this may not be the case. As a result, we recommend that the approach consider strategic investments in flow, and concentrate efforts where the return will be greatest.

5) Given scientific uncertainty, does the program of implementation allow for the development of a successful science-based adaptive management program?
The implementation program states that an adaptive management plan will be developed each year by a core operations group. Without an example of such a plan, it is not possible to determine if the adaptive management program will be either successful or science-based. The material available says nothing about what will be monitored and what performance measures will be used as the basis for adaptive management decisions nor the time frame in which these decisions will be made (weekly? monthly? annually?). A science-based adaptive management program is essential; one does not yet exist.

That said, some elements for an adaptive management program to are in place in this report, but vigilance (by the Delta Stewardship Council? The Delta Science Program? The DISB?) will be needed to ensure that this happens over the long term. Both financial and management contributions and oversight will be needed. While some sites that received environmental flow allocations have had effective monitoring and reporting, at most sites the collection of pre- and post-implementation data has been very limited, especially for the ecological response to flow alteration (Poff and Zimmerman 2010). Moreover, the pervasive low level of detail in post-project evaluations has drastically reduced the amount of knowledge that could have been gained from past river projects (Downs and Kondolf 2002).

We noted that the purpose of the implementation program described in Appendix A is to achieve the narrative flow objective by more closely approximating a natural flow regime, in particular during the months of February through June. Specific flow recommendations will be made to the Board by a panel of experts. The panel is charged to implement the objective "in a manner that best achieves the flow objective with minimal water supply costs." The charge to minimize water supply costs reflects an imbalance in priorities; perhaps that is what is intended. A more balanced charge would be to balance the trade-off in reduction of fish and wildlife beneficial use with cost of water supply.

Since the plan covers a 30-year time period and one that will likely see dramatic changes in hydrology and runoff from the Sierra Nevada Mountains, a well-defined adaptive management program is fundamental to addressing ecosystem needs under changing conditions. Data and modeling simulations indicate that climate change will likely influence the timing and variability of runoff (see recent paper by Cloern et al. (2011) Projected Evolution of California's San Francisco Bay-Delta-River System in a Century of Climate Change. PLoS ONE 6(9): e24465. doi:10.1371/journal.pone.0024465). This could have negative affects on the ecosystem particularly if less water is available during

critical times. It is essential that a well-defined adaptive management plan be part of the framework for implementing the proposed approach.
Bear in mind that climate change is also expected to increase the competition for water among users. Maintaining the flows necessary to sustain the protected species in the San Joaquin River and in fact the whole Delta likely will require establishment of adjusted minimum flows (as in this proposal), but more importantly, will require further refinement about the timing, frequency, duration, and magnitude of flows and the rates at which those flow parameters change.

References

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