Comments on the August 2002 Public Draft Red Bluff Diversion Dam Environmental Impact Statement/Environmental Impact Report

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SUMMARY

This report provides a technical peer review of the August 2002 Public Draft Red Bluff Diversion Dam (RBDD) Environmental Impact Statement/Environmental Impact Report (DEIS/EIR) as related to fishery resources. Based on an extensive review of information provided in the DEIS/EIR and a thorough review of numerous documents, data, and highly relevant information pertinent to upstream and downstream fish passage at the dam, it was determined that the DEIS/EIR is deficient, inadequately serves its original intended purpose, and is fatally flawed. The document does not provide a fair, impartial, scientifically balanced assessment to allow comparisons of project alternatives. The DEIS/EIR is incomplete and misleads the reader by suggesting incorrect or invalid cause and effect biological relationships on fish. These circumstances are attributable to a wide variety of reasons described in this detailed critique and include the following:

1) Fish passage conditions are not based on current RBDD operations
2) Misrepresentation of existing information
3) Lack of technically relevant references
4) Subjective conjecture leading to a preferred alternative

The DEIS/EIR provides its version of an analysis of alternative approaches and measures to improve fish passage at RBDD while concurrently improving water delivery reliability into the Tehama-Colusa and Corning irrigation canals. The DEIS/EIR uses a computer spreadsheet model to invoke an unscientific and arbitrary "ecological cost" and, more importantly, is used as the primary method to describe and compare each of the alternatives presented in the document. Unfortunately, the model possesses numerous defects in its assumptions, data, and computational procedures that invalidate the outputs. These flaws include:

1) Inconsistent logic in its analytical approach
2) Model structure proves a bias to one alternative
3) Methodology is nebulous, speculative, and arbitrary

There is clearly inconsistent logic in the analytical approach used to assess alternative effects on fishery resources. The analytical method is artificially structured to ensure that none of the gates-in alternatives with improved fish ladders can surpass the alternative with the largest pumping plant. This take place because the computer spreadsheet model and assumptions lack a scientifically sound foundation. There is so much speculation built into the fishery analysis methodology, that one cannot use it to assess impacts or benefits of the various alternatives in the DEIS/EIR. The document uses an inconsistent standard between alternatives then provides criteria for RBDD, without supporting scientific justification, dissimilar to other fish passage facilities elsewhere in North America. The analytical approach employed in the DEIS/EIR is not only counter-intuitive and invalid, but is contrary to accepted scientific principles, standards, and practices. Critically important conclusions drawn in the DEIS/EIR are not supported by empirical evidence. Much of the best available data and information is contrary to speculative assumptions used in the DEIR/EIR, but was not used or was disregarded.

Recommendations are provided to improve the final EIS/EIR. However, the technical defects are so severe and numerous that an entire re-analysis of project alternatives and re-write of the document are warranted. The final EIS/EIR needs to provide full consideration of all relevant information. The re-write should follow well-established scientific rules and objectivity. Impartial individuals with expertise on upstream and downstream fish passage studies and facilities should be involved in the formulation of the final document. Because of the numerous technical errors in the August 2002 draft, it is highly recommended that a second draft be submitted for public review prior to finalizing the document.

INTRODUCTION

This report provides a technical peer review of the Draft Red Bluff Diversion Dam Environmental Impact Statement/Environmental Impact Report (DEIS/EIR) as related to fishery resources. This review is based on a thorough examination of the DEIS/EIR, its Appendices, and data and studies cited. It is also based on an extensive review of the scientific technical literature concerning upstream and downstream fish passage research and the author's past long-term experience directing and conducting studies at RBDD and elsewhere throughout California which include 28 years working as a fishery scientist (15 years for the federal government and 13 years in the private sector). The following discussion describes the topics requiring major revision in the DEIS/EIR and the reasons why those corrections are necessary.

TOPICS REQUIRING MAJOR REVISION IN THE FINAL EIS/EIR

Problems/Errors with the DEIS/EIR Assumptions on Upstream Fish Passage

Overstatement of Existing Fish Passage Delay and Blockage

The problems associated with insufficient flow and attraction of adult salmon into the RBDD fish ladders were recognized nearly 30 years ago. In 1981, the U.S. Fish and Wildlife Service (USFWS) reported:

> "*The efficiency of the fishways can be increased significantly if appropriate modifications to the attraction flow diffuser chambers are provided. The necessary improvements were identified in 1975* [citing NMFS 1975] *and modifications were made in 1978. However, due to mechanical failure, the corrective features have not functioned and fishway operation basically remains unimproved*." (USFWS 1981)

A variety of studies to evaluate upstream fish passage at RBDD were performed from the 1970s to the mid-1980s when the RBDD gates were in 12 months a year. In the 1970s, the California Department of Fish and Game (CDFG) conducted a radio tagging study of adult chinook at the dam. Those results are reported in Hallock et al. 1982 but are only selectively included in the DEIR/EIS. Additional studies of upstream fish passage were conducted by the USFWS during the 1980s when the RBDD gates were in 12 months a year and are reported in Vogel et al. (1988). Once again, those studies are briefly mentioned in the DEIR/EIS, but relevant data and results were not included.

The DEIS/EIR provides highly misleading information on fish passage at RBDD by citing results from these experiments performed when the gates were in 12 months a year[1] to suggest those data are reflective of current dam operations when the gates are in

[1] "Vogel et al., (1988) determined from salmon tagging studies conducted from 1983 through 1988 that between 8 percent and 44 percent of adult chinook salmon, depending on run, were blocked from passing upstream of RBDD. Similarly, Hallock et al., (1982) determined that passage of 15 percent to 43 percent of adult chinook salmon, depending on run, were blocked by RBDD". . . . . . "Vogel et al., (1988) determined

only 4 months a year. The significance of this major error in the DEIS/EIR is that the studies referred to were performed in the 1970s to the mid-1980s ***prior*** to implementation of major fish passage improvements (discussed in a later section of these comments). Furthermore, those earlier studies found that the highest recorded fish passage delays and blockage at RBDD occurred during the winter or early spring months when high river flow conditions were known to delay fish migration. The DEIS/EIR is deceiving in this regard because it suggests that this situation is reflective of the current mode of RBDD operations when river flows are naturally much lower and fish passage is much more efficient. The DEIS/EIR is written such that an uninformed reader could not distinguish this highly relevant fact and be misled. The earlier studies determined that the adult salmon delay problems with high flow at RBDD were attributable to insufficiently sized and configured fish ladders on the dam (more details in a later section of these comments); these circumstances are of high importance to this DEIS/EIR.

Additionally, the DEIS/EIR ignored other relevant peer-reviewed reports on earlier studies performed in conditions similar to current RBDD operations. These reports found fish passage problems that were not nearly as severe as portrayed in the DEIS/EIR. For example, Hallock et al. (1982) found that radio-tagged fall-run salmon passing RBDD were delayed only 3.5 days downstream of the dam. Additionally, Vogel et al. (1988) found that fall-run salmon were delayed only 3.75 days below the dam.

The DEIS/EIR used raw data obtained from the USFWS on a radio-tagging study performed in 1999-2001 that presumably shows extremely severe delays of fall-run chinook downstream of RBDD when the gates are in.[2] Those data have not been published nor has the USFWS endorsed the DEIS/EIR's interpretation of those raw data (Tom Kisanuki and Kurt Brown, USFWS, personal communication). I obtained those data sets and concluded that the DEIS/EIR's use of the data may signify one or more circumstances:

1) the DEIS/EIR could have correctly analyzed the data which means that something has severely negatively impacted adult fish passage at RBDD since the period when the dam gates were in 12 months of the year;
2) the DEIS/EIR incorrectly analyzed the USFWS data;
3) the data cannot be appropriately analyzed using solely the data sets provided (e.g., data interpretation would require more extensive understanding of the study design, etc.);
4) something is wrong with the experimental design or methods used to develop the data; or
5) combinations of the above.

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that the mean time of delay in passage of adult chinook salmon at RBDD was greater than 3 to greater than 13 days, depending on the run." DEIS/EIR Pages B-5 and B-6

[2] Radio telemetry investigations conducted from 1999 to 2001, using adult fall-run Chinook salmon, indicate that delay in passage, under existing conditions at RBDD, may average approximately 21 days (USFWS, unpublished data)." DEIS/EIR Pages B-5 and B-6

If the data truly indicates that fish passage is as severe as portrayed in the DEIS/EIR (option 1), it would be very easy to rectify those problems based on experience acquired when the dam gates were in year-round and passage delays were measured as only about an average of 3.5 to 3.75 days in two separate extensive research projects. I concluded that option 3 is the more likely scenario.[3] Until that scenario is pursued, the other options cannot be determined.

However, it is useful to compare the DEIS/EIR interpretation of adult salmon delay below RBDD with other studies to place the issue in context. Table 1 shows the DEIS/EIR implication that fish passage at RBDD is now much more severe under the current mode of dam operations than it was during the 1970s to mid-1980s. The DEIS/EIR also suggests that adult salmon delay at RBDD is much more severe than recorded at the Columbia River dams (Figure 1, Table 1)

Figure 1. The RBDD DEIS/EIR suggests that adult passage at RBDD under current dam operations is more severe than fish passage at Columbia River dams shown above.

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[3] For example, I cannot determine if the DEIS/EIR accounted for the known delay caused by temporary fish trauma associated with fish capture, tagging, transport, and release. For example, in their radio tagging study at RBDD, Hallock et al. (1982) found that for adult salmon captured, tagged, and released approximately 2.5 miles downstream of the dam, only 59% approached the dam, a phenomenon attributed to tagging. Further substantiation of this artifact of tagging is notable from their study in the finding that, for those salmon released 2.5 miles downstream of the dam, it took an average of 5.3 days for the fish to migrate from the release site to the dam, uncharacteristically much slower migration rate than expected for non-tagged fish.

Table 1. Delay in hours of tagged adult chinook salmon below Columbia and Snake River Dams (after Haynes and Grey 1980) and Red Bluff Diversion Dam [adapted from Vogel and Smith (1984)].

Dam	Study Year(s)	Citation	Tag Type[1/]	Number of Fish	Time [2/] (Hours/Fish) Average Delay
Bonneville	1948	Schoning and Johnson (1956)	NT	35	67
Bonneville	1972	Monan and Liscom (1973)	R	20	141
Bonneville	1973	Monan and Liscom (1974)	R	52	96[3/]
Bonneville	1974	Monan and Liscom (1975)	R	42	54
The Dalles	1972	Monan and Liscom (1973)	R	30	33
Rock Island	1954-56	French and Wahle (1965)	NT	2,217	72
Lower Monumental	1973	Monan and Liscom (1974)	R	20	62
Lower Monumental	1975	Gray and Haynes (1976)	R	20	18
Little Goose	1975	Gray and Haynes (1976)	R	10	139
Little Goose	1976	Haynes and Grey (1980)	R, NT	45	216
Little Goose	1977	Haynes and Grey (1980)	R, NT	48	90
Lower Granite	1975	Liscom and Monan (1976)	R	30	78
Lower Granite	1976	Haynes and Grey (1980)	R	3	50
Lower Granite	1977	Haynes and Grey (1980)	R	18	58
RBDD	1979-1981	Hallock et al. (1982) fall-run chinook salmon	R	17	84
RBDD	1983-1988	Vogel et al. (1988) fall-run chinook salmon	R	60	90
RBDD	**2002**	**RBDD DEIS/EIR fall-run chinook salmon**	**R**	**?**	**504**

[1/] R = radio transmitter, NT = nontelemetering fish tag.

[2/] Values averaged over all fish used in a study.
[3/] Time from release 6.4 km downstream to dam passage.

Failure to Account for the Upstream Fish Passage Improvements

The following is a description of significant actions or features implemented that improved upstream fish passage at RBDD. However, the DEIS/EIR is implying that, for reasons unexplained, fish passage is now more severe than ever before.

Raising the RBDD Gates on a Seasonal Basis

The most significant improvement in upstream fish passage occurred as a result of a 10-Point Action Program for Winter-Run Chinook developed by this author and John Hayes of CDFG in June 1986. The first point was raising the RBDD gates from December 1 to April 1 annually "to allow more than two-thirds of the annual winter run to spawn in the upper reaches of the Sacramento River without delay or blockage at RBDD" (Vogel and Hayes 1986). In 1993, as a result of a revised National Marine Fisheries Service (NMFS) Biological Opinion, the RBDD gates were raised 8 months of the year (i.e., September 15 – May 15). The USFWS reported that "*the practice of raising the gates for extended periods of time during the fall, winter and spring months was found to have many beneficial effects, and continues today* [Tucker et al. (1998)]. Although the DEIS/EIR mentions this measure, its analytical technique inadequately accounts for the fish passage benefits (discussed in a later section).

Improved RBDD Fish Ladder Maintenance

The diffuser grates and diffuser cleaner pump intakes leading into the fish ladders at RBDD (critically important for attraction of fish into the ladders) were commonly found to be plugged with debris requiring manual cleaning by SCUBA divers (Vogel 1985a, 1985b, 1987b,1987c, 1988a). Much of the prior fish passage research at RBDD (e.g., Hallock et al. 1982) measured fish passage at RBDD when fish ladder maintenance was less than optimal. During the 1980s, the USFWS and the U.S. Bureau of Reclamation (USBR) incrementally and methodically improved fish ladder maintenance, a measure believed to enhance fish passage at the dam. In 1989, the USFWS reported:

> "*Because of inadequate trash racks, the grates between the lower section of the fish ladders and the supplemental water diffuser bay often become clogged with debris. This not only reduces the amount of fish attraction flows exiting the ladder mouth but also periodically causes the grates to blow out under the increased water pressure. The ladders then have to be shut down for a minimum of five days and sometimes up to three weeks until repairs can be completed. Repair of the blown-out grates usually costs several thousand dollars but more importantly, adult fish passage is severely compromised*." Vogel (1989)

In 1989, the USFWS initiated a monthly preventative maintenance schedule using commercial divers to inspect and clean debris from the fish ladder diffuser grates (Vogel 1989).

__Eliminating Adult Salmon Delay and Mortality at the Louver Bypass Terminal Box__

During the early 1980s, USFWS SCUBA divers discovered a major problem that caused physical injury, mortality, and delay of adult salmon downstream of RBDD. Adult fish were attracted into the high velocity structure of the old fish louver bypass system (Figure 2) where they rammed their heads into the 4-inch spaced grates, gilling the larger fish (Figure 3) and entrapping the smaller fish swimming inside the structure (called the bypass terminal box) (Figure 4). Smaller-sized adult live fish observed inside the structure had severe abrasions on their sides, obviously a result of wiggling through the steel grates. At my request, the USBR cut out alternate grates, making effective 8-inch openings which eliminated physical injury and allowed escape routes for salmon after entering the structure (Figure 5). Alternating grates on the fish louver bypass outfall structure were removed in 1985 (verified by Vogel 1985d).

Although adult salmon were commonly attracted to the old fish louver bypass outfall structure (Vogel 1987a), subsequent underwater observations demonstrated the fish did not delay for extended periods or suffer injury after modification of the grates and determined that the corrective measure was beneficial (Vogel 1983a, 1983b, Vogel 1983c, 1991a). Although some delay of fish inside the modified structure was noted, it was believed that it was not nearly as severe as it was prior to the modification. The biological significance of this circumstance is that physical injury, mortality, and delay to adult salmon had been occurring year-round for over 20 years since dam construction without anyone's knowledge (Vogel 1991a).

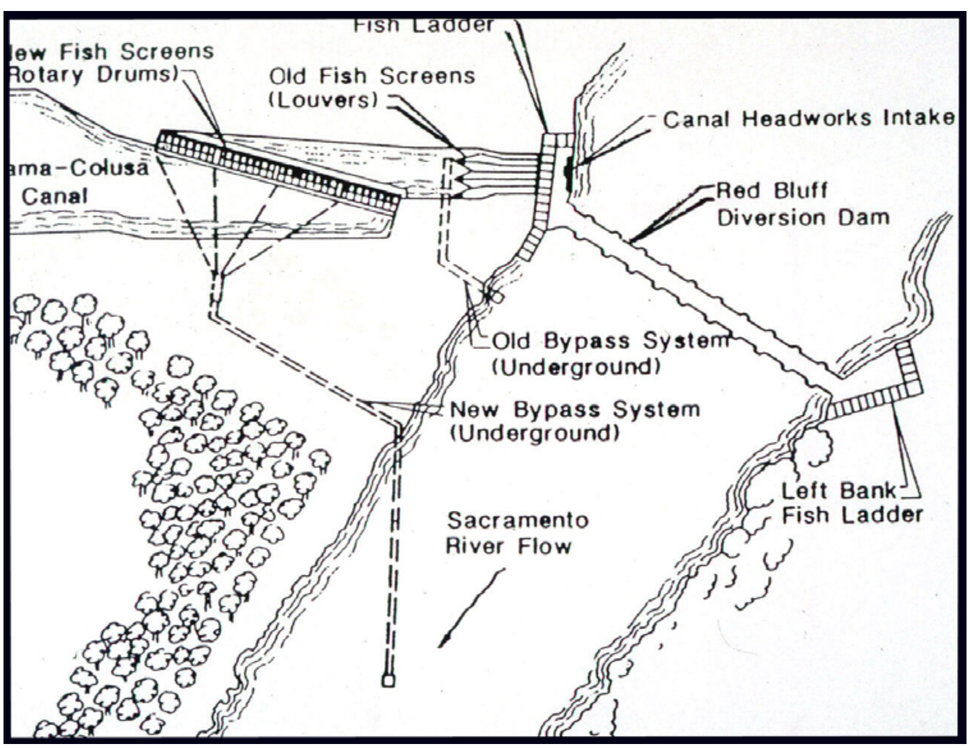

Figure 2. Plan view of RBDD showing the locations of the old fish louvers and bypass system and the new, angled rotary drum screens and bypass system (from Vogel et al. 1990).

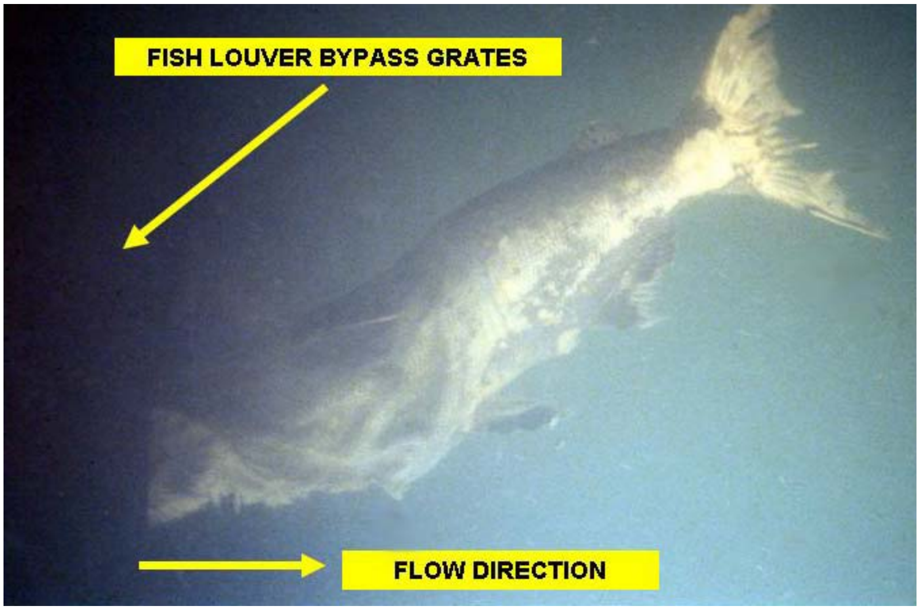

Figure 3. Underwater photograph taken by the author showing a dead salmon gilled inside the grates on the old fish louver bypass terminal box.

Figure 4. Underwater photograph taken by the author of a chinook salmon trapped inside the bypass terminal box prior to modification of the structure.

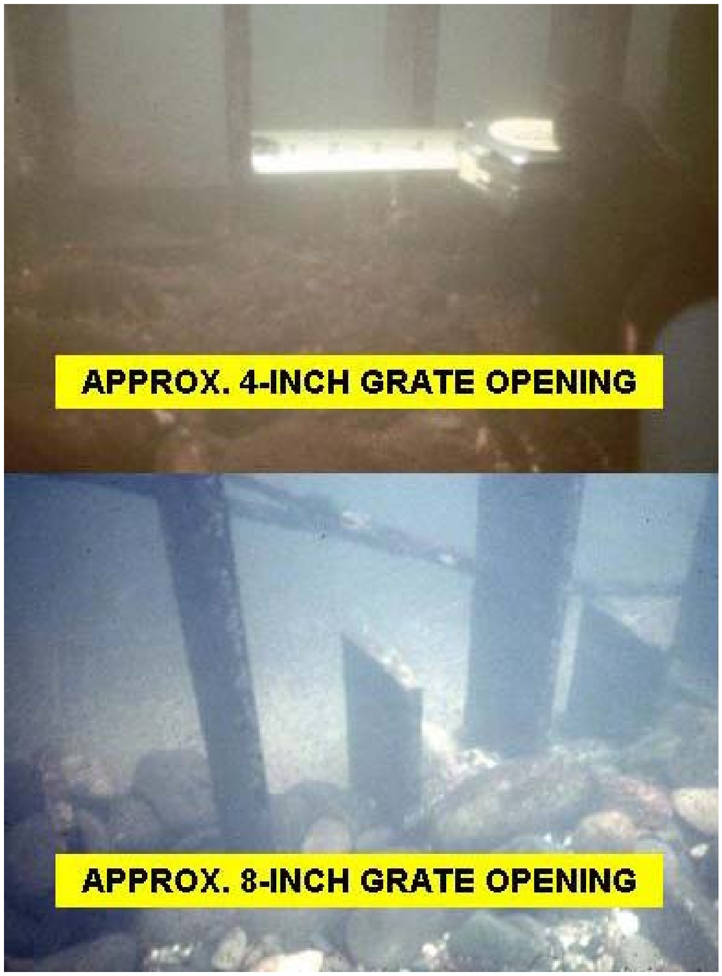

Figure 5. Underwater photographs taken by the author before and after modification to the RBDD fish louver bypass terminal box.

Installation of the Training Wall at the Right-Bank Fish Ladder

On January 29, 1984 USFWS SCUBA divers noted a large, pronounced back eddy at the fish entrance to the right bank (southwest) fish ladder at RBDD (Vogel 1984). The large eddy was believed to adversely impact adult fish attraction into the ladder. [4] Based on my recommendation, this was eliminated to improve physical configuration to the ladder with the USBR's installation of a sheet pile training wall adjacent to the ladder entrance (est. 1985 by Vogel 1985d). As an added benefit, the retaining wall also eliminated predatory fish holding habitat (Vogel and Smith 1984).

[4] "The presence of tailwater eddies near the fishway entrance can significantly increase delay. Eddies may cause fish to become confused and disoriented. A downstream retaining wall configuration has effectively damped eddies near the fishway while providing a guide wall for fish to move along the shoreline and directly into the entrance." Rainey (1991)

Relocation of the Fish Screen Bypass Outfall

As previously described, close proximity of the old fish screen bypass outfall just downstream of the dam attracted adult fish (delay and physical injury). Although removing the grates eliminated the physical injury problem, concern remained that the structure still caused some undesirable delay. A feature of the new fish screens installed in 1990 was the design and relocation of the outfall further downstream of the dam to solve the problem (Figure 2). Additionally, the new structure was designed with no grates to avoid the previously observed fish mortalities.

Miscalculation of Predicted Fish Passage Timing Due to Historical Migration Delays

The DEIS/EIR provides highly misleading information on the timing of salmon past RBDD and compounds errors associated with that information by using it in the DEIS/EIR's analysis.[5] When the RBDD gates are out, the DEIS/EIR admits there is difficulty in precisely characterizing the true run timing for spring-run chinook salmon.[6] Nevertheless, it proceeds with an analysis of run timing known to be incorrect.

The salmon run timing used is based on observations of salmon inside the fish ladders. Using the assumption in the DEIS/EIR that fish are delayed below the dam before the fish gets into the ladder, the "true" run timing of the fish passing Red Bluff would have been earlier. However, the DEIS/EIR does not account for that delay in its analysis. In other words, both instances cannot be correct. One cannot assume that by the time a salmon has entered the fish ladders at RBDD the fish was delayed "X" number of days downstream of the dam ***and then use the same run timing determined from fish ladder counts*** that the fish was not delayed "X" days below the dam. If the run timing is based on historical fish counts in the fish ladders when the RBDD gates are in (as the DEIS/EIR has assumed)[7], and the dam delays fish before entering the ladders (as the DEIS/EIR has assumed), then one has to conclude that the fish would have passed the dam earlier if the gates had been out of the water (as the DEIS/EIR ***has not*** assumed).

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[5] The passage timing for adult salmonids was obtained from data collected from fish ladder counts conducted at RBDD from 1982 to 1986 for fall, late-fall, and winter chinook salmon and steelhead (USFWS/CDFG, unpublished data). For spring chinook salmon, some of which may pass RBDD prior to installation of the RBDD dam gates, the current (1995 through 2000) ladder counts were used to estimate passage timing (USFWS/CDFG, unpublished data). For ladder counts made during 1995 and 2000, the average monthly percent (44) of spring Chinook passing RBDD during May were distributed equally between the before gates-in (<May 15) and after gates-in (>May 15) periods." DEIS/EIR Page B-5 and B-6

[6] "Currently, it is difficult to precisely characterize the temporal distribution of spring-run chinook salmon as they pass RBDD. This is because prior to mid-May the gates-out operations at RBDD preclude the use of the fish ladders and therefore the enumeration of adults as they pass RBDD. However, once the RBDD gates go in during in May, spring run chinook are identified as they pass." DEIR/EIS Page B-7

[7] "Approximately 72 percent of the annual adult spring chinook spawners passing through the project area must do so during the current gates-in operation (Figure B-7). The approximate average percentages of the annual population passing RBDD are listed by month as follows: Late May -- 22 percent, June -- 38 percent, July -- 9 percent, August -- 2 percent" (DEIS/EIR Page B-6)

I performed an analysis of run timing about a decade ago. Using the winter-run chinook salmon as an example, I determined that the "true" or natural run timing of winter-run chinook past Red Bluff is actually earlier than had been previously surmised (Figures 6 and 7). This phenomenon was attributable to the high flow conditions at RBDD and poor fish ladder attraction during the period winter-run salmon attempted to migrate past the dam. Examining years of low flow past the dam demonstrated that winter run migrated sooner than high flow years. These results were also corroborated by the radio-tagging studies previously described. The DEIS/EIR is defective in not accounting for this in the analysis.

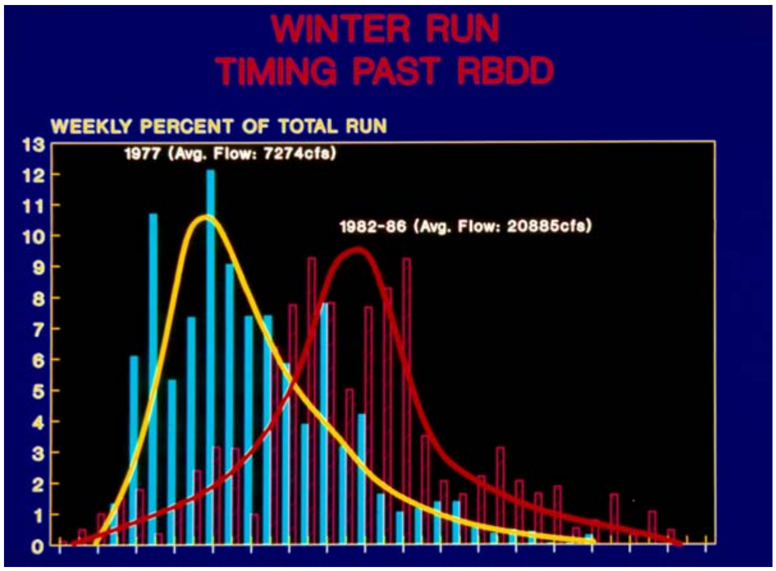

Figure 6. The timing of winter-run chinook past RBDD by week showing earlier run timing when delay and river flow is less. (from Vogel 1991b)

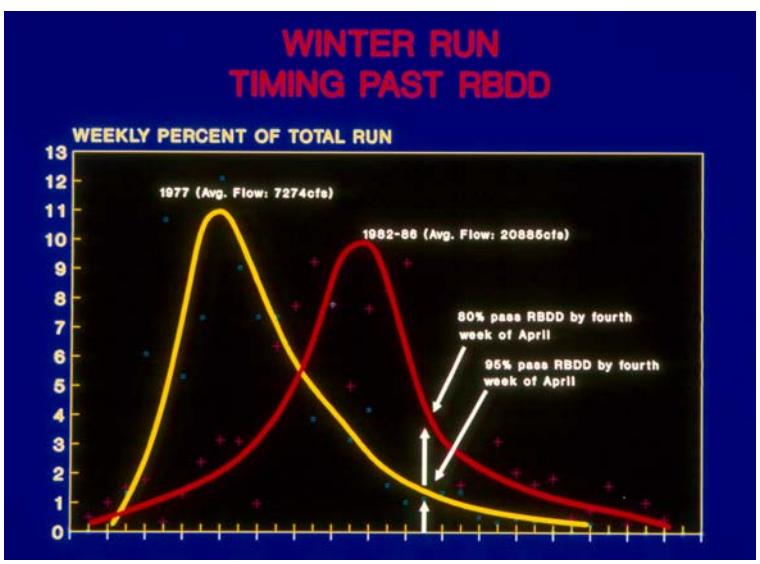

Figure 7. The timing of winter-run chinook past RBDD by week showing earlier run timing when delay and river flow is less. (from Vogel 1991b)

The DEIS/EIR erroneously concluded that RBDD effects are the same for all runs and all species evaluated, a statement well known to be incorrect. The DEIS/EIR contradicts itself by stating that fish passage effects at RBDD varies by salmon run[8], but then uses an analysis that assumes fish passage effects at RBDD are equal, not only among salmon runs, but also among fish species.[9,10]

Incorrect Assumptions on Flow Attraction and New Fish Ladders

Fish Attraction

The DEIS/EIR erroneously assumed that fish passage at RBDD is not flow related.[11] This is a major error and results in a fatal flaw to the document's analyses. Interestingly, the DEIS/EIR contradicts itself by assuming that fish passage is flow dependent[12] and concluding that run timing is not affected by flow. The all-important analysis portion of the document does not account for this flow dependency factor. [13]

As a result of the Hallock et al. (1982) RBDD adult salmon radio-tagging study, researchers found that delay of salmon downstream of the dam was a function of flow (the greater the flow, the longer the delay) (Hallock and Fisher 1985) and the correlation was statistically significant (Figure 8). Additionally, Hallock et al. (1982) found that adult salmon delay was a function of the number of gates partially opened on the dam. Furthermore, researchers found a strong relationship between the flow through, and adjacent to, the fish ladders and the delay of adult salmon downstream of the dam (Figure 9). All of these facts invalidate much of the subsequent analyses in the DEIS/EIR which are essential to the document's findings and conclusions.

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[8] "Vogel et al., (1988) determined from salmon tagging studies conducted from 1983 through 1988 that between 8 percent and 44 percent of adult chinook salmon, depending on run, were blocked from passing upstream of RBDD. Similarly, Hallock et al., (1982) determined that passage of 15 percent to 43 percent of adult chinook salmon, depending on run, were blocked by RBDD". . . . . . "Vogel et al., (1988) determined that the mean time of delay in passage of adult chinook salmon at RBDD was greater than 3 to greater than 13 days, depending on the run." DEIS/EIR Page B-5 and B-6

[9] Due to a limited set of actual field data, the delay values for any structural facility other than existing fish ladders that were used in the analysis were assumed to be the same among all of the species. DEIS/EIR Page B1-3

[10] "As with delay days in Table 2, values for delay-related passage efficiencies are the same among all of the species, due to the scarcity of available field data." DEIS/EIR Page B1-5

[11] "As there are no empirical data to develop a curve of passage delay versus time (efficiency), a linear relationship was assumed." DEIS/EIR Page B1-5

[12] "Factors that may affect the timing adult passage include water-year type, river flows, weather events, and RBDD operations." DEIS/EIR Page B-4

[13] "It is important to note that these delays are not flow-based (flow-weighted) (i.e., varying time of delay depending on the proportion of the ladder flow to river flow during any month). Flow-weighted delay relationship data was omitted for two reasons: 1) flow specific delay data are not available: and 2) the use of flow-weighted delay values without supporting empirical data increases the complexity of the (End of DEIS/EIR Page B1-13) analysis methodology without a concomitant increase in precision.

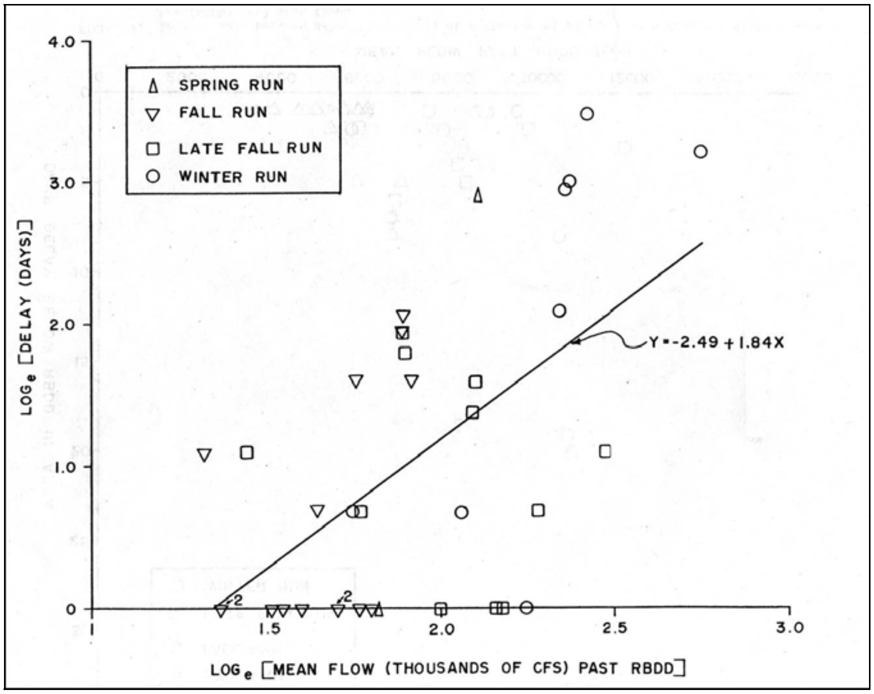

Figure 8. Relationship between mean delay (in Area 1) of radio-tagged salmon that passed RBDD and mean flow (all data transformed to natural logarithms) (from Hallock et al. 1982)

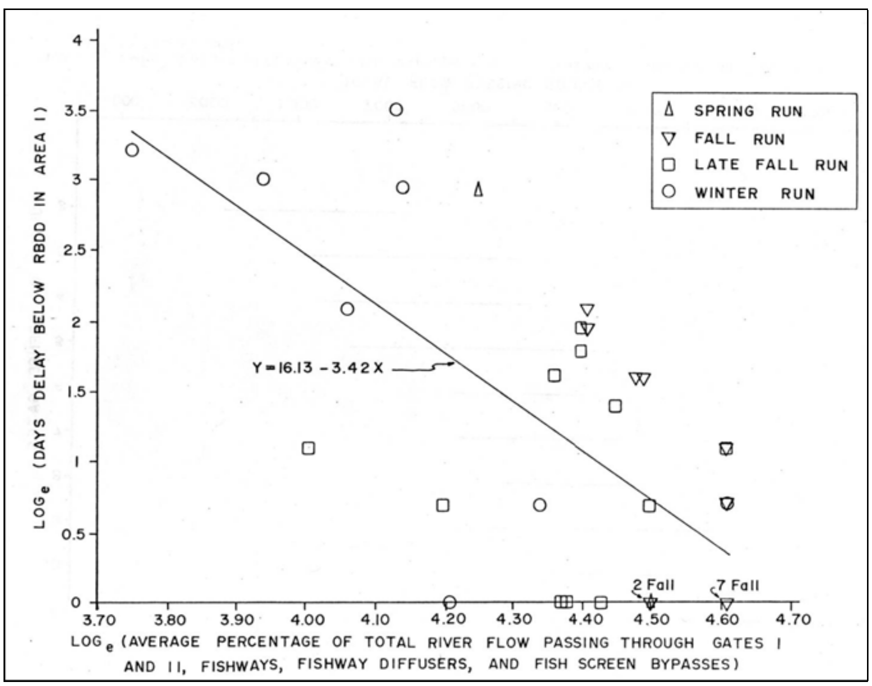

Figure 9. Relationship between delay (in Area 1) of radio-tagged salmon that passed RBDD, and mean proportion of the total river flow passing through or near the fishways (all data transformed to natural logarithms) (from Hallock et al. 1982).

I analyzed the Hallock et al. (1982) data and found that there was a strong, exponential relationship between the proportion of the flow through the RBDD fish ladders and delay of salmon below the dam. Those results are shown in Figure 10. Additionally, Vogel (1982) noted a strong relationship between attraction flow provided from Coyote Creek (10 miles downstream of RBDD) and adult salmon attraction into the creek (Figure 11). The DEIS/EIR again failed to include this research.

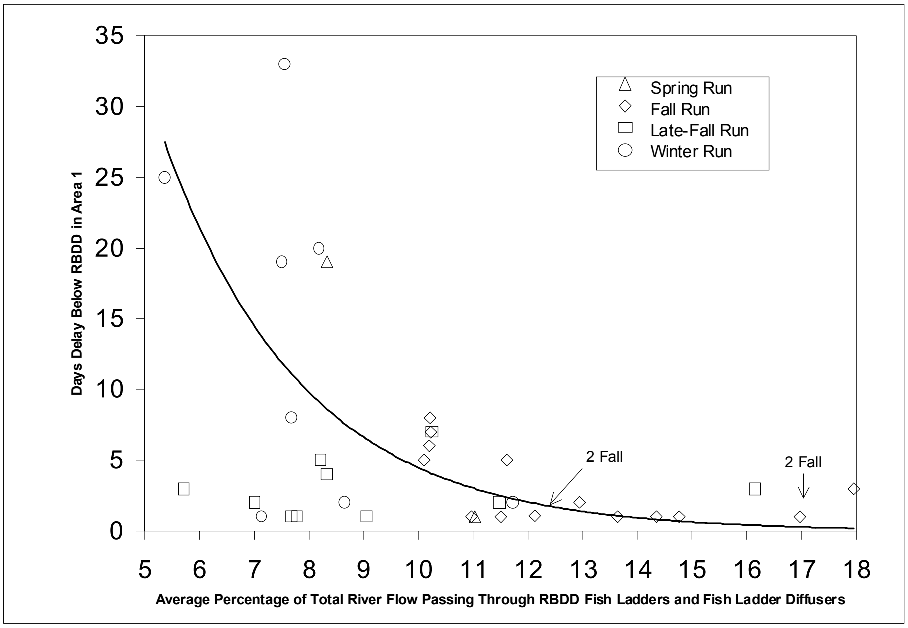

Figure 10. Relationship between delay of radio-tagged salmon that passed RBDD and mean proportion of the total river flow passing through the fishways [data derived from Hallock et al. (1982)].

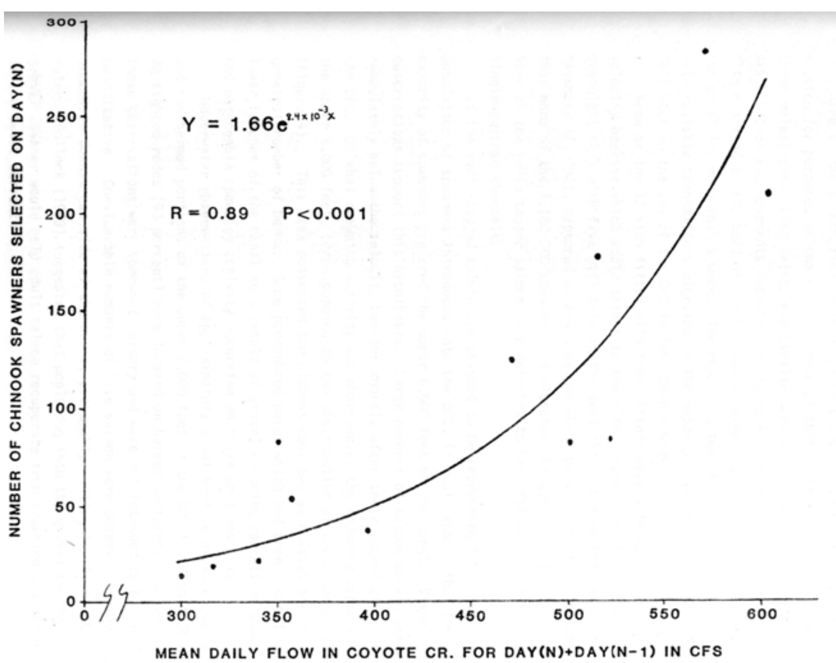

Figure 11. Relationship between attraction flow provided in Coyote Creek and numbers of chinook salmon entering the Tehama-Colusa spawning channels [from Vogel (1982)].

New Fish Ladders

Based on the foregoing information and extensive research by USFWS and CDFG, Vogel et al. (1990) stated: "*Increased flow through new fishways was recommended to reduce delay and blockage of upstream migrants*." Recommendations by USFWS to improve upstream fish passage included: "*constructing a new large-scale fish ladder on the left (northeast) bank, enlarging the size and flow capacity of the existing ladders, raising the dam gates during the non-irrigation season, and establishing a permanent program to ensure proper operation and maintenance of all fish passage facilities.*" (USFWS 1988). At that time, there was momentum toward construction of a new large left bank fish ladder that prompted Brown (1991) to report: "*It appears that a new fishway will be constructed on the east side of the dam*." Of all the features at RBDD that were identified and recommended for improvement, the one item that has languished for decades is the need for new and improved fish ladders. Problems with the existing facilities have been known for about 3 decades and no significant improvements have taken place. It is unknown why this action was not pursued further.

One of the more surprising aspects of the DEIS/EIR is the lack of relevant and important information concerning the design features and improvement in upstream fish passage facilities. The DEIS/EIR concludes that very little benefit would be derived from new and improved fish passage facilities at RBDD. The best available technical information on the topic demonstrates otherwise. The following discussion in "Fish Passage Technologies: Protection at Hydropower Facilities" (1995) is enlightening:

> *"Vertical slot fishways have had considerable application across the country with wide success. These fishways seem to work well for a variety of species. In the Pacific Northwest, vertical slot fishways were constructed at 21 tributary sites in the 1980s. Radio telemetry studies showed that fish moved past these facilities in less than a day."*

This reference provides a wealth of valuable information that not only describes the "how and why" fish ladders such as the existing RBDD ladders fail to work properly, but also how modern-day fish ladders should be designed (e.g., attraction flows, entrance configurations, etc.).

Additionally, expertise on fish ladder design standards is demonstrated in "Fishways: An Assessment of Their Development and Design" by Powers et al. (1985) for the Bonneville Power Administration, Rainey (1991), Clay (1995), Bell (1991), and numerous other documents. These documents provide very useful design criteria applicable to greatly improved RBDD fish ladders but are too lengthy to print here.

The DEIS/EIR ignores, without reference, the vast amount of experience and benefits derived from large fish ladders elsewhere and failed to include or discuss this highly relevant information.

Misleading Information on Spring-Run Chinook Salmon

The DEIS/EIR provides misleading information on the populations of spring run chinook upstream of RBDD.[14] The document adds to the misrepresentation by suggesting that the majority of Sacramento River basin spring-run exist upstream of RBDD[15] and implies that RBDD affects the entire population. The following statement in the DEIS/EIR describing the methodology for analyzing alternative effects on fish demonstrates this error:

> "*The index values represent the approximate portion of the species and life stage that is unaffected by operations of the RBDD facilities for the entire calendar year. For example, an adult passage index of 89 indicates that approximately 89 percent* ***of the entire annual population*** *would pass RBDD and Lake Red Bluff without blockage, delay, or some loss or injury because of the operation of RBDD*." DEIS/EIR Page 3-33 (emphasis added)

Conversely, the USFWS has stated:

> "*Presently, viable populations exist only in 2 tributaries of the Sacramento River, Mill and Deer creeks*." USFWS (1992) (Mill and Deer creeks are located downstream of RBDD.)

Since 1992, the populations of spring-run chinook have increased significantly in Butte Creek (also located downstream of RBDD).

Furthermore, on the topic of mainstem spring-run chinook, the USFWS and CDFG stated:

> *"There is some doubt, however, that the present-day spring run spawning in the mainstem upper Sacramento River is a true genetically distinct stock because of a significant overlap in the timing of their spawning period with fall-run chinook which may have resulted in significant transfer of genetic material between stocks (Slater 1963)." … "The two main remaining areas where significant numbers of genetically pure*

[14] "Spawning escapement of Central Valley spring-run chinook salmon has also varied since 1970 (Table B-2). The annual spring-run Chinook salmon escapement upstream of RBDD in the last 30 years has averaged less than 7,000 spawners and has ranged from greater than 25,000 in 1975 to less than 200 adults in 1998. Since 1990, spring-run chinook salmon spawning escapement upstream of RBDD has not exceeded 1,000 adults (Figure B-5)." DEIS/EIR Page B-3

[15] "Impedance of these adult spring chinook by RBDD operations may adversely affect their ability to successfully pass upstream into and through the Sacramento River and into tributary streams and headwater reaches (CDFG, 1998). It is in these headwater reaches in the tributaries and the most upstream portion of the mainstem Sacramento River that the majority of spring-run chinook salmon must hold throughout the summer months before spawning in the early fall." DEIS/EIR Page B-6

strains of spring-run chinook exist are in Mill and Deer Creeks." (Vogel and Rectenwald 1987).

Another example (among many) of how the DEIS/EIR distorts the available information is provided in the following:

> "*There is a measurable improvement for adult spring-run chinook salmon (16 percent). While the percent improvement in the passage index for adult spring-run chinook salmon seems relatively large (16 percent), the overall annual passage index for this species remains a rather low 61 out of a possible 100 (Table B-7).*
>
> *These small improvements in adult passage are a result of increased efficiencies in attraction to and passage within the new fish ladders featured in this alternative. Except for spring-run chinook, the magnitude of these improvements however, is generally not sufficiently beneficial to be considered a measurable improvement for adult passage of NAS species. Rather large components (approximately 39 percent) of threatened adult spring-run salmon would continue to be blocked or impeded under this alternative."* DEIS/EIR Page B-32

These statements and many others[16] are extremely misleading.

The DEIS/EIR implies that its analysis evaluates the entire spring run population, instead of the very small component of the Sacramento River spring run that may intermittently use a tributary, such as Cottonwood Creek upstream of Red Bluff. To simply determine the proportion of spring-run chinook upstream and downstream of RBDD, I obtained the annual spring-run chinook population estimates from CDFG. I used data collected since 1989 and included those Sacramento River tributaries from Butte Creek and upstream. The average annual proportional distribution of spring-run chinook is shown in Figure 12. These data clearly indicate that only a very small amount (about 3 percent) of the spring run population migrate up past Red Bluff. If one includes Feather River spring-run chinook, the percent upstream of Red Bluff would be much less than 3 percent. Of that small percent, an even smaller percent migrate past RBDD after May 15. In other words, the DEIS/EIR is assessing the fish passage of a "percent of a percent" of spring run, and not the "entire population" as stated in the DEIS/EIR.

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[16] E.g.: "The small improvement in passage index for adult rainbow trout for this alternative is a result of slight increases in efficiencies of attraction and passage in the new right bank fish ladder. There may also be some small but uncertain increase in passage through the bypass channel featured in this alternative. However, the magnitude of these improvements is generally not sufficient to be considered a measurable improvement for adult passage of rainbow trout. A rather large component (24 percent) of adult rainbow trout remains blocked or impeded by the gates at RBDD under this alternative (Figure B-20)." DEIS/EIR Page B-37

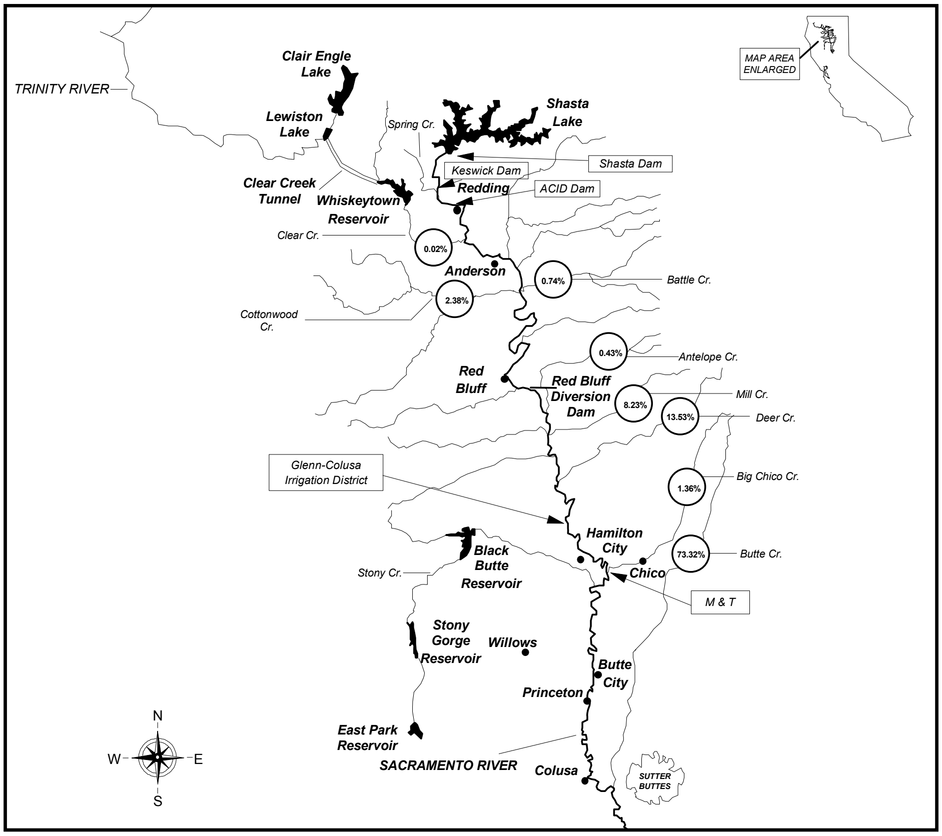

Figure 12. The upper Sacramento River basin showing the distribution of spring-run chinook salmon, 1989-2001.

Misleading Information on Green Sturgeon

Although the DEIS/EIR admits there is no evidence of a declining trend in Sacramento River green sturgeon populations, it nevertheless provides statements suggesting the green sturgeon are imperiled. To the contrary, available information indicates that green sturgeon populations are ***larger*** than suggested in the DEIS/EIR.[17] For example, CDFG recently reported:

> "*Green sturgeon abundance estimates have varied substantially in the Sacramento-San Joaquin Estuary (Table 10). Aside from the high estimated abundance in 2001 of 3,580 fish (based on September and October catches only, to be comparable with estimates in earlier years), the largest estimate was 1,906 in 1979 and the lowest was 198 in 1954. Even without the low estimate in 1954 and the high estimate in 2001, there*

[17] "…green sturgeon populations (fish greater than 101 cm) in the San Francisco Bay estuary are approximately 200 to 1,800 fish (Moyle et al., 1995)."

is no trend in these data ($F_{1,10} = 1.49$, $p > 0.25$), so they provide no evidence for a green sturgeon population decline in the Sacramento-San Joaquin Estuary." CDFG (2002)

CDFG specifically responded to the proposed sturgeon petition to list the species as threatened by stating that there are no data to indicate a decline in green sturgeon populations over the past 30 to 50 years (CDFG 2002). Moreover, CDFG believes green sturgeon populations are sufficiently abundant to allow angler harvest. The agency's regulations currently allow sport harvest permitting year-round take of one fish per day between 117 cm and 183 cm (3.8 feet to 6 feet long) total length and is not contemplating any changes in angling regulations at this time (CDFG 2002).

The DEIS/EIR incorrectly suggests that habitats for sturgeon upstream of RBDD are preferable to downstream habitats. In one instance, the DEIS/EIR implies that green sturgeon need colder and cleaner water upstream of RBDD[18] but fails to acknowledge that all the habitat attributes necessary for sturgeon spawning and rearing exist in abundant quantities downstream of RBDD. The reasoning is noticeably lacking.

The presence of green sturgeon at Red Bluff is apparently a relatively new phenomenon. For example, the USFWS reported:

> "*In recent years green sturgeon <u>Acipenser</u> <u>medirostris</u> adults have been observed below RBDD during electrofishing operations for adult salmon. Prior to this, the range of the green sturgeon had not been recorded farther upstream than the Delta*." USFWS 1992

Although some green sturgeon are now known to migrate upstream of RBDD prior to dam gate closure in the spring (May 15), the available information indicates that the number of fish that do so is very small when compared to the total population in the Sacramento River. Nevertheless, the DEIS/EIR implies that there is some sort of biological requirement for sturgeon to do so (again, for reasons not articulated in the document) and that the entire green sturgeon population must attain access to the mainstem upstream of RBDD. The reality is that there is no empirical evidence to prove it is biologically necessary for the species to do so. Furthermore, it is evident that the DEIS/EIR's analysis of the various alternative effects on sturgeon is just a small portion of the population.[19]

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[18] "Green sturgeon are thought to require colder and cleaner water than do white sturgeon (Moyle et al., 1995)." DEIS/EIR Page B-14

[19] This major error and misleading analytical approach are exemplified by the following statement in the DEIS/EIR: "These tables provide the summary of the passage index scores (scaled to 100 as a maximum value). The index values represent the approximate portion of the species and lifestage that is unaffected by operations of the RBDD facilities for the entire calendar year. For example, an adult passage index of 89 means that approximately 89 percent of the entire annual population would pass RBDD and Lake Red Bluff without blockage, delay or some loss or injury." DEIS/EIR Page B-26

The DEIS/EIR is actually assessing the effects of a percent of a percent of the sturgeon at RBDD (as similarly discussed re. spring-run chinook) which provides misleading results in the analyses. For example, assume the number of migrating green sturgeon reaching Red Bluff is small (e.g., one or two dozen) compared to the total population (hundreds to thousands). Of that small number, the majority reach and pass Red Bluff unimpeded prior to May 15 when the gates are lowered (e.g., two-thirds, using the estimates provided in the DEIS/EIR). Of the small proportion reaching Red Bluff after May 15 (a third of one or two dozen, or 4 or 8 fish), those fish can spawn and rear successfully downstream of RBDD. The spawning habitat available downstream of the dam is more than adequate for the small number of fish. The DEIS/EIR does not reconcile its misleading rationale. Furthermore, the DEIS/EIR used green sturgeon as a one of the primary fish species to focus on in the document[20] and, therefore, misleads uninformed reviewers of the document and artificially skews the analyses to invalid conclusions of project alternative effects on fish.

Interestingly, the CDFG states that fish ladders can be designed to pass sturgeon because the north ladder on Bonneville Dam on the Columbia River passes sturgeon successfully (CDFG 2002). Although the numbers of sturgeon using that ladder are small (Steve Rainey, NMFS, personal communication) it warrants further examination in the DEIS/EIR.

Problems/Errors with the DEIS/EIR Assumptions on Downstream Fish Passage

Distortion of Juvenile Fish Mortality

Prior to 1987 when RBDD was operated with the gates in 12 months/year, CDFG and USFWS performed numerous research projects to ascertain potential problems associated with downstream migration of juvenile salmonids at the dam. Most of these experiments fell into the category of “mark/recapture” experiments. A known number of juvenile salmon were either tagged or marked and released at a variety of locations upstream of the dam (experimental groups of fish) and other groups of differently tagged or marked juvenile salmon were released at various locations downstream of the dam (control groups of fish). A small portion of each group of these tagged/marked fish was subsequently recaptured either as juveniles (during the same year of the experiments) or as adult fish several years after the experiments. The proportion of each group recaptured was then compared to the groups released upstream and downstream of the dam to ascertain potential proportional differences in recapture rate. If the recapture rate was less for the group released downstream of the dam as compared to the group released upstream of the dam, the difference was assumed to be attributable to all sources of fish mortality associated with dam passage (e.g., entrainment into the Tehama-Colusa and Corning Canals, physical injury, and predation in Lake Red Bluff or immediately

[20] “The principal NAO fish species occurring at RBDD are green and white sturgeons and Pacific and river lampreys. Of these, the Fishtastic! analyses focused on the green sturgeon, because this species is known to congregate downstream of RBDD during periods when the dam gates are in place (K. Brown, pers. comm.).” DEIS/EIR Page B-28

downstream of RBDD). After many experiments over many years, the primary source of mortality was principally attributed to predation by pikeminnow immediately downstream of the dam. The studies also found that large numbers (hundreds of thousands) of juvenile salmon were entrained into the two large irrigation canals annually.

Results of these studies are provided in Table 2.

Table 2. Juvenile salmonid fish experiments associated with RBDD.				
Researcher(s) Author(s)	Study Date	RBDD Gate Operations	Type of Experiment*	Estimated Fish Mortality Rate (%)
Hallock 1983	Early June 1975	In 12 months/year	Daytime, short-term mark/recapture, Lake Red Bluff	29
Hallock 1983	Early June 1975	In 12 months/year	Daytime, long-term mark/recapture, Lake Red Bluff	77
Hallock 1983	Late May 1976	In 12 months/year	Daytime, short-term mark/recapture, Gate 10	0
Hallock 1983	Late May 1976	In 12 months/year	Daytime, long-term mark/recapture, Gate 10	29
Hallock 1983	Early/Mid May 1977	In 12 months/year	Daytime, short-term mark/recapture, Lake Red Bluff	29
Hallock 1983	Early/Mid May 1977	In 12 months/year	Daytime, long-term mark/recapture, Lake Red Bluff	29
Hallock 1983	Early/Mid May 1977	In 12 months/year	Daytime, short-term mark/recapture, Gate 11	9
Hallock 1983	Early/Mid May 1977	In 12 months/year	Daytime, long-term mark/recapture, Gate 11	29
Hallock 1980	Late February 1973, 1974, 1975	In 12 months/year	Nighttime, long-term mark/recapture, Lake Red Bluff, steelhead	29
Hallock 1980	Late February 1973, 1974, 1975	In 12 months/year	Nighttime, long-term mark/recapture, Lake Red Bluff, steelhead**	26
Hallock and Fisher 1985	1973-1977 and 1979-1982	In 12 months/year	Various study purposes, composite analyses for fall-run chinook, late-fall run chinook, and steelhead**	35 salmon, 25 steelhead
Vogel et. al 1988	May 1984	In 12 months/year	Daytime, short-term mark/recapture	55
Vogel et al. 1988	April 1984	In 12 months/year	Nighttime, short-term mark/recapture	16
RBDD DEIS/EIR 2002	**No Study**	**In 4 months/year**	**None**	**55**

* CWT – Fish tagged with coded-wire tags for subsequent recapture during the adult life phase in the ocean sport and commercial fisheries and returns to the hatchery.
Mark/recapture – Fish marked with a distinctive, short-term mark to allow recognition when recaptured during the juvenile life phase.
** Comparisons between groups of fish released at Coleman Hatchery and groups of fish released downstream of RBDD; estimated mortality include the 40-mile reach between Coleman Hatchery and Lake Red Bluff

In comparing these past research results at RBDD to that used in the DEIS/EIR, several noteworthy observations can be made. The document incorrectly or inappropriately:

1) Used results from only one of the many experiments performed at RBDD;
2) Used one of the highest juvenile salmon mortality estimates;
3) Used a daytime mortality estimate that does not reflect when most juvenile salmon migrate past the dam;
4) Used data collected when the RBDD gates were in year-round; and
5) Used fish mortality estimates developed prior to the period after extensive fish passage improvements at RBDD had been implemented.

The following describes how the DEIS/EIR analyzed project alternative effects on downstream migrating juvenile fish:

> "*Because there are not sufficient data to provide species-specific dietary preferences for predators, the passages efficiency values are not species-specific. The efficiency value selected by the user (see Figure 9) for each facility is calculated as the reciprocal of predator presence, where predator presence is determined empirically using predator study data (Vogel et al, 1988). Based on that data, the maximum predator effect is a 55 percent reduction in juvenile passage efficiency, corresponding to a downstream dam passage efficiency value of 0.45*." DEIS/EIR Page B1-20

Translated, this means that the DEIS/EIR assumed that all juvenile fish species would suffer a 55% mortality rate when predators downstream of the dam were seasonally most abundant regardless of the ***actual number*** of predators and of all the major fish passage improvements. Vogel and Smith (1984) reported "spectacular feeding behavior of squawfish on juvenile salmon" following the May 14 daytime fish release that resulted in the 55% fish mortality rate used in the DEIS/EIR's analyses. This author recalls the episode of many thousands (est. >10,000) of pikeminnow actively feeding on the Coleman Hatchery test fish we released during the daytime, upstream of the dam.

The DEIS/EIR reports that there are no existing data on juvenile salmon mortality[21] (now that the RBDD gates are in only 4 months of the year, instead of 12 months) and, therefore, used the "highest mortality rate reported in the literature"[22,23]. The following hypothetical scenario illustrates an analogous approach to the DEIS/EIR's. In estimating

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[21] "The current extent of predation on juvenile salmonids passing RBDD is unknown." DEIS/EIR Page 3-15

[22] "The principal factors applied to assess potential predation at RBDD were based on a maximum literature value for predation for juvenile salmonids (Vogel et al., 1988) and the actual presence of predatory species at RBDD (Tucker, 1997). The estimated predation rate of 55 percent (Vogel et al., 1988) was weighted by predator presence as estimated by catch per unit effort (CPE) of Sacramento pikeminnow and striped bass at RBDD (Tucker, 1997)." DEIS/EIR page B1-7

[23] "To estimated monthly rates of predation, or a predation hazard index, the maximum predation rate (55 percent) estimated by Vogel et al. (1988) was scaled against the monthly weighted combined predator presence estimates." DEIS/EIR Page B1-9

present-day automobile mortalities only data collected decades ago before installation of modern-day safety features were used (e.g., seat belts, air bags, road improvements and numerous other less-visible safety features). Since no data were collected since the safety improvements, using the DEIS/EIR rationale, there would have been no reductions in automobile mortalities. Assume also, of the data collected decades ago, the study showing the ***highest*** automotive mortality rate was used (i.e., worst-case scenario) to extrapolate to the modern day estimates. Using the DEIS/EIR's logic in this example, the assumption is that automobile mortalities have not changed and remain as severe as the worst-case study simply because modern-day "data are lacking". Therefore, automobile safety features have provided ***no benefit***. Obviously, this logic is invalid and it is also invalid for that assumed in the DEIS/EIR.

Failure to Account for the Numerous RBDD Downstream Fish Passage Improvements

A major deficiency in the DEIR/EIR is the failure to account for the many RBDD improvements for downstream migrant fish. The DEIS/EIR is written and structured in a way that assumes no fish passage improvements have occurred at the dam. This erroneous circumstance is, in part, attributable to the DEIS/EIR using information on downstream migrant salmon mortality collected at RBDD ***prior to*** the numerous improvements being implemented. For the document to have any meaningful comparisons among project alternatives, data derived from RBDD prior to major measures that have significantly reduced fish mortality cannot be used. Table 3 provides a listing of many measures that have been implemented since the previously described fish studies were conducted.

Table 3. Improvements for downstream fish passage at RBDD and percentage of results noted in the DEIS/EIR.			
Fish Protection Measure	Effective Date	Actual Fish Passage Improvement	Portion of Benefits Described or Assumed in the RBDD DEIS/EIR
RBDD lights off at night	1983	Significant reduction in predation when RBDD gates in	0 %
Improved louver maintenance	mid 1980s	Major reduction of entrainment when RBDD gates in	0 %
Unclogging fish bypass pipe	1985	Major elimination of physical injury when RBDD gates in	0 %
Abandonment of salmon spawning channels	1987	Elimination of seasonal entrainment and significant reduction when RBDD gates in	0 %
TCC headworks deflector wall	late 1980s	Significant reduction in entrainment when RBDD gates in	0 %
Installation of new fish screens	1990	Elimination of entrainment when RBDD gates in	0 %
Installation of new fish bypass	1990	Major reduction of predation when RBDD gates in	0 %
RBDD gates out 6 months/year	1987	Major seasonal elimination of predation and significant reduction of predation when RBDD gates in	0 %
RBDD gates out 8 months/year	1993	Major seasonal elimination of entrainment and significant reduction of predation when RBDD gates in	0 %
Fixing leaks on the Dual-Purpose Canal fish screens	1985, 1986	Elimination of fish entrainment into the Tehama-Colusa irrigation canal	0%
Change in Acrolein treatment in the Dual-Purpose Canal	mid-1980s	Elimination or significant reduction in juvenile salmon mortality	0%
Elimination of flow-straightening vanes inside fish bypasses	1985	Elimination of physical injury and mortality of large numbers of juvenile fish	0%
Implementation of spring pulse flow	1985	Significant reduction in salmon mortality at RBDD	0%

Following are details of some, but not all, of the significant actions or features implemented that have improved downstream fish passage at RBDD. These measures are not listed in order of importance. ***None*** of these improvements are accounted for in the DEIS/EIR's analyses.

RBDD Lights Out

Upon the recommendation of this author and CDFG, the USBR began turning off the large sodium vapor lights on RBDD at night (Figure 11) as a measure of reducing nighttime predation of juvenile salmon (Vogel and Smith 1984). The USFWS considered the measure very successful in reducing juvenile fish mortality.

Figure 11. Photographs of RBDD taken by the author with the large sodium vapor lights on top of the dam turned on and off.

Reduction in Fish Mortality in the Dual-Purpose Canal

During the course of fishery research projects in the Dual-Purpose Canal (DPC), located at the upper-most portion of the Tehama-Colusa Canal (TCC), it was discovered that the fish screens supposedly preventing fish entrainment into the Tehama-Colusa Irrigation Canal possessed leaks where young salmon could perish. Corrective action requiring SCUBA divers to plug the gaps in the screens was implemented (e.g., Vogel 1985c, 1986) eliminating the source of mortality.

Chemical Treatments in the Dual-Purpose Canal

The treatment of the Dual-Purpose Canal with an algaecide (acrolien) had occurred since 1976 and was known to kill large numbers of wild juvenile salmon (USFWS 1981). During the 1980s, the USFWS monitored the problems associated with the large fish kills in the DPC and worked with the USBR in altering the timing of acrolien application or, in some instances, elimination of the treatment which reduced fish mortalities.

Installation of the New Fish Screens at the Tehama-Colusa Canal Headworks

The problems associated with the fish louver screens in the Tehama-Colusa Canal headworks at RBDD performing inefficiently and leaking wild fish into the canal system was recognized as early as 1972 (USFWS 1981) but not solved until the new, angled rotary drum screens were installed in 1990 (Figure 2). Installation of these screens prevented the well-documented annual entrainment of hundreds of thousands of juvenile salmon into the TCC (Vogel 1989b). The DEIS/EIR assumes this $15,000,000 fish screen resulted in no benefit to fish.

Elimination of the Fish Louver Bypass System Mortality

During the mid-1980s, I found a major problem adversely impacting juvenile salmon at the old fish louver bypass system. Based on underwater observations of hydraulic characteristics of flow emanating from the fish bypass system, I became convinced that flow constriction was occurring in at least one of the five fish bypass pipes. I encouraged the USBR staff at RBDD to temporarily shut down the fish bypass system and I volunteered to crawl up into the 30-inch diameter pipes to inspect the system. I found a large amount of riverine debris crammed inside one of the fish bypass pipes. It turns out, after discussion with USBR personnel, that three steel vanes were added (welded) to the inside of each of the five fish bypass pipes shortly after dam construction to allow USBR engineers to improve accuracy of flow measurements though the pipes. However, after the flow measurements, all fifteen vanes were inadvertently left welded inside the pipes. After my discovery, the USBR used cutting torches to remove the vanes and ground the pipe surfaces smooth (Vogel 1991a). Downstream migrant juvenile salmon were highly concentrated in the flow through these pipes because each louver bay was approximately 500 cfs and the fish were concentrated down from this volume of water to only 30 cfs. This means that if the flow into the TCC headworks was 2,500 cfs, the fish in that volume of water were subsequently concentrated down to only 150 cfs (30 cfs per louver bypass) or a concentration factor of 16 fold. Large numbers were undoubtedly killed every year in those pipes since dam construction until the problem was corrected in the mid-1980s.

Relocation of the TCC Fish Screen Bypass Outfall

During the design phase for the new TCC fish screens at the RBDD headworks, the engineers for the project originally contemplated routing fish from the fish screen bypasses to the river at a location near the old fish louver bypass outfall structure. However, based on my underwater observations of major predation by pikeminnow on juvenile salmon entering the river at that location, I and the other fishery resource agencies insisted that the new bypass outfall be located further downstream away from the high concentrations of pikeminnow immediately downstream of the dam and in high velocity water away from eddies that may harbor predators. Ultimately, this latter option was chosen which added approximately $1 million to the new fish screen project. The biological rationale and benefits of this strategy are also recognized on the Columbia

River.[24] Also, the design of the new bypass system ensured that air entrainment throughout the pipe would be eliminated to correct the previously discovered problem in the old fish louver bypass system. This was accomplished inside the bypass system at an intermediate structure where four fish screen bypass pipes converged into two larger-diameter pipes back to the river (Rainey 1990).

RBDD Gates Out Most of the Year

The DEIS/EIR admits that raising the RBDD gates for 8 months of the year has resulted in significant benefits:

> *"Operation of RBDD under the Reasonable and Prudent Alternatives specified in the Winter-run Chinook Salmon Biological Opinion (NMFS, 1993) which specified that the gates may not go in prior to May 15th,* ***have greatly reduced the impacts of predation on salmonids from pikeminnows****."* DEIS/EIR Page B-35 (emphasis added)

Inexplicably, the DEIS/EIR does not account for those benefits in the analysis section of the document. Instead, the DEIS/EIR chose to select the "highest level of predation reported in the literature for RBDD" (55%) to analyze the various gates-in alternatives. This is a direct contradiction in the document.

Failure to Account for Daytime versus Nighttime Fish Passage

Contrary to the assumptions presented in the DEIS/EIR, the majority of downstream migration of juvenile salmon occurs at night, not day (Vogel 1982a, Vogel et al. 1988, USFWS 1989).[25] The DEIS/EIR not only inappropriately used historical data developed prior to implementation of improvement measures discussed earlier, but also assumed that all juvenile fish pass the dam during the day, not night. This is an enormous error in the DEIS/EIR's model outputs. This error is further compounded for all runs of chinook salmon, steelhead, sturgeon, and other fish species listed in the DEIS/EIR because of the inappropriate use of the 55% mortality results for ***daytime*** tests on fall-run chinook juveniles as a surrogate for all other fish species.

The natural phenomenon of higher downstream migration of salmon occurring at night as compared to day is evident in rivers and streams elsewhere in the Central Valley. These results are consistent with more recent sampling by the USFWS at RBDD where the researchers found:

> *"Outmigrating salmon exhibited distinct diel patterns of abundance. Catches from traps indicated that during eight of twelve months, juvenile*

[24] "Based on our results to date, we recommend that when siting new or modifying existing bypass facilities that the outfall be in an area of high water velocity and distant from eddies, submerged cover, and littorial areas in general." (Poe et al. 1993)

[25] Except during periods of high river flow and turbidity and during mass releases of fish from Coleman National Fish Hatchery.

salmonid abundance was significantly (P<0.05) greater in nocturnal periods. Typically diurnal levels of abundance were lower than those observed during nocturnal sampling except during months of increased river flows." (Johnson and Martin 1997)

Furthermore, researchers established that the abundance of most larval non-salmonid fish species captured with the experimental pumps at RBDD was greater at night than during the day, a finding that was consistent with that of additional research by Bothwick et al. (1999) (Bortwick and Weber 2001). However, the DEIS/EIR implicitly assumed that all juvenile salmon and all other fish species emigration occurs during the day, not night.

The DEIS/EIR also assumed that a 55% mortality of all young fish species will occur when the fish migrate down through the ladders. A review by Marine (1992) of several comprehensive publications on fish ladder design and improvements revealed that there are no data or discussion available on the potential mortality associated with the downstream passage of juvenile salmon through fish ladders (Clay 1961 and Powers et al. 1985, as cited by Marine 1992). Civil works on the Columbia River dams designed to carry fish, such as the fish collection and turbine bypass systems, have been measured to cause on average approximately 2% mortality to fish passing through those facilities (Rieman et al. 1988, as cited by Marine 1992).

The same mistake of using inappropriate data was made in 1992 for "The Appraisal Study of Options for Improving Fish Passage at Red Bluff Diversion Dam". Specifically referencing that report, Vogel and Marine (1992) pointed out:

"*Predation rates for downstream migrants rely heavily upon data developed by Vogel et al.* [1988] *which considered fall-run chinook salmon smolts and tagged fall-run and late-fall-run smolts released at Coleman National Fish Hatchery and below RBDD. The conditions reported by Vogel et al. (1988) were different from the present operating conditions. The gates at the RBDD are now raised during the non irrigating season and predaceous squawfish are allowed to migrate upstream thereby reducing predation of downstream migrant fall-run salmon. It is not appropriate to use these historical databases to analyze existing conditions.*"

It is not clear why the document chose the "highest" mortality value instead of a composite or range of values. The DEIS/EIR has artificially skewed the analyses to result in biased weighting against many of the alternatives presented. Therefore, this circumstance precludes the Fishtastic computer model from serving as a useful decision-making tool.[26]

[26] "Although quantification of natural processes, particularly involving complex organisms, is at best, only an approximation based on many assumptions, Fishtastic! was designed to be a decision-making tool." DEIS/EIR Page B1-1

Incorrect Data on Timing of Pikeminnow Migration at RBDD

The DEIS/EIR has apparently failed to use a more comprehensive database concerning pikeminnow migration in the fish ladders at RBDD. A later migration timing is assumed whereas the historical database on pikeminnow indicates an earlier seasonal timing through the RBDD fish ladders. Those data are shown in Figure 12.

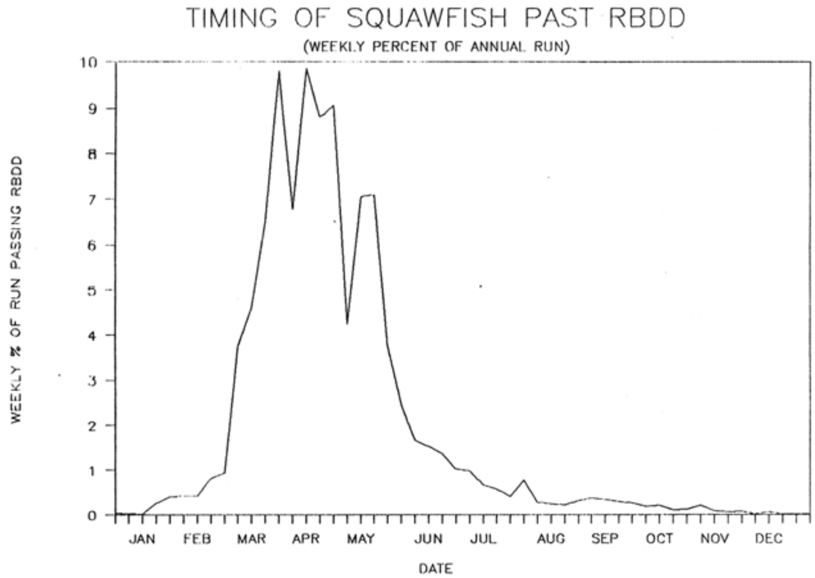

Figure 12. Timing of pikeminnow (squawfish) past RBDD – weekly percent of annual run based on counts in the RBDD fish ladders (from Vogel et al. 1988)

As evidenced in Figure 12, the vast majority of pikeminnow historically passed through the ladders prior to May 15. For the previously described reasons, a higher proportion would now be expected to pass Red Bluff prior to May 15 with the current mode of RBDD operations. This expected significant reduction in pikeminnow concentration downstream of RBDD was corroborated by Tucker et al. (1998).[27] However, the DEIS/EIR does not incorporate these significant findings into the document's analysis of alternative effects on fish.

Incorrect Characterization of Lake Red Bluff Environment for Fish

Much of the DEIS/EIR's description of Lake Red Bluff suggests that it is a warm water environment full of ideal habitat for predatory fish species such as pikeminnow and striped bass[28]. The document and the scoping report are replete with statements that bird

[27] "Comparing current data to those found in previous studies of Sacramento squawfish indicates that densities within the study area are much lower now than they were when the dam gates were left in year round." … "However, the overall trend has shown a definite reduction in Sacramento squawfish passage since the raising of the gates became a standard practice in 1986 (unpublished USFWS data, Red Bluff, California)." … "There is additional evidence that Sacramento squawfish densities behind RBDD have continued to decrease even after the policy of raising gates for extended periods was implemented." (Tucker et al. 1998)

[28] "…Lake Red Bluff, which is good habitat for predatory species like stripers." DEIS/EIR page B-39

and fish predators in Lake Red Bluff eat young salmonids.[29,30] The DEIS/EIR further implies that when the RBDD gates are lowered and Lake Red Bluff is formed, habitat is created where predator fish become instantaneously abundant and reproduce, etc. Biologically, this obviously cannot occur because of the very limited "ideal" predatory fish habitats present in Lake Red Bluff and the slow colonization that would naturally occur (explained below).

The DEIS/EIR's assumptions appear to be largely based on a juvenile salmonid radio-tagging study by Vogel et al. (1988) in Lake Red Bluff. The DEIS/EIR failed to recognize that researchers believed the predation on radio-tagged juvenile steelhead was likely a function of the highly visible, shiny radio transmitters attached to the backs of the test fish. For example, Vogel et al. (1990) reported:

> *"In addition, some predation of juvenile test fish by piscivorous birds was noted, but may have been attributable to the presence of the externally attached radio transmitters causing the fish to be more visible to the birds and/or less able to avoid capture."*

After noting the problem, we subsequently camouflaged the transmitters to make them less visible (Vogel 1991a). Recently, in some of my juvenile salmon migration research in the Sacramento-San Joaquin Delta, I have employed surgical implantation procedures to further reduce the potential problems of predation of radio-tagged juvenile salmon.

In 1989, the USFWS reported "*juvenile salmon showed little difference in migration rates with the gates in or out of the water*" (Vogel 1989), an extremely relevant fact not reported in the DEIS/EIR. Furthermore, Vogel et al. (1990) stated:

> *"The release and subsequent detailed monitoring of 192 radio-tagged juvenile steelhead trout and chinook salmon showed that delay of downstream migrants in the reservoir above the dam was minimal. This was further substantiated by hourly sampling of downstream migrant hatchery chinook immediately following their release from a location 30 miles (48 km) upstream; the fish moved through the reservoir in a matter of only a few hours."*

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29 An additional effect of the existing operations of RBDD on juvenile salmonids, especially on steelhead smolts, includes predation by avian species while passing through Lake Red Bluff and downstream of the dam (Vogel et al., 1988; USFWS/USBR, 1998)." (DEIS/EIR Page B-7)

30 "Juvenile salmonids passing downstream of RBDD are also susceptible to disorientation and predation when they arrive downstream of the dam, resulting in a decrease in their survival rates. Both Sacramento pike minnows (formerly known as Sacramento squawfish) and striped bass are known to prey heavily on juvenile salmonids both within Lake Red Bluff and downstream of RBDD."…"Lake Red Bluff provides a habitat that enhances predation on juvenile salmonids and reduces their survival rates. In addition to losses of juvenile salmonids to predatory fish, predation by fish-eating birds is known to occur in Lake Red Bluff. Reduction in the period of time that Lake Red Bluff is in existence likely has reduced the losses of emmigrating (sic) juvenile salmonids from both avian species and predatory fish." (CH2MHILL 2000)

Because the small reservoir upstream of RBDD is relatively shallow and the water residence time is short, Lake Red Bluff could be more appropriately treated as a short-term, elevated riverine environment instead of the more lacustrine (lake-like) environment described in the DEIS/EIR. For example, Lake Red Bluff is estimated to be approximately 3,000 acre-feet in volume. With a summertime Sacramento River flow of 10,000 cfs, the exchange rate (or residence time) of the volume of water in Lake Red Bluff would change 6.6 times every 24 hours or replenish itself every 3.6 hours. This value is uncharacteristically very high for a typical reservoir and is why the summertime water temperature in the lake is very cold (with the exception of Sand Slough).

Historically, Lake Red Bluff was known to provide an extensive nursery area for salmon fry when the dam gates were in year-round. In the fall of 1969, 301,643 winter run fry were captured, in the fall of 1970, 109,100 were captured, and in the fall of 1971, 309,266 winter-run fry were captured. The fact that approximately 720,000 juvenile winter-run chinook salmon were sampled in Lake Red Bluff during September and October during this period, in addition to sampling in 1973 [Hallock and Reisenbichler (1980), Hallock and Fisher (1985)], indicate that this area was historically a large nursery for winter-run chinook fry. My recollection of the location is at the lower end of Lake Red Bluff in the left-side channel over relatively shallow, sand and gravel substrate near large amounts of aquatic macrophytes. Unlike the further-upstream Sand Slough, this part of Lake Red Bluff possessed flow-through current and was cold, similar to the main river channel. The aquatic macrophytes became established because of the relatively stable year-round river elevation but have since disappeared because of the current mode of dam gate operations.

Using the rationale articulated in the DEIS/EIR, if the 4-month formation of Lake Red Bluff is considered ideal habitat for predatory species, then the naturally abundant, year-round river oxbows present downstream of RBDD must be considered phenomenal habitats for predators. Therefore, the "ecological costs" associated with the numerous, naturally occurring oxbows downstream of Red Bluff would be very high. The DEIS/EIR does not reconcile its inconsistent logic on this topic.

IMPACTS FROM THE PROPOSED LARGE-SCALE PUMPING PLANT AT THE MILL SITE

One of the alternatives proposed in the DEIS/EIR is construction of a very large-scale pumping plant at the Mill Site (Alternative 3). To justify this alternative, the DEIS/EIR suggests that a large pumping plant could be constructed and operated with no adverse affects on fish. Most surprising is the lack of information and detail in the DEIS/EIR as compared to other alternatives described in the document. In fact, the DEIS/EIR states:

> "*However, because only preliminary site investigations have been completed at the Mill Site, site constraints and development requirements are not fully known*." DEIS/EIR Page A-42

Due to these missing elements, the final document must provide more substantive information for evaluation among the potential project alternatives in order to meet its goal.[31]

I noted that the DEIS/EIR provided a table showing the average depths at different sites contemplated for the proposed pumping station (DEIS/EIR Table A-3, Page A-11), but did not show similar data for the Mill Site. I performed a reconnaissance-level survey to determine the site's bathymetry when the RBDD gates were out. Those results are shown in Figure 13.

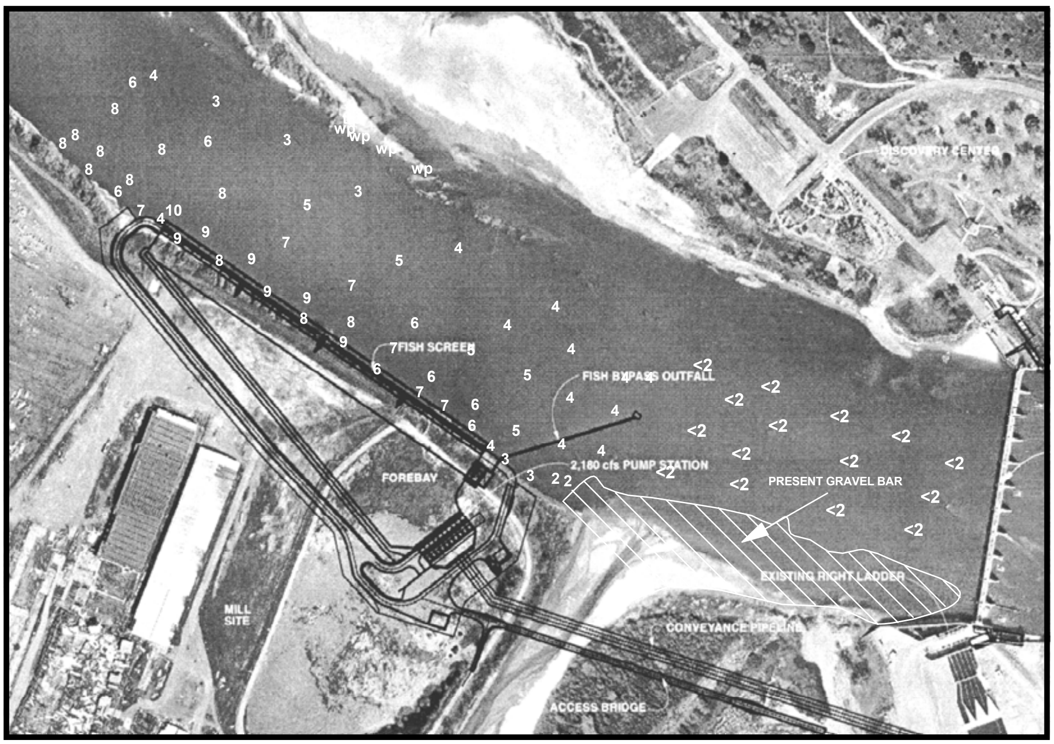

Figure 13. Bathymetry map of water depths (feet) in the vicinity of the proposed large fish screen at the Mill Site when the RBDD gates are out (modified graphic from the DEIS/EIR).

The most striking result from this survey showed that the shallow water at this site will make it highly problematic to place a large-scale fish screen on the river. This circumstance is, in part, attributable to severe aggradation of the mainstem riverbed just downstream of the Mill Site in recent years. Figures 14 – 16 show the large gravel bar

[31] "NEPA is a procedural law requiring agencies to evaluate a range of reasonable alternatives, disclose potential impacts, and identify feasible mitigation. Reasonable alternatives must be rigorously and objectively evaluated under NEPA (as compared to CEQA's requirement that they be discussed in 'meaningful detail')." DEIS/EIR Page 1-3

extending out from the Red Bank Creek confluence into the main river channel that did not exist 25 years ago and resulted in the course change of the Sacramento River.

Figure 14. Aerial photograph taken by Marshall Pike on September 20, 2002.

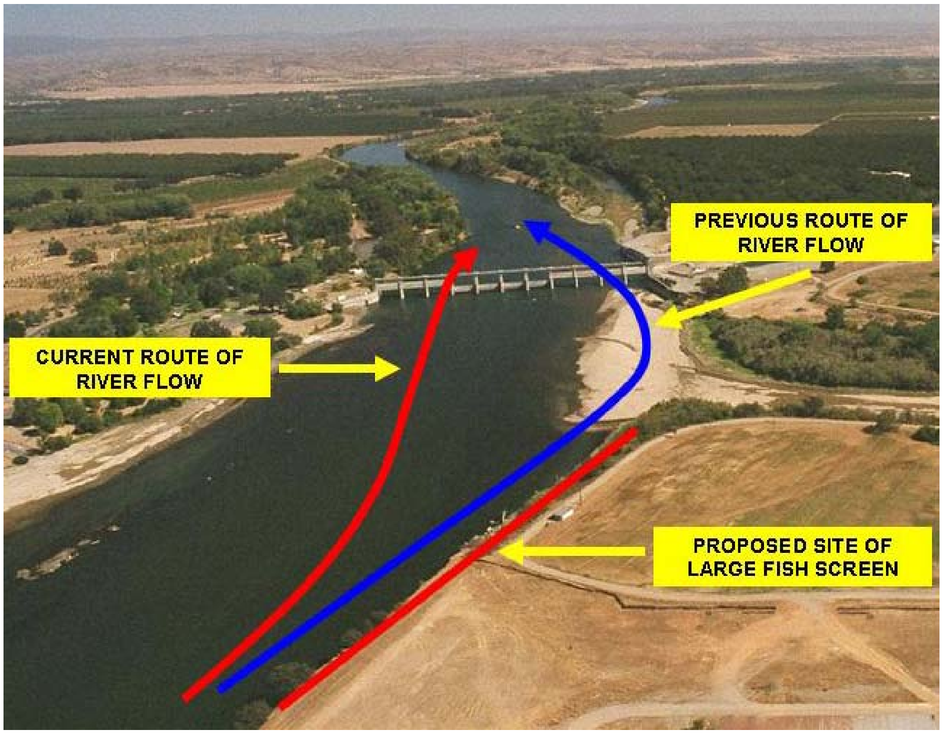

Figure 15. Aerial photograph taken by Marshall Pike on September 20, 2002.

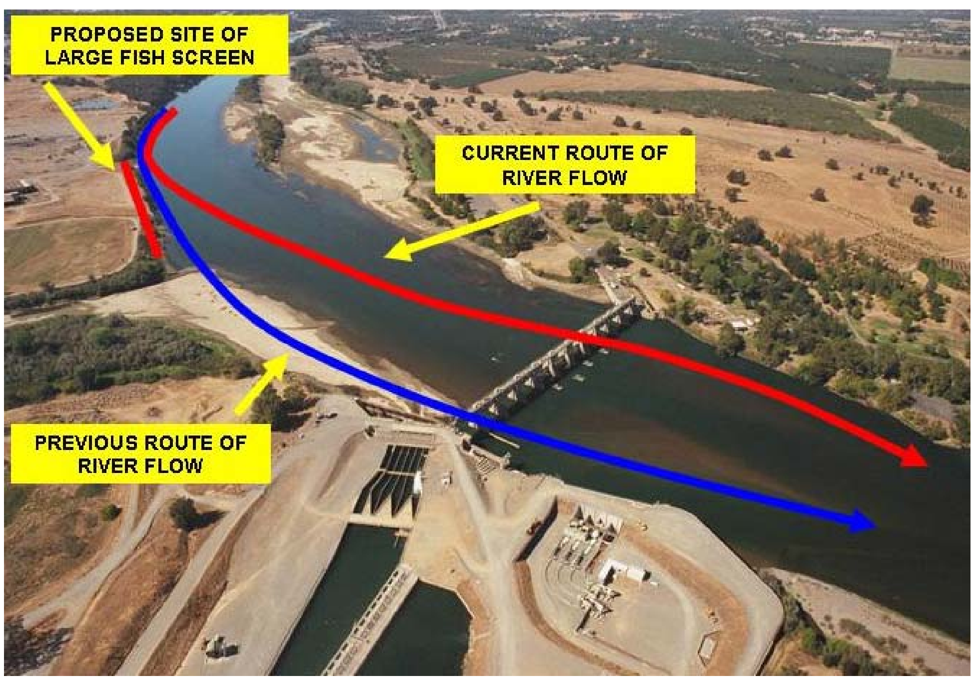

Figure 16. Aerial photograph taken by Marshall Pike on September 20, 2002.

I examined some of my prior USFWS research reports and found that I had taken bathymetry profiles in this area during the mid-1980s in preparation for specialized field sampling efforts with fish trawling equipment (Figure 17 - 18).

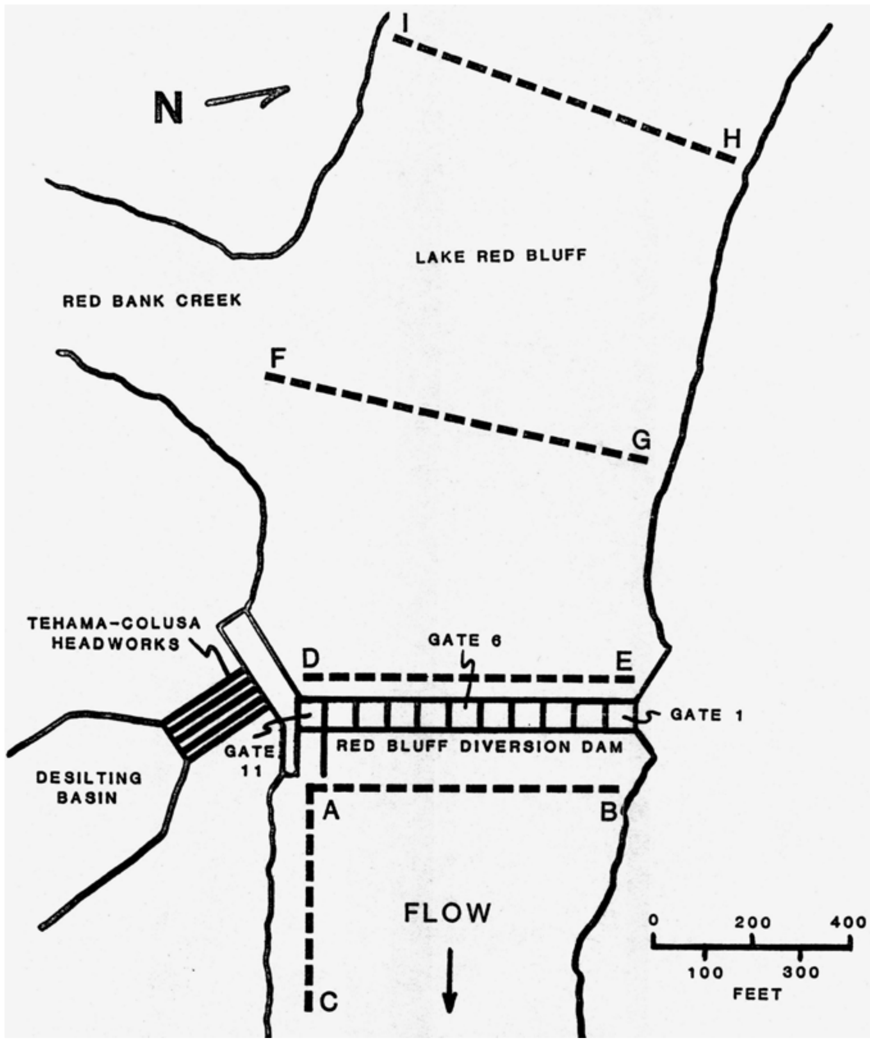

Figure 17. Location of depth profiles (transects) measured near RBDD by the USFWS in 1984 (from Vogel and Smith 1984).

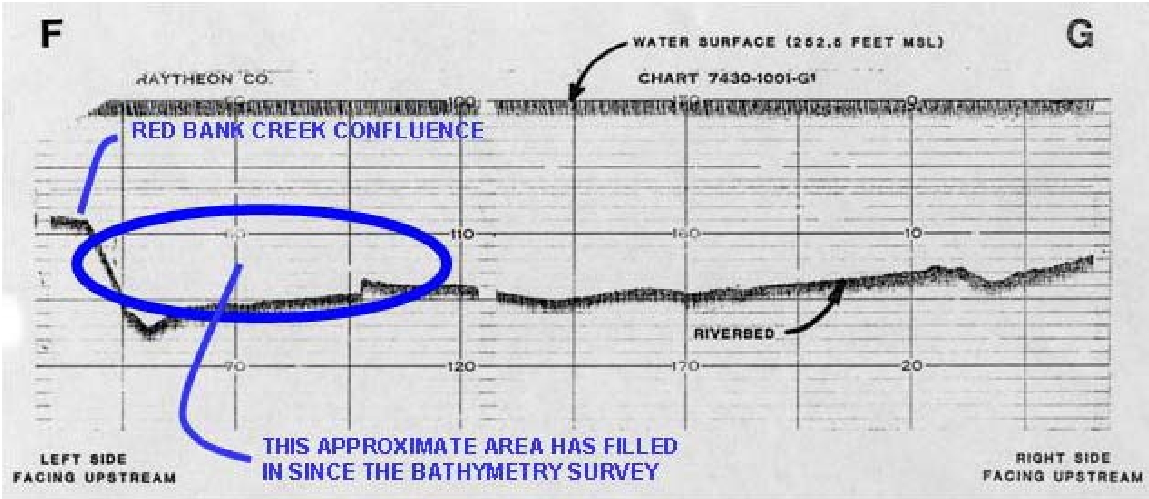

Figure 18. Cross-sectional depth profile measured in Lake Red Bluff upstream of RBDD at the confluence with Red Bank Creek in 1984; refer to Figure for location of transect F-G (from Vogel and Smith 1984).

Installation of a new large pumping plant and fish screen on the bank of the Sacramento River, while concurrently ensuring a reliable water supply and meeting fish protection criteria, will not be an easy proposition as suggested in the DEIS/EIR. In fact, it may be impossible to construct without a massive, permanent reconfiguration of the channel geometry and hydraulics in combination with a regular (seasonal) in-river dredging program. Initial, large-scale dredging in the river will be necessary to make the channel deeper to accommodate the required depth and surface area on the screens to meet the required maximum approach velocity of 0.33 feet/second and provide the necessary sweeping flows past the screens. The enormous area of sediment at the mouth of Red Bank Creek will have to be removed for the fish screens to function properly (Figure 14). These dredged sumps would be deeper than the surrounding riverbed and create predatory fish habitat impacting juvenile fish encountering the screens.

To meet the fish protection measures at the pumping plant mentioned above, a regular river channel maintenance (dredging) program will have to occur to ensure adequate depth and keep the area from re-aggrading. These measures at the downstream end of the proposed screens will probably create ideal habitat for predatory fish that will easily prey on large numbers of juvenile fish concentrated down to a lesser amount of flow at the end of the screens. Because of "competing" hydraulic conditions in the river and to the pumping station, some sort of a permanent training wall in the main river channel opposite the fish screens will probably be required to concentrate the flow against the fish screens. Positioning the necessary fish bypass outfall structure will also be very difficult because of the relatively recent changes in the river's route (Figures 15 – 16). If the bypass is located in an area subject to significant change, the fish could ultimately be routed into undesirable predator holding habitat.

It can fully be expected that this new, yet-to-be-designed large fish screen on the river will be much more problematic for fish protection than the existing screens at the TCC headworks where physical and hydraulic conditions have been proven to meet fish screening criteria. A major advantage to the existing TCC screens is the controlled hydraulics that can never change. Conversely, on-river fish screens have greater opportunity to go out of variance of accepted criteria for fish protection. Routine maintenance of a large-scale pumping plant may jeopardize not only fish beyond the normal 4-month period when the RBDD gates are traditionally in, but also the reliability of the water supply for the TCC, eliminating the two primary objectives of the proposed project. However, a smaller-sized facility positioned at the upstream-most end of the Mill Site may be less problematic but will still require extensive and careful analysis for the previously described reasons.

The DEIS/EIR does not describe the environmental impacts that will occur by allowing unimpeded access of striped bass past the dam during the summer months under the gates-out alternative. Unlike the pikeminnow[32], this predator is not native to the Sacramento River and do not pass through fish ladders. Also, pikeminnow have naturally co-existed with salmon for thousands of years[33], whereas striped bass have not. There are many knowledgeable scientists that attribute declines in some Central Valley salmon runs to striped bass (voluminous testimony available through the archives of State Water Resources Control Board Hearings). Raising the RBDD gates year-round will allow striped bass to enter all the prime summer salmon nursery areas for fry and juvenile salmon upstream of Red Bluff. Because of RBDD operations, the striped bass upstream migration has been blocked from those salmon nursery areas for nearly 40 years.

The biological consequences on the salmon runs could be severe because of the extreme predatory nature of striped bass compared to all other native or non-native fish species present in the Sacramento River. For example, nation-wide notoriety occurred at Lake Davis where a non-native predator, northern pike, was introduced and unsuccessfully eradicated in an attempt to avoid adverse impacts on Central Valley salmon. Allowing striped bass unrestricted access to areas upstream of Red Bluff would be not unlike artificially stocking large numbers of adult northern pike in the upper river. Details on this potential disaster were severely lacking as noted by its reference only twice in the entire voluminous document.[34,35]This circumstance must be considered as an adverse impact to any rearing Sacramento River salmonids upstream of RBDD during the summer months (e.g., endangered winter-run chinook fry and threatened steelhead trout fry). A worst-case scenario is that this consequence could affect the species' survival. A

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[32] "This species can and does readily pass through the existing fish ladders at RBDD."DEIS/EIR Page B-35

[33] "The Sacramento squawfish *Ptychocheilus grandis* is a native piscivorous species that co-evolved in the system with salmon and steelhead. In a natural free flowing river setting the predator-prey relationship between Sacramento squawfish and salmon is balanced and has no significant long term affect on salmonid populations." [Brown and Moyle (1981), as cited by Tucker et al. (1998)]

[34] This may result in undesirable increases in predation by striped bass on juvenile salmonids upstream of RBDD." DEIS/EIR Page B-39

[35] "The alternative would allow adult stripers to migrate unimpeded as far as Redding, and by doing so, may result in undesirable increases in predation of rearing anadromous salmonids in the Sacramento River upstream of RBDD." DEIS/EIR Page B-44

lesser, but still important consequence, is that the recovery of the species may be affected.

Another undisclosed fact in the DEIS/EIR is that the pumping plant will likely have some effects on downstream migrating fish not just only during the May 15 to September 15 period, but earlier and later in the season (Figure 19). Those effects will be both operationally- and structurally-facilitated. This circumstance will encompass a greater range of the downstream migration period for the threatened and endangered fish species of concern (i.e., winter-run chinook, spring-run chinook, and steelhead).

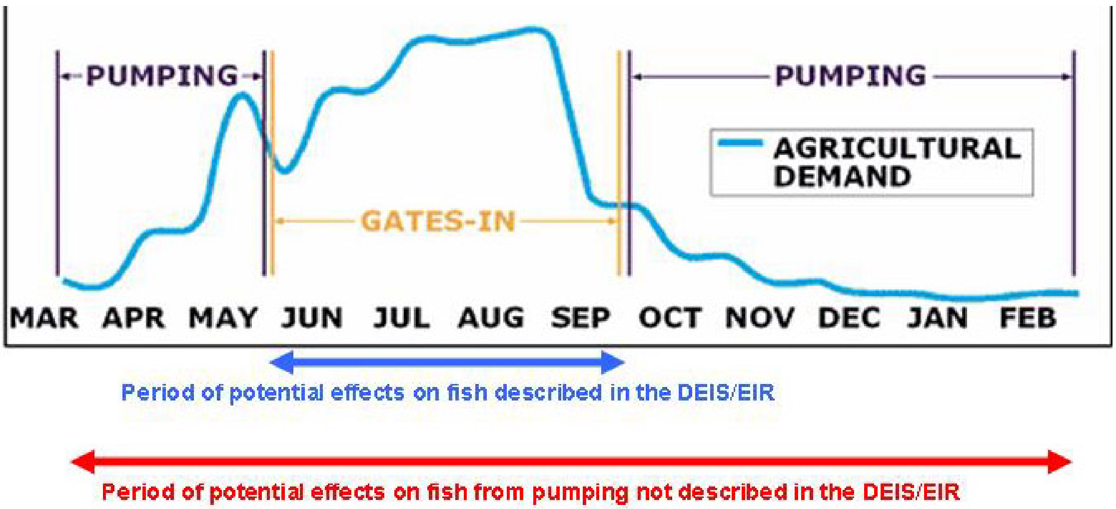

Figure 19. Period of potential impacts on fish resulting from year-round pumping (adapted from DEIS/EIR graphic)

Astonishingly, the DEIS/EIR states that no effects on fish will result from operations of the proposed large-scale pumping plant on the river at the Mill Site.[36]

Recent lessons learned from new fish screens constructed elsewhere on the Sacramento River must be heeded. For example, the M&T/Lano Seco Fish Screen Facility, located on the Sacramento River 50 river miles downstream of RBDD (Figure 12), was constructed in 1997 at a cost of $4.7 million. The full capacity of the diversion is only 150 cfs (CALFED 2002a).

> "*Since then, river dynamics have created substantial sediment depositions and the pumping plant intake is now in an eddy behind the gravel bar at the mouth of Big Chico Creek and in danger of being severed from the Sacramento River during seasonally increased river flows. Intake screens are no longer providing sufficient sweeping flows critical to fish screen operation and fish survival.*" (CALFED 2002a)

[36] "Gates-out Alternative: Operations. No significant adverse impact to fishery resources would occur with operations of this alternative. Therefore, no mitigation is required." DEIS/EIR Page B-43

> *"… the intake screens are no longer providing sufficient sweeping flows consistent with National Marine Fisheries Service and CDFG fish screen criteria due to the deposition of sediment. Eddy currents are also unable to maintain a clean screen as originally designed. As a result of these changes, anadromous fish including spring-, fall-, late fall-, and winter-run chinook salmon and steelhead trout in the Sacramento River and Big Chico Creek have the potential to be adversely impacted by non-functioning fish screens.*" (CALFED 2002a).

A short-term partial solution was proposed to CALFED in order to alleviate the immediate problems at this water intake. This approach recommended excavation of up to 100,000 cubic yards of sand and gravel from within the active river channel. In addition, the preparation of a "Feasibility Report" was proposed to: 1) gather existing data, 2) research existing conditions in the river, 3) understand fluvial geomorphology, 4) monitor the gravel bar, 5) gather data from surveyors, hydrologists, and geo-technical engineers, and 6) prepare a river model to assist in determining an appropriate long-term solution (CALFED 2002a). An expected outcome of this proposed project was to "*provide a valuable opportunity to advance the science and practice of river restoration and management that can be applied to future fish screen projects on the Sacramento River."* (CALFED 2002a)

This $1,816,500 proposed project was rejected for funding and considered a "directed action" for potential future funding consideration. The CALFED Proposal Selection Panel recommended a re-write so that the actions "*not be solely focused on protecting the existing facility, but should consider alternative means of meeting the water needs of beneficiaries of the present facility, including modifications to the existing facility to accommodate river meander and sediment deposition*." (CALFED 2002b) This proposal has been subsequently resubmitted to CALFED for funding consideration.

COMMENTS ON THE USE OF THE RBDD DEIS/EIR'S FISHTASTIC MODEL

The DEIS/EIR describes a simple computer spreadsheet model (called "Fishtastic") used to analyze the various fish passage alternative effects on fish. The Fishtastic model is largely based on speculation.[37,38] There are numerous major errors in the model's assumptions that render the DEIR/EIS fish passage analyses and results meaningless. In every instance, the assumed impacts to fish and fish passage are greatly overstated and based on a disproportionate manner for each alternative. Although the DEIS/EIR provides a few caveats stating that the model outputs are mostly biologically meaningless, it nevertheless used those outputs to describe presumed specific cause and

[37] E.g.: "The efficiency values assigned to the "future" facilities (e.g., "new" ladders) were estimated based on perceptions of their relative efficiency as compared to the existing facilities' efficiencies." DEIS/EIR Page B1-2

[38] Therefore, the assumed adult passage delay from other dam facilities (e.g., new ladders or a bypass channel), were extrapolated and were subjective." DEIS/EIR Page B1-3

effect biological relationships on fish and show presumed biological benefits of one alternative over other alternatives.[39] The method is not technically sound.

Inappropriate and Invalid Model Parameter

The DEIS/EIR attempts to create a new paradigm on how an upstream and downstream fish passage project should be evaluated:

> "*The ultimate output of the adult module in Fishtastic! is neither actual numbers of fish passing the dam, nor percentages of the overall population passing the dam, but instead a relative index score (from 0 to 100). At each step in the adult module, an ecological "cost" or consequence of passage to that species is calculated. Although this concept is relative and somewhat abstract, it is necessary to avoid inappropriate assumptions or conclusions regarding species survivorship or injury and consequent changes in populations. Therefore, the passage index represents a relative score in terms of a composite of possible costs, such as reduced energy for egg development, swimming stamina, reduced survivorship, recovery from injury, etc. Thus, it is important for the user to understand that Fishtastic! is merely a tool for evaluating the relative effects of RBDD facilities management, rather than an absolute cost, in numbers (mortalities), to a given population*." DEIS/EIR Page B1-11

Despite the convoluted logic and ambiguity with these statements, the DEIS/EIR proceeded to use the model outputs to derive conclusionary statements on so-called quantifiable fish passage benefits in order to compare the project alternatives.

The model possesses an inconsistent and non-objective application between DEIS/EIR alternatives that results in a fatally flawed approach and invalidates its usefulness. For example, when assessing the affects of any gates-in alternative, it reduces the "fish passage index" and increases the "ecological cost" for juvenile fish screened out of the existing TCC canal (due to the new angled rotary drum screens) because the fish are "affected" by the facilities. Conversely, the model fails to reduce the fish passage index for juvenile fish exposed to the proposed facilities at the Mill Site. The TCC screens have eliminated entrainment and impingement and possess a state-of-the-art fish bypass system that routes juvenile fish pasy the dam to a location downstream of predator fish concentration. This existing feature has also been demonstrated to not injure fish nor increase the vulnerability of juvenile salmon to predators from potential stress (Vogel and Marine 1997).

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[39] "The following describes the development of a tool ***for quantifying fish passage*** under a variety of dam facility management scenarios (Project Alternatives), ***and to describe the results and repercussions*** of this analysis. The analytical tool is called Fishtastic!, and was developed specifically to gain a better understanding of fish passage at the Red Bluff Diversion Dam (RBDD) in Red Bluff, California." [emphasis added] DEIS/EIR Page B1-1

The DEIS/EIR has chosen to ignore all of these facts and assumes that juvenile fish are impacted as though the new fish protective facilities were never constructed.[40] Incredibly, the DEIS/EIR proceeds with its "analysis" by stating that zero impacts on fish will occur from a new facility that has been far from adequately described.[41]

Distortion By Use of Proportion, Not Abundance

Unfortunately, the Fishtastic model juvenile fish component is driven by the 55% mortality value (assumed pikeminnow predation at RBDD) previously discussed. Although the DEIS/EIR makes the statement, "*This is an indication that the densities of these predators are now much lower since the RBDD gates are in only from mid-May through mid-September*." (DEIS/EIR Page 3-15), the document and model completely ignore the biological significance in the analysis.[42] For example, when I performed my USFWS research at RBDD in the early 1980s, and derived the daytime estimate of 55% juvenile salmon mortality, the abundance of pikeminnow downstream of the dam in May was estimated at more than 10,000 fish. This was consistent with a prior estimate by CDFG in May and June 1977 when the dam gates were always closed [Hall (1977), as cited by Tucker et al. (1998)]. It is now a known fact that the pikeminnow abundance in May has diminished by probably an order of magnitude as compared to the dam gates in year-round.

Unequal Application of the Model between Project Alternatives

The DEIS/EIR makes the statement:

> "*For analysis purposes, it was assumed that there would be no impacts or benefits to juvenile life stages from the ladder and/or bypass elements of the alternatives*." DEIS/EIR Page B-25

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[40] "In the juvenile analysis module of Fishtastic!, provisions for spatially distributing downstream migrating juvenile fish present at RBDD were built into the tool. The parsing of juveniles could be assigned to each of the RBDD's facilities at other locations around RBDD depending upon the proportion of river flow at each location. However, after much discussion with the Fish Technical Advisory Team, it was decided that differential predation rates based on the location of juveniles within the river or at various RBDD facilities was not feasible. Therefore, in Fishtastic!, juveniles were subjected to the predation assessment (*"E. A. Gobbler"* sub-routine) without regard to any flow-based spatial juvenile distributions. The principal factors applied to assess potential predation at RBDD were based on a maximum literature value for predation for juvenile salmonids (Vogel et al., 1988) and the actual presence of predatory species at RBDD (Tucker, 1997). The estimated predation rate of 55 percent (Vogel et. Al, 1988) was weighted by predator presence as estimated by catch per unit effort (CPE) of Sacramento pikeminnow and striped bass at RBDD (Tucker, 1997)." DEIS/EIR Page B1-7

[41] "Gates-out Alternative: …this alternative would result in passage indices of 100 (on a scale of 100)." DEIS/EIR Page 43

[42] This occurs because the computer model erroneously uses seasonal proportional presence at RBDD, not estimated numbers of predators or . In doing so, the model has not compensated for the known reduction in predator concentrations.

In actuality, the DEIS/EIR artificially inflates implied mortality (reducing the index) for fish passing through the ladders and bypasses by erroneously assuming a maximum 55% mortality whereas zero mortality for fish is assumed using a new fish screen bypass system.

Distortion By Unrealistic Biological Assumptions

The computer model assumes "instantaneous" maximum mortality for juvenile fish passing RBDD immediately following May 15 when the RBDD gates are placed back in the river. It also assumes maximum delay up to 21 days for adult salmon approaching RBDD in early September immediately prior to dam gate removal on September 15. Neither of these circumstances can be true.

Overstatement of Predation

The DEIS/EIR states: "Tucker et al., (1998) determined that during summer months (gates-in operations), approximately 66 percent (by weight) of the stomach contents of Sacramento pikeminnows consisted of juvenile salmonids." What the DEIS/EIR failed to report is that Tucker et al. (1998) found that of the pikeminnow stomachs sampled ***only 24%*** obtained food items.

Dissimilarity with Other Fish Passage Projects

The DEIS/EIR has created a new analytical paradigm inconsistent with scientific principles and recent fish passage projects elsewhere. The DEIS/EIR's use of this approach was apparently not applied to another recent Sacramento River mainstem fish passage improvement project at Lake Redding and the Anderson Cottonwood Irrigation District diversion dam where new, improved fish ladders were installed (CALFED 1997). Numerous examples throughout California, the Pacific Northwest, and elsewhere exist where this approach has not been employed. This inconsistent logic is not reconciled in the DEIS/EIR.

Unrealistic Standards

The DEIS/EIR suggests a juvenile fish passage standard at RBDD that is impossible to achieve. Using the standard applied in the DEIS/EIR, there can never be a suitable or satisfactory fish passage facility at the dam. However, the DEIS/EIR does not apply this standard equally between project alternatives. The document assumes that there is an "ecological cost" associated with juvenile fish passage at the recent TCC screens, but then conversely assumes that there is no "ecological cost" associated with the un-described fish screens at the Mill Site.

The DEIS/EIR Fishtastic model arbitrarily suggests that greater than 3 days delay downstream of RBDD should be the lower incipient threshold for presumed severe adverse impacts to adult salmon. No factual basis for this value is provided in the document. The effect of delay in salmon passage is further assumed in the DEIS/EIR to have a linear relationship after a three-day period. The irony of this assumption is the very large increase in the fall run salmon populations (numerically the largest salmon run most affected by the existing gate operations) passing RBDD in recent years. In fact, the DEIS/EIR cites 1997 as the highest run of salmon passing RBDD in the last 30 years[43]. Obviously, the current mode of operation has not adversely impacted the fall run salmon populations, yet the DEIS/EIR remains silent on this and many other relevant facts.

Speculation and Subjectivity

In performing this technical review of the DEIS/EIR, I contemplated executing my own "model runs" of the Fishtastic computer spreadsheet model. Having read the model's documentation and adjusted the parameters, I concluded that such an exercise is worthless because the parameters driving the model are so subjective, the outputs are of no value.

A computer model is only as good as the assumptions and data entered into the model. Here, the DEIS/EIR model is clearly deficient. According to the document, no matter what design features are incorporated into new fish ladder(s) and/or fish bypass, it will always be substandard. The Fishtastic computer model allows any individual to derive any conclusions they desire (Figure 20). The final EIS/EIR must use a different approach to overcome this deficiency.

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[43] The annual fall chinook escapement upstream of RBDD has ranged from over 205,000 (1997) to less than 30,000 (1977) ***with an increasing trend in escapement over that period*** (Figure B-2). DEIS/EIR Page B-3. (emphasis added)

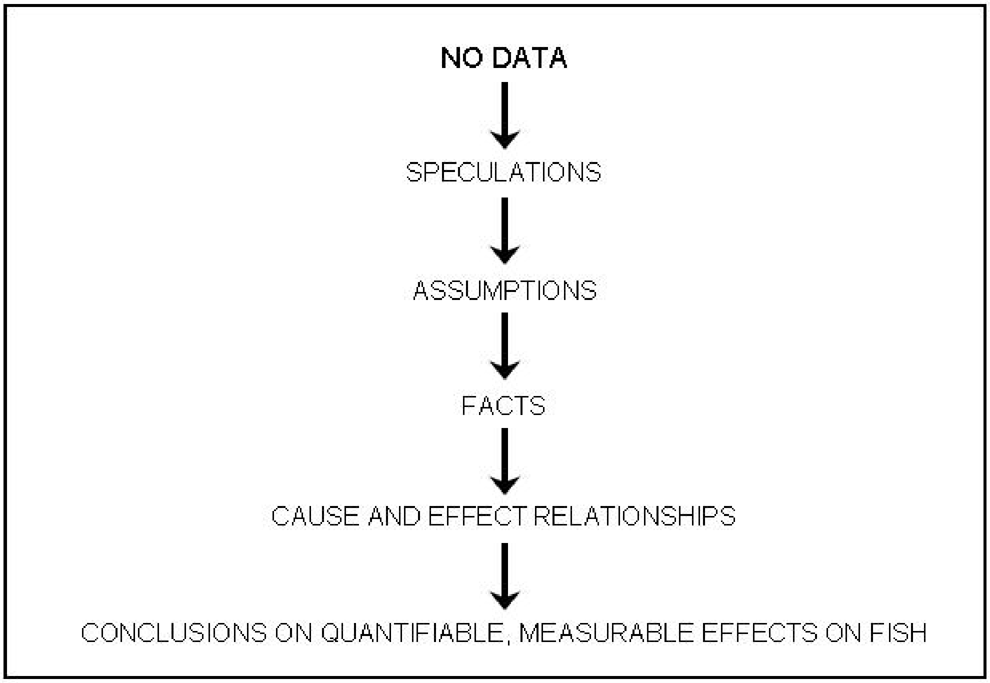

Figure 20. The DEIS/EIR's process to develop conclusions concerning the proposed project alternatives' effects on fish at RBDD.

OPPORTUNITIES FOR IMPROVED FISH PASSAGE

There is every reason to believe, based on the abundance of available information, that upstream and downstream fish passage can be dramatically improved with new, large fish ladder(s) (and/or a bypass). Extensive historical data collected at RBDD and elsewhere clearly demonstrates that upstream fish passage is largely affected by river flow, flow through the fish ladders, and physical configuration of the ladder entrances. Because river flow is seasonally low during the current gates-in period, there is ample opportunity to build new large fish ladder(s) with modern-day physical configurations resulting in minimal or no fish delay or blockage. Unlike other dams where available flow through fish ladders and their auxiliary diffusers (for fish attraction) may be extremely limited during summer-time low-flow periods (e.g., bypassing hydroelectric turbines or reducing limited irrigation water supplies), this practical restriction does not exist at RBDD. Additionally, the northeast side of RBDD is largely undeveloped, federal land, that would allow construction of appropriately-sized fish passage facilities and consequently allow more flow for fish passage. The improved facilities will undoubtedly disperse the concentration of the indigenous pikeminnow that can prey on salmon behind the RBDD gates. Also, more flow through fishways translates into less flow through (under) the dam gates further reducing potential predation down to ultimate limited levels. These measures will serve multiple beneficial purposes to greatly improve anadromous fish passage.

New, larger-scale fish ladder(s) will, with certainty, greatly improve fish passage not only for salmon, but also for pikeminnow. This will greatly diminish the concentration of pikeminnow downstream of the dam and reduce juvenile salmon predation mortality in the area. The DEIS/EIR falsely assumes there would be no measurable improvement to pikeminnow passage with new fish ladder(s).[44] The lack of supporting scientific justification was surprising[45] due to the fact the best available information indicates otherwise.

RECOMMENDATIONS

This critique has proven that the DEIS/EIR is clearly flawed and must be re-written. The draft document falls far short of achieving its intended purpose. The critically important assumptions and analytical approach used to compare project alternative effects on fish must be re-addressed. The numerous speculative statements and conclusions that only increase ambiguity and uncertainty should be deleted. Large amounts of highly relevant data and information were not used in formulating the document; that must be corrected to provide a meaningful final EIS/EIR. The profound influence that errors have placed on the analysis and conclusions must also be corrected. The document should be re-structured to allow a fair and balanced analysis and discussion of viable project alternatives. The document must provide clear scientific objectivity that will go far towards reaching its intended goals.

It is highly recommended that formation of a group of outside experts without a vested interest in the outcome be brought into the process to ensure a scientifically balanced and objective assessment of potential alternatives. Individuals with broader expertise in fish passage investigations and structural facilities should be included in developing the final EIS/EIR. For example, experts with experience on the large fish passage facilities in the Columbia River basin (U.S. Army Corps of Engineers[46] or U.S. Bureau of Reclamation)

[44] Under the 4-month Improved Ladder Alternative there may be additional passage opportunity provided for adult pikeminnow through the new fish ladders proposed for the left and right banks. However, the incremental increase in ladder passage provided to pikeminnows by the new ladders ***is likely to be small and not measurable.*** DEIS/EIR Page B-35 (emphasis added)

[45] "It was assumed that ladder designs were not sufficiently important in estimating juvenile fish downstream passage efficiency. The assumption was that predation was the single most important factor contributing to reduced passage efficiency at RBDD. It was assumed that any alternative would include juvenile fish protection facilities in accordance to existing NMFS and California Department of Fish and Game (CDFG) criteria, and therefore, there would be no difference in juvenile passage efficiencies related to these facilities. Thus, it was assumed that ladder design (and pump station/fish screen designs) would have no calculable effect on juvenile passage efficiency and calculation of their indices. The principal mechanism of impact to downstream migrating juvenile fish was therefore assumed to be from predation related to RBDD facilities." DEIS/EIR Page B1-7

[46] "In general, the adult passage facilities constructed by the Corps proved to be effective in design and operation. Steve Pettit, a fish passage specialist for the Idaho Department of Fish and Game, praised the ladders in 1990, noting that 'the Corps knows how to build them well.' This view remains widely held

could provide a wealth of highly valuable information for a future fish passage program at RBDD. To a large degree, because of the importance of this project, it may be warranted to acquire additional field data relevant to the current mode of gate operations during the May 15 to September 15 period to correct the obvious deficiencies in the DEIS/EIR.

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among fisheries scientists familiar with adult fish passage problems caused by dams." Mighetto and Ebel (1994)

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