The Informational Proceeding to
Develop Flow Criteria for the Delta Ecosystem

Noticed for March 22, 23, and 24, 2010

QUESTIONS ON WRITTEN TESTIMONY

Submitted on Behalf of
The San Luis & Delta-Mendota Water Authority,
State Water Contractors,
Westlands Water District,
Santa Clara Valley Water District,
Kern County Water Agency, and
Metropolitan Water District of Southern California

PANEL 1

Department of the Interior

On page 6 of DOI's summary of written testimony, it states "consideration of the timing, magnitude, and variability of unimpaired flows can be used to guide what conditions species within the ecosystem have evolved and adapted under." Are there data that depict flows within the Bay Delta at a time when the system was unaffected by human activity? If not, what does DOI consider as "unimpaired flows"? How do flows pre-human activity compare with the flows DOI considers "unimpaired flows"? How do flows under those two conditions compare to flows with the major water projects operating?

Environmental Defense Fund

In EDF Exhibit 1, EDF wrote: "The simplest approach to ensuring that future flows in the Delta are protective of the public trust resources would be to re-establish the full natural flow regimes of the Sacramento and San Joaquin Rivers and their tributaries while dramatically reducing CVP and SWP export levels in all but flood flow conditions." Did EDF consider whether changing flow and exports to a "full natural" level is feasible in a system with substantial alterations (i.e. levees, invasive species)? If it did, what are the impacts of such a change on the abundance of fish species dependent upon the Delta, on the ability of water projects to provide flood protection, to provide cold water for the benefit of salmon, to provide water for municipal, industrial and agricultural purposes, etc.?

PANEL 2

Department of the Interior

If X2 is at or downstream of 74 km in the winter and spring months, does DOI believe the risk of the CVP and SWP entraining pelagic fish is acceptable?

What studies, if any, exist that conclude there is a statistically significant relationship between the location of X2 and Delta smelt abundance?

Ms. Poage states, in respect to Delta smelt, flows must be sufficient to provide appropriate temperatures for various life stages, turbidity for cover and feeding, and to dilute contaminants. Does DOI agree that Delta water temperatures are almost entirely influenced by ambient air temperatures? Could DOI provide a table that depicts the amount of water reservoirs would have to release or bypass to affect Delta water temperature (i.e., how much temperature would change per 500 cubic feet per second release or bypass)? Can DOI provide a similar table for turbidity and contaminant dilution?

Feyrer et al. (2007) attempts to correlate the location of Fall X2 with subsequent abundance of delta smelt. Is it true that the correlation by Feyrer et al. was driven by a single data point in 1999, and that, if that data point is removed, the correlation is no longer significant? Is it also true that if years before 1987 are included in that analysis, then the analysis shows that low fall flows instead of higher fall flows have a beneficial effect on smelt?

Department of Fish and Game

On pages 9-10, the Department of Fish and Game expresses a belief that increasing outflows are beneficial for longfin smelt. How does DFG reconcile that belief with Kimmerer et al. (2009), which found that longfin smelt abundance is related to X2, but that the X2 relationship with habitat is weak, indicating other mechanisms are likely operating to cause increases in abundance as flows increase?

Dr. Rick Deriso analyzed Feyrer et al. (2007) and concluded that Feyrer et al. used the wrong type of model to investigate whether the position of X2 in the fall was important to subsequent delta smelt abundance. As explained by Dr. Deriso, Feyrer, et al. used a linear additive model with the biologically inappropriate assumption that juveniles can be produced even if there are no adult parents in existence. According to Dr. Deriso, instead of a linear additive model, Feyrer et al. should have used a multiplicative stock recruitment model to investigate the Fall X2-abundance relationship. Using such a biologically appropriate multiplicative model, Dr. Deriso found that Feyrer et al. (2007) conclusions about Fall X2 are simply wrong. Is DFG aware of Dr. Deriso's analysis of Feyrer et al? Has DFG re-analyzed Feyrer et al.'s work or the Fall X2-abundance relationship using an industry-standard Ricker or Beverton-Holt multiplicative model? If not, why not?

Environmental Defense Fund

In EDF's summary of testimony, it states, "In developing its proposed flow criteria, the Board should adopt the 4-tiered hierarchy (discussed in TBI Exh.1) with regard to prioritizing the best available scientific information to guide development of the Board's flow criteria: (1) mechanistic explanations; (2) statistically significant correlations; (3) historic flows associated with more productive periods; and (4) unimpaired flows." If there is a mechanistic explanation but statistical correlations do not support that mechanism, how would the State Water Board know that the mechanism is relevant and not just theoretical? With all of the many changes in food web dynamics, alien species, and physical habitat attributes such as turbidity and temperature, how would the State Water Board know that returning flows to some historic level will improve abundance of pelagic fish?

EDF's flow recommendations are based in large part on hypothesized effects, which EDF argues is appropriate because certainty of effect should not be a necessary precondition for establishing flow requirements. But what if hypothesized effects are unimportant? Might the State Water Board set flow criteria that cost the State water without providing any measurable benefit to pelagic fish?

The Bay Institute

In Exhibit TBI-4, page 5, TBI states studies (based in large part on abundance indices, like the Summer Tow Net, Fall Mid-Water Trawl, etc.) that have concluded there is no statistically significant relationship between entrainment and population abundance have "limited value" because of: (a) measurement errors in entrainment mortality; (b) measurement errors for population abundance indices; (c) significant effects of distribution on vulnerability to entrainment; and (d) large inter-annual variations in environmental and biological conditions. What analyses does TBI rely upon to support that statement?

Would TBI explain why it feels abundance indices have limited value with respect to studies that find no statistically significant relationship between entrainment and population abundance but support other studies that rely upon abundance indices (e.g., status of delta smelt, the level of take that should be authorized by biological opinions, etc.)?

State and Federal Contractors

Are there data to support the statement that flows positively affect spatial distribution by facilitating the movement of organisms and by making suitable habitat available through floodplain inundation, salinity gradient, and other mechanisms?

Are there studies that show limited food supply contributes to reduced year-class success and therefore has population-level implications?

PANEL 3

National Marine Fisheries Service

The NMFS' flow recommendation is based upon an assertion that increased flows will decrease predation on juvenile salmonids. However, NMFS cites no science to support the recommendation. Has any study to date found that increasing flows through the Delta will reduce predation? If so, flows from which river(s), at what flow rates, and when and to what extent is predation reduced, and which predators will be affected?

NMFS states that, based on observations by Vogel Environmental, predation losses could be the single greatest source of juvenile salmon mortality on the Mokelumne River and that predation losses on other rivers is also likely to be significant (p. 3-Xc-25.) Are there measures available, other than use of flow, that could be implemented to reduce predation?

NMFS recognizes that recreational angler harvest is also a significant source of mortality for adult spawners, particularly on the American River where roughly 25-50% of the spawners were harvested by anglers over the past three years (p. 3-Xc-56). Has NMFS investigated how flow enhancements and harvest restrictions compare to each other in terms of potential to improve escapement? Has NMFS discussed with DFG the potential to impose recreational harvest restrictions?

Does increased Delta survival of salmon smolts necessarily lead to a greater salmon escapement? What studies support NMFS' response?

Does NMFS agree with the conclusion by the Department of Fish and Game, that "exports have little influence upon [San Joaquin River outmigrating] salmon smolt survival." (DFG, Ex. 3, p. 13.) If not, why not?

Does NMFS agree that data analyses conducted since 2000, including a recent analysis conducted by Vogel, show predation as the most significant factor affecting San Joaquin outmigrating salmon smolt survival?

Can NMFS identify any published studies that indicate entrainment of salmon smolts increases when Old and Middle River flows are more negative than -5,000 cubic feet per second?

Can NMFS identify any published studies that indicate that regulation of flows in Old and Middle River increase year-to-year abundance of salmon, as measured by escapement?

Are there empirical data to support specific flow recommendations for green sturgeon? If so, what are the data?

<u>Department of Fish and Game</u>

On page 7 of DFG Ex. 3, it states, "Outmigration success by juvenile salmonids may be . . . greatly influenced by water diversions . . ." On page 13 of DFG Ex. 3, it states "exports have little influence upon salmon smolt survival." On page 13 of DFG Ex. 3, it also states, "further indication that the state and federal exports, though capable of entraining juvenile salmon, are not a substantial source of mortality for outmigrating SJR juvenile salmon." How does DFG reconcile these statements?

On page 1 of DFG Ex. 3, DFG states: "Two independent measures of survival rated smolt survival increases with increasing Sacramento River flow at Rio Vista. Maximum survival was observed at or above 20,000 to 30,000 cfs." What are the two independent measures? Has anyone studied the mechanisms/stressors addressed by the flow? If so, what are the results of the studies? Has anyone studied the sensitivity between the mechanisms/stressors and flow rates? If so, what are the results of the studies?

Does DFG understand why survival is lower for fish selecting Sutter and Steamboat Sloughs compared to the mainstem of the Sacramento River? If so, what does DFG believe is the reason for the differential survival levels?

DFG acknowledges that pacific herring adults select salinities of 8-28 parts per thousand, while larval survival is highest at salinities of 4-32 parts per thousand. Are not these salinities found downstream from the position of X2?

DFG would agree that Kimmerer *et al.* acknowledge that pacific herring were widespread along the coast and are likely under the influence of ocean conditions? Do ocean conditions exert a stronger influence over pacific herring abundance than Bay-Delta estuarine conditions?

Department of the Interior

DOI states: "Indirect and direct mortality of juvenile salmonids increases as OMR flows become more negative as well. For example, not only does juvenile salmonid entrainment increase as OMR flows become more negative, but so does their residence time which results in greater losses due to predation." Does DOI agree there are no data to support an assertion that negative OMR flows increase residence time of juvenile salmonids? If DOI does not agree, can DOI produce the supporting data?

DOI states: "I-IV-39 and 3-Xe-19 of the working paper, includes a Delta flow objective to maintain positive QWEST flows from Oct 1 through June 30 to address the biological objective of increased survival of emigrating salmonid smolts. Maintaining a positive QWEST flow would increase the survival of smolts migrating down the mainstem rivers, decrease the number diverted into the Central Delta, increase the survival of smolts diverted into the Central Delta." What studies are available which estimate (with confidence intervals) how much QWEST flows improve survival of juvenile salmonids entering the interior Delta? What studies show that QWEST affects the number of smolts "diverted into the Central Delta?

DOI states: "Delta inflow and outflow are important for Chinook salmon in the Delta." Does DOI believe that there are target values for Delta outflows which are important for salmonids? What specific empirical evidence is there to support such a relationship for outflows?

Environmental Defense Fund

EDF Exhibit 1 states: "NMFS (2009a) examined losses of juvenile Chinook salmon *(Oncorhynchus tshawytscha)* at the CVP and SWP export facilities between 1995–2007 and found that losses increased dramatically when estimated reverse flows in Old and Middle Rivers (i.e., flows towards the pumps) exceeded 5,000 cfs." Has EDF analyzed the data relied upon in NMFS 2009a? Is the finding in NMFS 2009a based upon a relationship between absolute losses and OMR flow? As an alternative, did EDF analyze the relationship between percentage of population lost and OMR flow? If so, what was the result of that analysis?

In EDF's summary of testimony, it states, "In developing its proposed flow criteria, the Board should adopt the 4-tiered hierarchy (discussed in TBI Exh.1) with regard to prioritizing the best available scientific information to guide development of the Board's flow criteria: (1) mechanistic explanations; (2) statistically significant correlations; (3) historic flows associated with more productive periods; and (4) unimpaired flows." If there is a mechanistic explanation but statistical correlations do not support that mechanism, how could the State Water Board know that the mechanism is relevant and not just theoretical? With all of the many changes in food web dynamics, alien species, and physical habitat attributes such as turbidity and temperature, how could the State Water Board know that returning flows to some historic level will improve abundance of anadromous fish?

EDF's flow recommendations are based in large part on hypothesized effects, which EDF argues is appropriate because certainty of effect should not be a necessary precondition for establishing flow requirements. But what if hypothesized effects are unimportant? Might the State Water Board set flow criteria that cost the State water without providing any measurable benefit to anadromous fish?

The Bay Institute

TBI's summary of testimony states: "Many factors affect the health of public trust resources, but, after all is said and done, the relationship between flows and viability of public trust species is probably the strongest biological signal in the estuary." On page 23 of TBI-4, TBI recommends a San Joaquin River inflow versus export ratio. Does TBI base that recommendation on protecting San Joaquin fall run salmon? Is that a species protected under the state or federal endangered species act? Has TBI analyzed the effect of its recommended San Joaquin River inflow versus export ratio on the availability of water resources to provide protection for other fish species? Based on the data presented in Figure 13, has TBI been able to correlate "the cohort return ratio" to "the Vernalis flow/export ratio"? If so, what are the R^2 and P values of that correlation?

State and Federal Contractors

NMFS states that, based on observations by Vogel Environmental, predation losses could be the single greatest source of juvenile salmon mortality on the Mokelumne River and that predation losses on other rivers is also likely to be significant (p. 3-Xc-25). Can predators be controlled by non-flow related actions? If so, what types of actions could be implemented to control predators?

PANEL 4

Sacramento Regional Community Services District

SRCSD's testimony summarizes the conclusions of the independent expert panel at the CALFED summit, March 10-11, 2009, contained in "A Framework for Research Addressing the Role of Ammonia/Ammonium in the Sacramento- San Joaquin Delta and the San Francisco Bay Estuary Ecosystem," April 13, 2009. (SRCSD, p. 2.) The CALFED independent expert panel concluded that (1) the recent spread of cyanobacterial genus in the Delta (microcystis) "...indicate[s] sufficient and possibly excessive N loading to the Delta," and that the presence of ammonia in the system exacerbates the spread of toxic algae, (Framework, p. 4, see also, pp. 5-6), and (2) it is possible that when ammonia/um concentrations exceeded 4 µM in the Delta and Bay in recent years [that] diatom productivity decreased? (Framework, p. 5.) Why did SRCSD exclude those conclusions from its testimony?

Figure 4 of Dr. Engle's testimony shows a muted response of chlorophyll to low ammonium levels in the Sacramento River in the reach from Hood to Three Mile Slough. Dr. Engle did not include in Figure 4 data from lower in the Delta system. Did Dr. Engle evaluate the diatom/ammonium relationship around the confluence of the Sacramento and San Joaquin Rivers? If so, did Dr. Engle obtain similar results as those presented in Figure 4? Did Dr. Engle estimate average annual ammonium concentrations in the confluence and Suisun Bay Regions? If so, did Dr. Engle get similar results? If not, is Dr. Engle aware of anyone who has performed that estimate and whether such an estimate was presented at the Summit or elsewhere?

SRCSD states that Werner *et. al.* (2009) validates SRCSD's weekly and quarterly acute bioassays which "...do not show acute effects to fish in effluent...[or] evidence of chronic toxicity to fish, zooplankton, or algae test species...." SRCSD would agree that SRCSD's bioassay results have repeatedly, particularly since 2004, exhibited toxicity above the 8TU toxicity threshold in their extended NPDES permit, which actually does indicate acute toxicity to aquatic organisms at a level of concern for the Regional Board?

If a study were to disclose that the nutrients included in the discharges by SRCSD are changing the composition of the food web and thus adversely affecting fish, including Delta smelt, would the conclusions by Dr. Engle change?

Figure 4 of Dr. Engle's testimony suggests that Sacramento Regional plant discharges do not have an effect on the level of chlorophyll in the Sacramento River downstream of the plant. If that is the case, is it reasonable to expect an immediate change in the river from a change in nutrient composition?

Diana Engle states that the acute-to-chronic ratios (ACR) that Inge Werner used are inappropriate because they are not consistent with USEPA's derivation of ACRs. Are you aware of the default ACR of 12.4 being used by the Regional Water Board in their Methodology for Derivation of Pesticide Water Quality Criteria for the Protection of Aquatic Life - Phase II? Are you aware of the in-depth published work by TenBrook et al 2009 that formed the basis for this default ACR? Are you aware that if one uses this widely accepted ACR with Inge Werner's LC50 determinations for delta smelt that the average ammonia/um concentrations reported by SRCSD exceeds the chronic threshold for delta smelt?

State and Federal Water Contractors

What statistical evidence, if any, can the State and Federal Water Contractors provide that the effluent ammonium from SRCSD is affecting the availability of ammonium in Suisun bay?

To what extent is the ammonium transport within the Sacramento River a function of Sacramento River flow? Has the relationship between ammonium transport and flow changed over time? If so, what is a possible reason that the relationship change?

Is there evidence from the literature that ammonium suppression of nitrogen uptake by algae occurs in other systems? If so, is there a physiological basis for that and can the relationship change depending on the dominant algal species?

It has been debated that nutrients should not be of concern in this system because even though the levels are relatively high, there are no classic symptoms of eutrophication (chlorophyll is not high, no hypoxia, etc). Is there evidence that the quantity or quality of nutrients should be of concern?

Is there any relationship between the change in nutrient loading over time and the change in fish abundance?

Is there any evidence that nutrient ratios may be related to the recent proliferation of microcystis?

Does Figure 4 of Dr. Engle's testimony show a muted response of chlorophyll to low ammonium levels in the Sacramento River in the reach from Hood to Three Mile Slough? Did Dr. Engle include in Figure 4 data from lower in the Delta system? Have the State and Federal Water Contractors considered data from lower in the Delta system? Did Dr. Engle evaluate the diatom/ammonium relationship around the confluence of the Sacramento and San Joaquin Rivers? Did the State and Federal Water Contractors estimate average annual ammonium concentrations in the confluence and Suisun Bay Regions? What were the results of those estimates?

Department of Fish and Game

DFG states that as flows decrease in late spring, abundance of *Eurytemora* and *Pseudodiaptomus* decreases to extremely low levels throughout the estuary. Could that decrease be attributable to higher contaminant loads creating conditions unfavorable to *Eurytemora* and *Pseudodiaptomus*? What data, if any, does DFG have that could attribute the decline in *Eurytemora* and *Pseudodiaptomus* to contaminants? If contaminants are having a strong negative effect on zooplankton, does DFG feel the best solution is for the SWRCB to dilute the contaminants with more flow?

Habitat is defined by both biotic (consumed) and abiotic (not consumed) characteristics. In determining fall habitat suitability, Feyrer et al. (2007) examined only three abiotic factors (salinity as indexed by X_2, temperature, and turbidity) that may be impairing Delta smelt habitat. Are there other factors that may affect Delta smelt? Other researchers have pointed to food limitation and contaminants as important stressors on delta smelt. Has DFG considered how important these other stressors are, as compared with Feyrer et al.'s abiotic characteristics?

Does DFG believe the Amur River clam has and continues to suppress the estuarine food web?

If increased X2 days in Suisun Bay leads to increasing production of food web organisms, might that increased production support increases in the amount of Amur River clams?

The Bay Institute

In TBI's summary of written testimony, TBI writes: "improved flow conditions address some so-called "other stressors" that adversely affect public trust resources; for instance, higher peak flow events in the Delta can help control the spread of invasive species . . ." What data are available to support the assertion that flow can control invasive species?

PANEL 5

Department of the Interior

What are the known mechanisms affecting fish abundance? Of these mechanisms, which ones are currently are influenced/affected by flow?

Mr. Guinee presents Figure 20 to support a contention that habitat has declined (habitat is defined as the combined benefits of food, sediment, and flow). Has DOI evaluated the relative contribution of each of these variables to the composite habitat value (Z-score)? Are there any studies relating the composite habitat value to abundance? Are there any studies relating the individual variables (flow, food, sediment) to abundance?

DOI states that the Yolo Bypass floods via the Fremont Weir when flows on the Sacramento River exceed about 70,000 cubic feet per second in about 60% of years. On p. 8-9, DOI proposes flows to increase floodplain inundation by weir modification and increased outflows. Has DOI considered the effect of a 70,000 cubic foot per second flow regimen in more than 60% of years on the available water supply for the protection of all fish species (i.e., the availability of cold water from Shasta Reservoir to provide habitat for salmonids)?