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August 31, 2012

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
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Washington, D.C. 20426

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Subject: Comments on Turlock Irrigation District and Modesto Irrigation District Salmonid Population Information Integration and Synthesis Study Plan, Don Pedro Hydroelectric Project (No. 2299-075), Tuolumne River, California

Dear Secretary Bose and Messrs. Nees and Dias:

The California Department of Fish and Game (Department) respectfully submits the following comments in response to the June 15, 2012 "Filling on behalf of the Turlock Irrigation District and Modesto Irrigation District's Don Pedro Project" concerning "Final Meeting Notes and Relicensing Participants Comments on the April 10, 2012 Salmonid Information Synthesis Workshop No. 1" and to the Draft Meeting Notes the Department received on July 25, 2012 concerning the Don Pedro Relicensing Salmonid Population Information Synthesis Workshop held on June 26, 2012.

On June 26, 2012, the Turlock Irrigation District and Modesto Irrigation District (collectively, the Districts) conducted a second workshop for the Salmonid Population Information Synthesis to discuss the development of the Districts' preliminary conceptual population models for Chinook salmon and *O. mykiss*. The Districts have presented their materials and the June 26, 2012 workshop as first steps in the effort to summarize relevant and available information regarding in-river and out-of-basin factors affecting Chinook salmon and *O. mykiss* population in the Tuolumne River. According to the Salmonid Populations Information Integration and Synthesis Study Plan

(Synthesis Study Plan), the primary goal of this effort is "to help readers make sense of a wide and complex set of studies through a focused examination of the available literature." (Synthesis Study Plan at p. 3). The Synthesis Study Plan also states that "[t]he review and synthesis of available data will provide the context for rejecting, accepting, or refining hypotheses and will improve understanding of key uncertainties affecting any conclusions drawn from th[e] [Synthesis Study Plan]." (*Id*. at p. 4).

The Department has reviewed the June 15, 2012 filling on behalf of the Districts and the June 26, 2012 Draft Meeting Notes and other related materials and provides the following comments regarding the information presented by the Districts.

June 15, 2012 Filing on Behalf of Districts

In the June 15, 2012 filing submitted to the Federal Energy Regulatory Commission (Commission or FERC), the Districts state that they "do not agree with the [Department's] characterizations regarding 'declining' salmonid populations" (Filing on Behalf of Districts at p. 3). The Districts' response to data sources and other information the Department has submitted to the Commission and relicensing participants highlights a concern the Department has previously expressed; namely the Districts' proposed Salmonid Populations Information Integration and Synthesis is inherently a subjective exercise.

Moreover, in the filing on behalf of the Districts, the Districts fail to articulate any rationale for characterizing the Department's information and conclusions as having "limitations." (*See* id. at p. 3). To oppose the Department's conclusions, the Districts paraphrase a statement in the April 12, 2012 FERC Order Clarifying Proceeding on Interim Conditions (139 FERC ¶ 61,045). (*Id*.) However, the Districts do not provide the full context of the Commission statement and they do not cite any data sources to support their disagreement with the current role inadequate instream flows have in the degradation of aquatic habitat and water temperatures in the Tuolumne River.

The Department reiterates that impaired instream flows and water temperatures are key drivers in the long term decline of the Tuolumne River fall-run Chinook salmon population and notes that it has provided numerous sources in support of this conclusion. To date, the Synthesis Study Plan exercise appears to be largely guided by the Districts' goals and objectives. As such, the Department believes that the end product should be characterized as a compilation prepared on behalf of the Districts.

June 26, 2012 Workshop and July 25, 2012 Draft Meeting Notes

Two representatives from the Department participated in the June 26, 2012 workshop: Ms. Gretchen Murphey (in person) and Ms. Annie Manji (by phone). Please note in the meeting notes Ms. Murphey's last name is misspelled. Based on that participation and upon review of the related filings, the Department has the following comments.

Conceptual Model Information Sources

One purpose of the workshop was to identify and begin to rank key impacts on salmonid populations based on a review of relevant sources of information. However, the Department notes that the basis for ranking various sources of information was vague and not adequately discussed during the workshop. Without specific evaluation criteria and the opportunity to collaboratively review and assess references, the Department believes that the classification of hypotheses as unlikely, inconclusive, or sound should be clearly labeled as the Districts' perspective.

The Department notes that sources that establish the significance of instream flow and water temperature were given less weight by the Districts, without discussion of the merits of the information or other efforts to seek consensus. During the workshop, the Districts appeared to briefly raise the following concerns: 1) several Department-recommended references were literature reviews and already had a degree of synthesis; 2) without specific page numbers it is difficult to evaluate extensive references; and 3) references without numeric data are less meaningful for purposes of building a model. To assist in understanding the science underlying the key role of flow and water temperature on salmon populations in the lower Tuolumne River, the Department resubmits the following excerpts along with specific pages and numeric data from the cited sources.

- **Mr. Timothy Heyne's testimony[1]**

In Timothy Heyne's testimony to the Administrative Law Judge proceeding on interim conditions pending relicensing, the Department wishes to highlight the following four concepts that should be considered in the Synthesis Study Plan:

[1] (Mr. Heyne is a Senior Environmental Scientist employed by the California Department of Fish and Game)

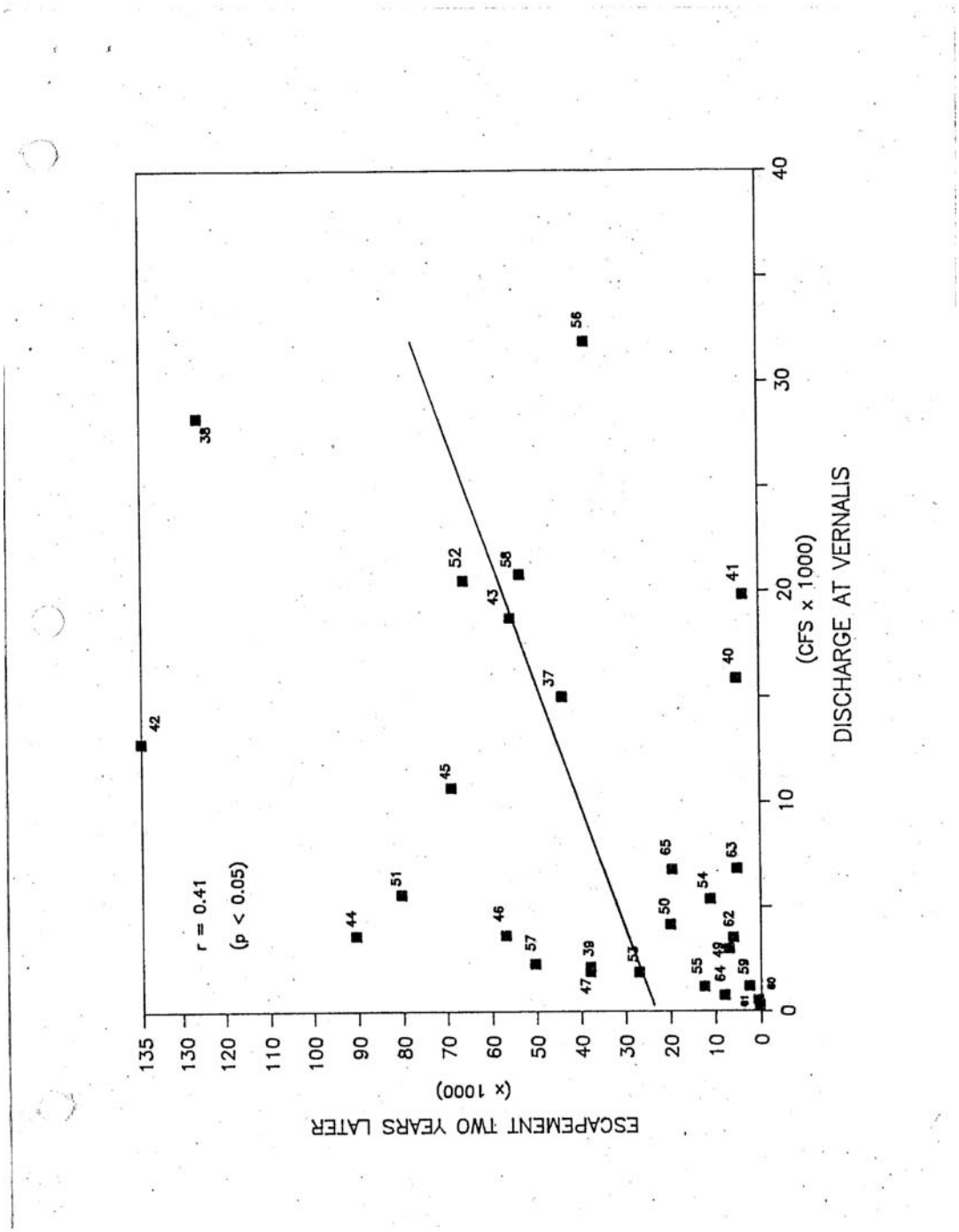
- "Current flow releases to the lower Tuolumne River required under Article 37 of the Project license are insufficient to conserve fall-run Chinook salmon and steelhead." (Exhibit DFG-2, at p. 2).

- "The single most important impact of Project operations affecting anadromous fish populations is the manipulation of flows in the Tuolumne River." (Id. at p. 4).

- "Providing more flow to the river at specific times of the year will improve habitat and water temperature for fall-run Chinook and steelhead." (Id. at p. 7).

- Inadequate spring flows "have been identified repeatedly as the principle limiting factor on fall-run Chinook salmon populations in the Tuolumne River." (Id. at p. 14).

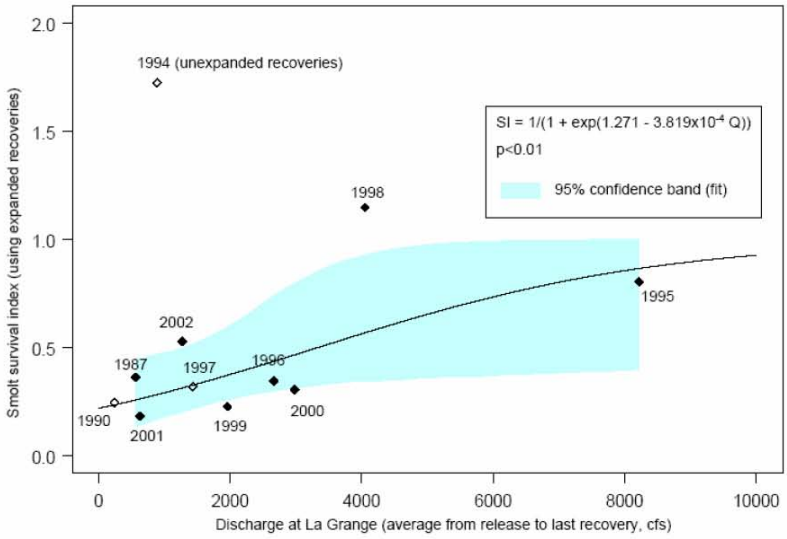
Mr. Heyne's testimony includes several sources of information and analyses that support his interpretation of the positive relationship between flows and the fall-run Chinook salmon populations in the Tuolumne River as well as other major San Joaquin tributaries. First, Mr. Heyne's testimony includes a table from the 1987 Department report to the State Water Resources Control Board (SWRCB) entitled: "The Status of San Joaquin Drainage Chinook Salmon Stocks, Habitat Conditions and Natural Production Factors." In the original document this table is labeled Figure 13 and appears on page two of the Errata sheet of the above-referenced document. In his testimony, Mr. Heyne noted that this data, as shown in the graph below, was provided to the SWRCB to illustrate the relationship between the spring time flows in the San Joaquin tributaries (as measured at Vernalis) and the number of returning adults.


ESCAPEMENT TWO YEARS LATER
(x 1000)
DISCHARGE AT VERNALIS
(CFS x 1000)
r = 0.41
(p < 0.05)

As indicated in the above graph, as flows at Vernalis increase, the number of Chinook salmon that return to spawn in San Joaquin tributaries two years later also increases.

Second, and more specific to the Tuolumne River, Mr. Heyne's testimony also provides information from the Districts' 2005 Ten Year Summary Report to the Commission to illustrate the relationship between flow and smolt survival. The original graph and discussion can be found at page 3-119 of the Districts 2005 report. The graph is labeled Figure 4 Tuolumne River Smolt Survival Relationship in Mr. Heyne's testimony and shows a statistically significant increase in smolt survival with increasing discharges from La Grange Dam.

Figure 4. Tuolumne River Smolt Survival Relationship



Figures 3 and 4 illustrate the benefits increased spring time flows can provide for the fall-run Chinook salmon population. However, the spring stream flow levels provided by the Project are grossly deficient (in terms of flow magnitude, flow duration, and elevated flow frequency) and do not produce an adequate supply of smolts to conserve the fall-run Chinook salmon population. The artificially low flows cause the juveniles to stop migrating and also cause excessive warming of water as flow level recedes. Low flows during the spring out-migration also impact smolts moving through the Delta where predation and water quality are significant sources of mortality. The losses of smolts associated with current Project releases in the spring are a significant impact on the fishery and have been correlated with fewer

Third, Mr. Heyne's testimony illustrates the relationship of spring flows to salmon populations by compiling data from rotary screw traps. These traps have been operated for almost two decades with the most recent years' results available on the Tuolumne River Technical Advisory Committee website. The following pages from Mr. Heyne's testimony evaluate the correlation between outmigrant success and spring flow utilizing spawning females as a basis for estimating egg production. Again, as flows increase so does production of outmigrant smolts.

Additional data supporting the conclusion that current spring flows are insufficient come from analyses of smolts collected in rotary screw traps, seines, and trawls in the lower Tuolumne and Delta. These smolt production evaluations have been performed since the early 1980s, with the rotary screw trap estimates beginning in mid 1990s. Observed trends in smolt number, size, and river mile have been correlated with spring flow conditions as well as water temperature. Data from all of these long term evaluations demonstrate that fish production is heavily dependent on river flows. To maximize smolt production, spring flows must be elevated during the smolt out-migration season, which, as demonstrated by the licensees' juvenile monitoring, occurs from about mid-March to mid-June. Elevated flows (defined as increased flow magnitude, flow duration, and flow level frequency) during this spring time would maximize smolt survival and reduce water temperature, both of which would substantially enhance likelihood of smolt survival out of the Tuolumne River.

The licensees raised a concern on the smolt survival evaluations about the use of hatchery fish. Due to the concerns regarding how well hatchery fish represent wild fish and a desire to understand the migration and abundance of wild fall-run Chinook salmon smolts, DFG had already begun (1995) a program of using a capture device called a rotary screwtrap at the mouth of the Tuolumne to document the numbers of fish leaving the Tuolumne River. This program, too, was

operated in conjunction with the licensees. The result of screw trapping is an estimate of the number of juvenile fall-run Chinook salmon leaving the river each year. These estimated number of outmigrants are presented in the table below (Table1) with the estimated number of eggs that produced those outmigrants. The egg estimates are produced by DFG each year after they perform adult spawning surveys. When you divide the outmigrants by the eggs produced and then multiply by 5,000 you have an estimate of the number of outmigrants that make it out of the river per average female. By comparing the "high" production years and low production years to streamflow it is clear that streamflow has a large impact on production, affecting the number of outmigrants/female making out of the river.

Table 1. Evaluation of Production of Outmigrant Juveniles per Spawning Female Compared Spring Flows in the Tuolumne River.

Outmigration Year	Potential Eggs	RST Outmigrants	% Leaving River	Outmigrants / Avg. Female	Spring Flow Apr-Jun
1998	21,520,864.77	1,615,673	7.507%	375	3931
1999	22,640,987.17	1,073,669	4.742%	237	1381
2000	18,842,659.42	132,017	0.701%	35	1029
2001	68,954,846.59	111,644	0.162%	8	467
2002	30,833,259.73	14,540	0.047%	2	388
2003	23,220,487.01	7,261	0.031%	2	453
2004	7,939,399.75	13,134	0.165%	8	503
2005	5,227,439.49	74,471	1.425%	71	4426
2006	2,813,709.71	178,034	6.327%	316	6703
2007	1,802,677.00	937	0.052%	3	338
2008	543,200.66	3,283	0.604%	30	448

I submit that after three major and substantially independent evaluation programs, all reaching the same conclusion, it is time to act on the information available. Current spring flows are inadequate and need to increase to keep the fall-run Chinook salmon populations from declining to zero (extinction).

- **Mesick et al., 2008. Limiting factor analyses & recommended studies for fall-run Chinook salmon and rainbow trout in the Tuolumne River.**

Rotary screw trap surveys and coded-wire tag smolt survival studies also inform the limiting factor analyses prepared by Mesick et al. (2008) which is cited in the testimony of both Mr. Heyne and Dr. Andrew Gordus. Mesick et al. finds that spring flows are highly correlated with Chinook salmon recruitment. The following excerpt from the Mesick et al. study details the relationship between salmon abundance and instream flow.

Salmon Abundance and Flow

The intent of the 1996 FERC Settlement Agreement[iii] (FSA) and subsequent modified FERC License No. 2299 (License) Articles 37 and 58 was to improve minimum flow levels from the New Don Pedro Project, implement an adaptive management research program, and restore critical habitat to help recover the fall-run Chinook salmon population in the Tuolumne River. However, the number of adult Tuolumne River fall-run Chinook salmon produced at a given spring flow has significantly declined by about 50% since the FSA was implemented (Figure 3). The statistical test of significance was based on a permutation test conducted by Dr. Allan Hubbard[1] to avoid violations of assumptions for correlation tests resulting from potential autocorrelations in population trend analyses. His analysis indicates that the intercepts of the regressions between the two data sets shown in Figure 3 are significantly different ($P = 0.01$).

[1] Dr. Allan Hubbard, Assistant Professor of Biostatistics (Division of Biostatistics, School of Public Health, University of California, 101 Haviland Hall, MC 7358, Berkeley, CA 94720

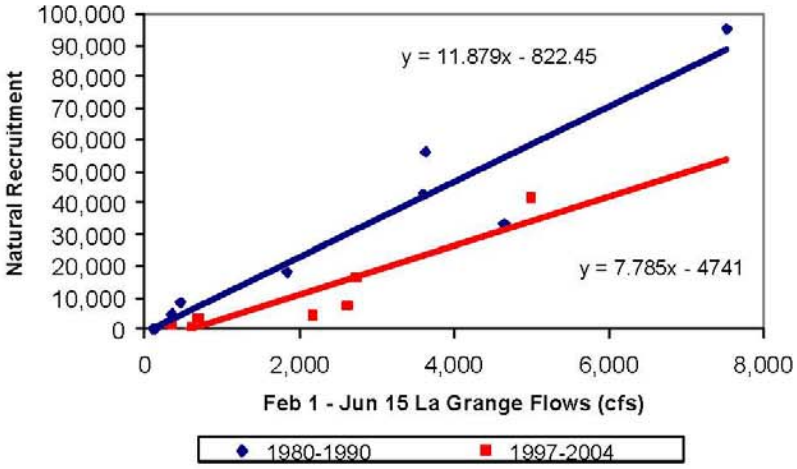


Figure 3. Tuolumne River natural fall-run Chinook salmon recruitment plotted with mean flow in the San Joaquin River at Vernalis during February 1 through June 15 during two periods: 1980 to 1990 (pre-FSA) and from 1997 to 2004 (post-FSA). Recruitment is the number of adults in the escapement and ocean harvest (including shaker mortality) that belong to individual cohorts of same-aged fish (Mesick et al. 2007). Estimates were excluded for which spawner abundance was less than 650 Age 3 equivalent fish to minimize the effect of spawner abundance on the relationship between flow and recruitment.

Prior trend analysis suggests that the number of naturally produced and hatchery adult salmon that return to the lower Tuolumne River is strongly correlated with spring time flow (e.g. April and May) when the fish migrated to the ocean as juveniles (as summarized in Mesick and Marston 2007). The most recent evaluation by Mesick and Marston (2007) indicates that the mean spring flow in the San Joaquin River near Vernalis between March 1 and June 15 explains about 92% of the variation (adjusted R-squared) in total (natural and hatchery) adult recruitment to the Tuolumne River between 1980 and 2003 (Figure 4). Instream flow releases in the Tuolumne River as gauged at La Grange are almost as important as they explain about 82% of the variation in Tuolumne River recruitment. Adding stock abundance and a categorical variable to account for the population change that occurred sometime between 1987 and 1994, increases the amount of variation explained by the Vernalis flow model to about 95%. Other factors, such as *Microcystis* blooms, pyrethroid insecticides, water quality in the Stockton Deep-Water Ship Channel, CVP and SWP Delta export rates, Delta Cross Channel Gate operations, and ocean productivity (e.g., upwelling and Pacific Interdecadal Oscillation) explain relatively little variation in adult recruitment to the Tuolumne, Stanislaus, and Merced rivers (Mesick and Marston 2007).

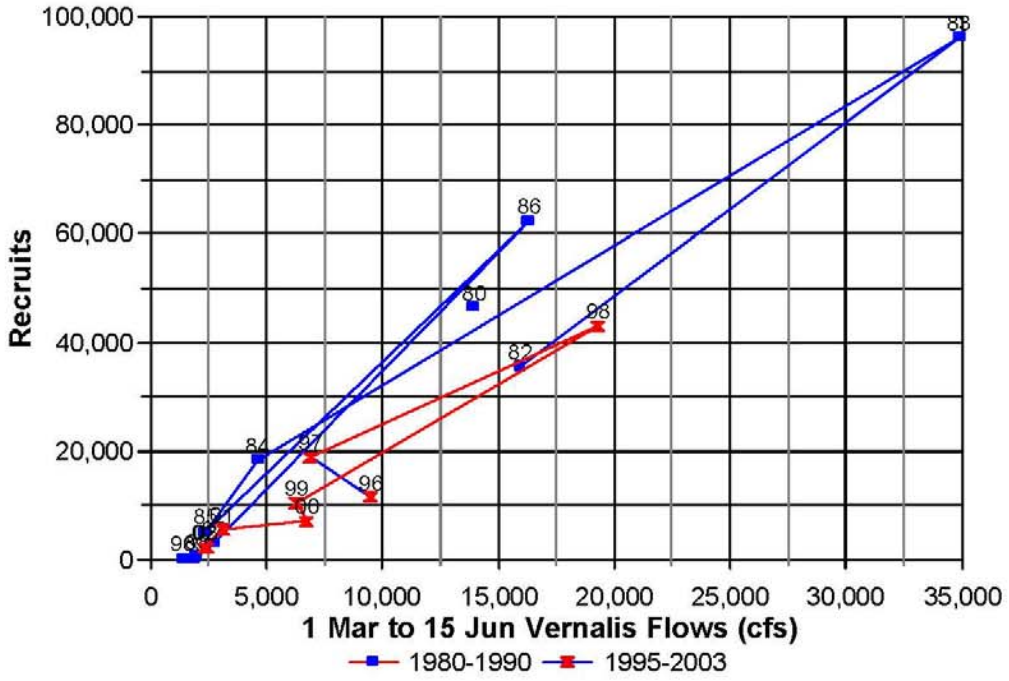


Figure 4. Number of fall-run Chinook salmon recruits to the Tuolumne River plotted with flows in the San Joaquin River at Vernalis from March 1 to June 15 from 1980 to 2003. This analysis excludes recruitment estimates that were affected by a low number of spawners (< 500 Age 3 equivalent fish) to better illustrate the relationship with flow. The recruitment estimates are labeled according to the year when the fish outmigrated as smolts.

Spring flow affects juvenile survival in the Tuolumne River as well as the Delta based on rotary screw trap surveys in the Tuolumne and Stanislaus rivers and coded-wire-tag smolt survival studies in the Tuolumne River and Delta[iv]. Preliminary analyses of rotary screw trap data from the Tuolumne River near Grayson (RM 5.2) suggest that spring flow releases at La Grange from March 1 to June 15 are highly correlated (adj-R^2 = 0.82, P = 0.0005) with the number of Tuolumne River smolt outmigrants passing the Grayson traps at rivermile 5 (Figure 5)[v] and the number of Tuolumne River smolt outmigrants is highly correlated (adj-R^2 = 0.96, P = 0.0004) with the number of Tuolumne River adult recruits (Figure 6).

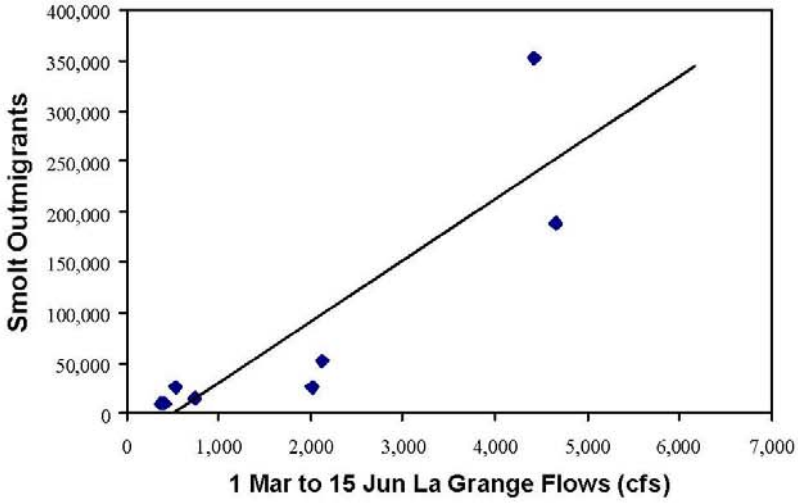


Figure 5. The Number of smolt-sized Chinook salmon outmigrants (FL > 70 mm) passing the Grayson rotary screw trap site (RM 5) plotted with flows at La Grange between March 1 and June 15 in the Tuolumne River from 1998 to 2005. The regression model has an adj-R2 of 0.73 and a probability level of 0.0004.

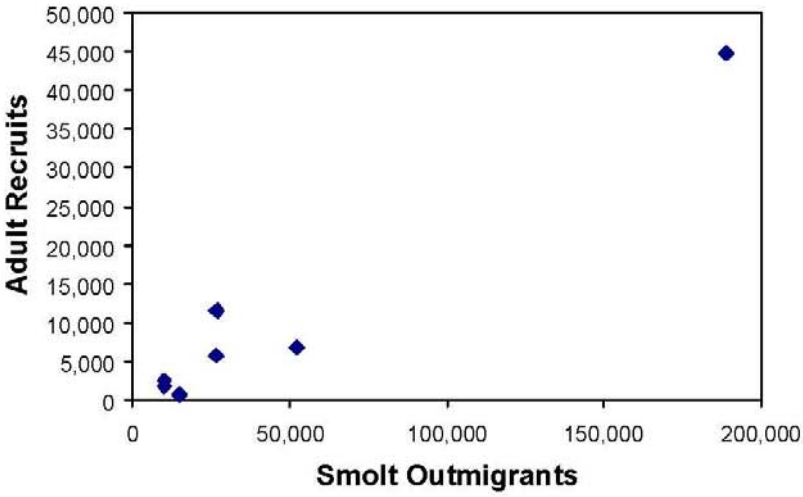


Figure 6. The number of smolt-sized Chinook salmon outmigrants (FL ≥ 70 mm) measured at the Grayson rotary screw trap site (RM 5) regressed with the number of adult recruits in the Tuolumne River from 1998 to 2003. The regression model has an adj-R^2 of 0.95 and a probability level of 0.0001.

- **Dr. Andrew Gordus' testimony[2]**

While Mr. Heyne's testimony addressed the relationship of flow and salmon populations, Dr. Andrew Gordus' testimony focused specifically on the mechanism of water temperature. In his testimony to the Administrative Law Judge proceeding on interim conditions pending relicensing, Dr. Gordus concluded as follows:

> "Elevated water temperatures contribute to the ongoing decline [of] fall-run Chinook salmon in the Tuolumne River by: 1) inducing adult mortality as adults migrate into the San Joaquin River and adjacent tributaries to spawn (i.e. pre-spawn mortality); 2) reducing egg viability for eggs deposited in stream gravels; 3) increasing stress levels, thereby reducing survival of juveniles within the tributary nursery habitats; and 4) reducing salmon smolt out-migration survival as smolts leave the nursery habitats within the tributaries to migrate down the San Joaquin River to Vernalis and through the south Delta" (Exhibit DFG-4, at p. 12).

In support of this conclusion, Dr. Gordus cited findings from both the United States Environmental Protection Agency (EPA) and the SWRCB that water temperature is impaired on the lower Tuolumne River. The June 15, 2012 filing on behalf of the District notes the Department's references on water temperature but emphasizes that only primary data sources will be used for assessing temperature impacts (Filing on Behalf of Districts at p. 3). The Districts also imply that the proposed Temperature Criteria Assessment for Chinook Salmon and *O. mykiss* Study will have a role in identifying appropriate regional water temperature standards using historical data. (*Id*.) To clarify the Department's perspective on water temperature, we strongly recommend the use of the EPA temperature criteria to evaluate project impacts. The Commission has reaffirmed this perspective in the December 2011 Study Plan Determination:

> "CDFG and NMFS reference several documents that support use of EPA (2003) temperature criteria for all life stages of salmonids in the lower Tuolumne River. We have reviewed these documents and have determined that the existing information concerning the effects of water temperature on

[2] (Dr. Gordus is a Water Quality Biologist employed by the California Department of Fish and Game)

> specific life-stages of salmonids is sufficient (study criterion 4)." (Study Plan Determination for the Don Pedro Hydroelectric Project at p. 55).

Given the lack of proposed studies to quantify the mechanisms of water temperature impacts on the lower Tuolumne River, the Department does not understand how the Districts' proposed Temperature Criteria Assessment Study Plan will inform the ongoing synthesis.

Conceptual Model Flow Charts

Another purpose of the June 26, 2012 workshop was to present conceptual salmon and steelhead population models as a prelude to developing actual modeling tools. During the workshop two frequently cited proximate mechanisms, prey availability and disease/parasites, were characterized as not being well documented but also unlikely to be a significant problem. We note that two studies the Department recommended earlier in the relicensing process were specifically recommended to better understand these proximate causes; namely the bioenergetics and fish health/disease studies. However, the Districts opted not to pursue these lines of investigation.

Moreover, the Department is also concerned that the Districts' proposed salmon modeling emphasizes mortality (as opposed to survival) and lacks a clear nexus with subsequent life stages. The Department notes that all of the Districts' flow chart processes and mechanisms ultimately feed into direct mortality. It is not clear how the abundance of survivors (i.e., those that avoid the direct mortality outcome) will feed into the next life stage. This linkage is missing in the Districts' current schematics. The Department has raised these concerns previously. In fact, in comments on the Districts' proposed study plan submitted to the Commission and Districts on October 24, 2011, the Department stated that:

> "As a first stage review, the proposal lacks: i) the key component of non-fry juveniles to adult recruitment; ii) an acknowledgment of the nexus of fry abundance to parr/smolt abundance; iii) an acknowledgment of the importance of both winter and spring flow level to fry abundance thence both parr and smolt abundance; iv) an acknowledgment of the statistically significant relationship between flow in the lower Tuolumne River and smolt survival; and v) any accounting for the relationship between juvenile

> out-migration (fry, parr, and smolt) patterns and adult recruitment." (Revised Study Requests and Comments, at pp. 20-21)

Finally, the Districts' proposed modeling hierarchy conveys implicit priorities. The Department is concerned that factors of high importance from our perspective (such as flow magnitude, frequency and duration and water temperature) are relegated to less prominent positions within the model structure based on preliminary District assessments. The proposed structure appears to assign, by default, a less important role to factors such as water temperature and habitat quality and quantity as they do not appear in the bottom tier proximate to biotic responses.

The Department submits the following comments to illustrate alternative modeling concepts and linkages.

- Except during rare spill events, the Don Pedro Project directly controls flow releases to the lower Tuolumne River. With over 2 million acre feet storage capacity, the Project controls the timing, magnitude and duration of instream flows in the lower Tuolumne River most of the time. However no portion of the instream flow regime is classified as an anthropogenic input. Instead Project controlled flow releases and storage are included in the same category as water year type, groundwater upwelling and tributary inflow. The Department recommends Project operations involving water management be separated from unimpaired instream flow contributions into a distinct controllable system input.

- Hatchery introductions are specifically listed as an anthropogenic input in several life stages (sometimes the only such input). As there is no Chinook salmon hatchery on the Tuolumne River, the presence of hatchery Chinook in the lower Tuolumne River is actually an indirect impact, more correctly characterized as straying. (The Department notes that the draft meeting notes have replaced hatchery introduction with straying of hatchery fish in the relevant flow charts and agrees this is more accurate.)

- Lack of passage to historic spawning habitat is not included in the spawning flow chart, based on the rationale that existing structures are baseline and not relevant to a forward looking modeling exercise. Meanwhile in both the in-river and Delta rearing flow charts, non-native introductions are listed as the first anthropogenic input. There has been no formal introduction of non-native fish into the lower Tuolumne or San Joaquin River watersheds for over a decade.

Non-native fishes are a legacy of past actions and would seem to constitute a "baseline" similar to the lack of passage facilities. A more appropriate current anthropogenic input involving non-native fishes would be angler regulation and/or harvest.

- The proposal to treat predation as a proximate mechanism leading to direct mortality requires clarification. Predation is an essential part of a functioning aquatic ecosystem and not a classic impact such as impaired water temperature or reduced quality/quantity of rearing habitat. Even in pristine systems, predation is a common outcome for juvenile salmonids and a mechanism for removal of less fit individuals from a population. Predation is also a more likely outcome for juveniles experiencing stressors such as the high water temperatures and lack of cover habitat in the lower Tuolumne River. Therefore, the Department agrees predation may be a likely "biotic response" in a degraded environment; however, predation is not necessarily a key mechanism for declining trends in populations. A more appropriate concept would be analogous to the food (prey) abundance mechanism where the distribution and abundance of predators is the mechanism of interest.

- Similar to predation, competitive exclusion during spawning and redd superimposition during incubation are actually consequences of limited high quality spawning habitat and/or altered run timing. The mechanisms of interest would be factors that reduce habitat quality or constrain habitat quantity such as impaired water temperatures and passage barriers.

- The in-river flow chart does not include the temporal aspect of smolt out migration which is strongly linked to survival rates. Simply put, out-migration transit times are reduced and survival rates improved by increased flow. Also missing in the Districts' proposed modeling hierarchy is the duration of floodplain rearing habitat, with longer periods of inundation linked to improved prey availability and reduced predation. To address this issue, the Department recommends inserting a flow timing and availability box as a first tier mechanism in the in-river rearing and out-migration chart. This mechanism should have system inputs from meteorology, unimpaired flow and anthropogenic water management operations. The flow timing and availability mechanism in turns impacts water temperature, water quality, habitat availability, predator and food distribution and abundance, disease and straying.

- In the Draft Meeting Notes, the Delta rearing and out migration flow chart now includes the flow elements of timing and variability added as a bullet at the bottom of the instream flow box. This bullet should also include at a minimum, the magnitude and duration of flow. Given the large role of flow elements, the Department recommends adoption of the same structure of a distinct flow timing and availability mechanism as described previously for the in-river flow chart. The Department does not support lumping flow elements into a catch-all of system inputs far removed from actual mechanisms and processes of interest.

- The water temperature component should have various mechanisms identified and treated as distinct processes/inputs. At a minimum the elements of: 1) snow melt (or conversely the interruption of snow melt); 2) groundwater seepage (or conversely lack of seepage due to overdraft); 3) riparian vegetation shading (or conversely loss of shading); and 4) tail water (heat sink) returns should be explicitly inserted into the appropriate flow charts. The Department also notes the importance of the relationship between thermal mass and shifts in downstream temperature which is dependant on Project storage practices and release volumes. This relationship is missing in the Districts' current schematics.

- Both the in-river and Delta rearing charts should include metabolic processes as a distinct mechanism with input from water temperature and food availability and directly impacting disease and growth. In addition, the prey abundance mechanism should be broadened to food abundance. (The Department notes that the Draft Meeting Notes include revised flow charts with prey replaced by food and appreciate the refinement. Along this line, instead of "availability", the distribution and abundance characterization recommended for predators would also be appropriate for food).

- Both in-river and Delta rearing flow charts should also include migration as a distinct process on the same tier as entrainment and disease. Migration is impacted by flow availability and duration, habitat availability, metabolic processes, and water temperature and quality. The duration and timing of migration behaviors, in turn, impacts survival (or indirect mortality as presented in the conceptual flow chart).

- As appropriate mechanisms are added, the in-river rearing/out-migration flow chart becomes quite complex. The Department recommends splitting this critical phase into two distinct life stages: in-river rearing and smolt out-migration. These are in fact different life stages (fry versus smolt) with different stressors.

Classification of various factors as anthropogenic or not, or mechanisms versus inputs may seem to be a matter of semantics; however, when identifying controllable factors under the Commission's jurisdiction, such distinctions become important. The Department notes that the December 22, 2011 Commission Study Plan Determination required that the Synthesis Study Plan effort and the related modeling studies specifically identify project related impacts:

> "The objective for the quantitative models is to identify critical in-river life stages affected by the project and then allow an evaluation of appropriate PM&E's to inform license conditions. The model objective is not to predict the precise population size of any particular life-stage, as in a life-cycle model, but rather identify all in-river life stages affected by the project and then allow an evaluation of appropriate PM&E's." (Study Plan Determination for the Don Pedro Hydroelectric Project, at p. 38).

The Department believes the modifications recommended above will result in a better understanding and assist parties in developing and evaluating protection, mitigation, and enhancement (PM&E) measures.

Preliminary Ranking of Issues Affecting Chinook Salmon Population Levels

The Department laments that the Districts' preliminary ranking table was not clearly articulated until after the workshop with the distribution of the July 25, 2012 Draft Meeting Notes. Our review of the Draft Meeting Notes' preliminary ranking table revealed that flow is not considered an issue (of any rank) affecting Chinook salmon population levels. Flow (timing, magnitude, duration and availability) does not meet the criteria of a process or mechanism in this summary presentation. The only processes/mechanisms affecting populations and consistently having the support of conclusive evidence appear to be redd superimposition, predation, and entrainment. In contrast, most process and mechanisms involving water temperature impacts are categorized as "unlikely" or "inconclusive."

In some cases, the notes section cites a lack of biological data specific to the Tuolumne River. *In situ* sampling of delicate/widely distributed life stages (such as those needed for egg viability, fry metabolism and floodplain juvenile mortality studies) is notoriously difficult. However, this should not translate into a lack of impacts. While predators and redds may be more amenable to tracking and quantification, this convenience should

not override relationships based on laboratory studies or scientific research in comparable ecosystems. Finally, as noted previously, water temperature criteria developed through the Districts' proposed Temperature Criteria Assessment Study Plan to assist in assessing risk of mortality is not an appropriate substitute for the EPA temperature criteria.

For the reasons explained above, the Department does not concur with the Districts' preliminary set of issues nor the proposed ranking. The Department recommends the following life history components be addressed by any Tuolumne River salmon population model. (The chart below is organized by highest to lowest priority, first by life stage and secondarily by component.)

#1 Smolt out migration		
Flow is the primary determinant of smolt survival, and ultimately, the contribution to adult recruitment in Tuolumne River.		
Process/Mechanism	**Season**	**Notes**
a) Water quality (temp, contaminants, DO)	Apr-Jun	Increased flow improves water quality and reduces mortality causal factors of disease, contaminants, starvation
b) Smoltification and out migrant transit time	Apr-Jun	Increased flow reduces duration of vulnerable stages
c) Predation	Apr-Jun	Increased flow reduces predation by reducing temperature, improving water quality, increasing velocity, increasing flood-related turbidity
d) Entrainment	Apr-Jun	Minor factor
#2 In-river rearing		
Flow is the primary determinant of number of juvenile salmon that survive to smolt size, and ultimately, the contribution to adult recruitment in Tuolumne River.		
Process/Mechanism	**Season**	**Notes**
a) Habitat quantity and quality (floodplain)	Feb-May	Increased flows increases floodplain habitat

Process/Mechanism	Season	Notes
b) Food availability	Feb-May	Increased flow inundates floodplain and increases food availability
c) Water quality (temp, contaminants, DO)	Feb-May	Increased flows reduce temperature, improve water quality, reduce mortality from other stressors (disease, contaminants, starvation)
d) Predation	Feb-May	Increased flow reduces predation
#3 Delta rearing		
Spring flows (Feb-May) improve the number of fry and parr that survive migration through Tuolumne River and San Joaquin River and Delta, but provide minor contributions to adult recruitment compared to the number of smolts produced in the Tuolumne River. (This is a consequence of many stressors severely reducing the quality of Delta and estuary rearing habitats.)		
#4 Adult up-migration and spawning		
Fall flows (Sep-Oct) improve egg viability, reduce egg mortality from redd superimposition and minimize straying of early arriving adult salmon. Fall attraction flow releases were implemented starting in the mid 1990s, but based on documented responses to date; these flows appear to have a relatively minor effect on adult recruitment.		
#5 Egg survival to emergence		
The incubation period (Oct - Jan) is not considered a major bottleneck, given the current poor survival of fry and smolts. If higher winter and spring flows were provided to improve juvenile survival, then improving spawning habitat (e.g. restoration of spawning gravel quality and fluvial processes) would increase in importance.		
#6 Ocean Rearing		
Ocean mortality is generally small compared to factors affecting juvenile survival in Tuolumne River and Delta.		

For greater detail on how to utilize these factors in a conceptual Chinook salmon population model, please refer to the 2008 limiting factor paper by Mesick et al. (specifically pages 45 through 48)

Future Consultation

The Department appreciates the amount of effort involved in building a population model while simultaneously seeking input from other parties. In fact, the Department biologists and environmental specialists with expertise in issues involving salmonid populations of the Tuolumne River have been working on a salmon population model for the San Joaquin and its major tributaries (including the Tuolumne River) for over seven years. The development of the Department's model has included several rounds of peer review.

Unfortunately, the Districts have dismissed utilizing the framework of the Department's San Joaquin River Salmon Population Model for this relicensing by noting that not all concerns raised during the first two rounds of peer review had been resolved (TID/MID, 2011, page 314). The Districts have incorrectly concluded that because the Department has yet to address a few remaining peer review concerns, the model is not functional and should not be considered.

Despite the Districts' conclusions, the Department continues to believe that the San Joaquin Salmon Population Model is worth the significant amount of resources invested in its development, peer review and refinement. Furthermore, the Department notes that its staff, with the expertise to develop the Tuolumne River salmon population model, are already fully committed to providing a credible and informative tool to assist the respective regulatory agencies in managing San Joaquin River Watershed resources. Consequently, this Department staff are unable to commit to an additional modeling effort, even one with limited scope and compressed development phase such as proposed in the Tuolumne River Chinook Salmon Population Model Study Plan.

While the Department will continue to actively consult and participate on study plan development for those studies the Department has requested, due to the pre-existing high priority commitments of the Department's modeling experts, this particular information synthesis and conceptual modeling effort is one in which our participation will, unfortunately, be minimal at best. The Department brings this to the attention of the relicensing parties due to the decision of the Commission not to require peer review of this modeling effort. In particular, the Department is concerned with the following excerpt from the Commission's December 22, 2011 Study Plan Determination:

> "However, we agree with the Districts that establishment of a scientific review panel and any associated cost is not necessary, as participation by experienced biologists from NMFS, FWS, CDFG, the Conservation Groups, and Commission staff would ensure a rigorous scientific review (study criterion 7)." (Study Plan Determination for the Don Pedro Hydroelectric Project, at p. 39).

Based on the concerns and the recommendations set forth above, the Department strongly recommends the Districts reconsider the decision not to obtain an independent review of their proposed model to ensure their investment of time and effort results in a credible and useable product. The Department notes that the Delta Science Panel is a pre-existing body of respected, knowledgeable and independent experts who could inject a valuable degree of scientific rigor and credibility into this process.

The Department appreciates the opportunity to comment on the above-reference filing and workshop meeting notes and other related materials the Districts have provided as a prelude to the development of a salmon population model. If you have any questions regarding these comments please contact Ms. Annie Manji, Staff Environmental Scientist, at (530) 225-2315, or Mr. Dean Marston, Environmental Program Manager, at (559) 243-4014, extension 241.

Sincerely,

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References

California Department of Fish and Game. 1987. The Status of San Joaquin Drainage Chinook Salmon Stocks, Habitat Conditions, and Natural Production Factors. Prepared for State Water Resources Control Board Bay/Delta Hearing Process PHASE I by Region 4, Fresno Ca, July 1987. 121 pp.

California Department of Fish and Game. 2011. Revised Study Requests and Comments, Turlock and Modesto Irrigation Districts' Proposed Study Plan Don Pedro Hydroelectric Project (FERC Project No. 2299-075), Tuolumne River, California. by Central Region, Fresno, Ca. October 24, 2011. 101 pp.

Federal Energy Regulatory Commission. 2011. Study Plan Determination for the Don Pedro Hydroelectric Project. December 22, 2011. 146 pp.

Federal Energy Regulatory Commission. 2012. Order Clarifying Proceeding on Interim Conditions, 139 FERC ¶ 61,045, Project No. 2299-076. April 19. 2012. 23 pp.

Gordus, A. G. 2009. Direct Testimony of Andrew G. Gordus, Ph. D. on Behalf of the California Department of Fish and Game, Exhibit No. DFG-4. 16 pp.

Heyne, T. 2009. Direct Testimony of Timothy Heyne on Behalf of the California Department of Fish and Game, Exhibit No. DFG-2. 21 pp.

Mesick, C., J. McLain, D. Marston, T. Heyne. 2008. Limiting factor analyses & recommended studies for fall-run Chinook salmon and rainbow trout in the Tuolumne River. Anadromous Fish Restoration Program, U.S. Fish and Wildlife Service, Office of the National Marine Fisheries Service. Sacramento, California, and California Department of Fish and Game, Fresno, California. 104 pp.

Turlock Irrigation District and Modesto Irrigation District. 2005. Ten Year Summary Report, Don Pedro Project No. 2299-024. 254 pp.

Turlock Irrigation District and Modesto Irrigation District. 2011. Don Pedro Project FERC No. 2299, Proposed Study Plan, July 2011. 499 pp.