March 16, 2017

Jeanine Townsend, Clerk
State Water Resources Control Board
1001 I Street, 24th Floor
Sacramento, CA 95814-0100

RE: Comments on the Revised Draft Substitute Environmental Document for Phase I of the Update of the Bay-Delta Water Quality Control Plan

Sent via email to: commentletters@waterboards.ca.gov

Dear Ms. Townsend:

On behalf of the Natural Resources Defense Council, The Bay Institute, Defenders of Wildlife, and San Francisco Baykeeper, we are writing to provide comments on the revised draft Substitute Environmental Document for Phase I of the Update of the Bay-Delta Water Quality Control Plan ("SED"). As you know, our organizations are dedicated to helping to protect and restore the health of the Bay-Delta estuary and watershed, including its native fish and wildlife populations. We have participated in this proceeding since the State Water Resources Control Board issued its initial notice of preparation in 2009, and in many cases our involvement goes back decades. Whether for fishermen whose livelihoods depend on healthy salmon runs, or members of the public who recreate in and value these rivers that are held in Public Trust for all of us, the health and abundance of our native salmon runs, the health of these three rivers – the Stanislaus, Tuolumne, and Merced – and the health of the Bay-Delta estuary is of paramount importance.

The State Water Resources Control Board ("SWRCB") last meaningfully updated the Plan more than 20 years ago, and since that time, salmon populations have continued to decline, jeopardizing the state's salmon fishery and demonstrating the inadequacy of existing flow conditions to achieve the narrative salmon protection objective. While the SED proposes to increase flows, the available scientific evidence demonstrates that the proposal fails to provide the flow conditions necessary to achieve the Bay-Delta Plan's existing salmon protection objective, the proposed San Joaquin migratory fish viability objective, maintain fish in good condition, and protect the Public Trust. We therefore urge the SWRCB to adopt a flow range of 40-60% of unimpaired flow, and a starting point of 50%, consistent with the best available science and the requirements of State law.

In 2013, several of our organizations provided written comments demonstrating flaws with the 2012 proposal and analyses, emphasizing that the proposed flows were inadequate and higher flows were necessary. Those prior comments (TBI et al. 2013) are hereby incorporated by reference. Other state and federal agencies, including the California Department of Fish and Wildlife, likewise concluded that higher flow levels were necessary to achieve the existing narrative salmon protection objective and to protect the Public Trust. While the SWRCB has addressed several of those prior flaws, its revised proposal still fails to provide adequate flow conditions to protect and restore salmon and the health of these rivers. On the pages that follow, we emphasize that:

I. The Narrative Objective Must Be Revised to Be Consistent with the Existing Narrative Salmon Protection Objective, and the SED Must Demonstrate that the Program of Implementation is Likely to Achieve that Objective;
II. The SED and Existing Scientific Information Demonstrates that Current Flows Violate Section 5937 of the Fish and Game Code, and the SWRCB Must Ensure that Instream Flows Below Reservoirs Are Sufficient to Maintain Fish in Good Condition;
III. The SED Fails to Utilize Scientifically Sound Analyses Regarding the Effects of Flow Alternatives on Fisheries and Ecosystems, the SED fails to demonstrate that the Program of Implementation is Likely to Achieve the Narrative Salmon Protection Objective and the San Joaquin Migratory Fish Viability Objective, and the Preferred Alternative Fails to Provide Flows that are Likely Adequate to Achieve the Narrative Salmon Protection Objective or Maintain Fish in Good Condition;
IV. The SED Fails to Analyze Potential Adverse Environmental Impacts of Waiving Instream Flow Requirements in Future Drought Emergencies, as Authorized in the Program of Implementation;
V. The Program of Implementation Fails to Ensure that Discretion in Flow Shaping and Volume will Achieve Water Quality Control Plan Objectives and the SMART Biological and Environmental Targets Used To Track Compliance And Effectiveness;
VI. The Program of Implementation Must Include Enforceable Carryover Storage Requirements in Upstream Reservoirs to Mitigate and Avoid Impacts, Consistent with the Substitute Environmental Document;
VII. The SED Fails to Consider the SWRCB's Legal Authority to Require Water Rights Holders to Invest in Habitat Restoration and Other Non-Flow Measures;

VIII. The SED's Analysis of Changes in CVP/SWP Water Exports is Flawed Because it Fails to Consider the Right of Upstream Water Users to Dedicate these Flows Under Section 1707;

IX. The SED Fails to Adequately Consider the Feasibility of Protecting Public Trust Resources Because it Fails to Consider Improvements in Water Use Efficiency and Alternative Water Supplies; and,

X. The SED's Analysis of Water Supply Impacts is Flawed and Overestimates Likely Impacts.

We urge the SWRCB to revise the SED and adopt higher instream flows, consistent with the best available science and the recommendations below and in TBI et al. 2013.

I. The Narrative Objective Must Be Revised to Be Consistent with the Existing Narrative Salmon Protection Objective, and the SED Must Demonstrate that the Program of Implementation is Likely to Achieve that Objective.

Our 2013 comments on the draft SED provided detailed explanation why the language of the proposed San Joaquin River inflow narrative objective must be revised to be consistent with the existing salmon protection objective (also known as the salmon doubling objective), and we provided proposed changes to the San Joaquin River inflow narrative objective to accomplish this requirement. *See* TBI et al. 2013 at 3-6. Our 2013 comments also addressed the legal requirement that the Board demonstrate that the program of implementation is likely to achieve the salmon doubling objective. *Id*. at 3; *id.*, Exhibit 2, at 10-11. In addition, our 2013 comments discussed at length how the SWRCB cannot balance away the achievement of the salmon doubling objective or the California Endangered Species Act ("CESA"), how the SWRCB must protect Public Trust resources to the extent feasible, and how the SWRCB must consider alternative water supplies in any balancing. *Id*. at 4, 42-46; *id*., Exhibit 2. Our 2013 comments regarding these points are hereby incorporated by reference; these comments apply to the narrative objective in the 2016 draft SED, to the SWRCB's duty to ensure that the flows are likely to achieve the narrative salmon protection objective and protect the Public Trust to the extent feasible, and to the limits on the SWRCB's authority to balance beneficial uses.

Unfortunately, in Appendix K of the draft 2016 SED, the SWRCB failed to change the language of the San Joaquin River inflow narrative migratory fish viability objective to be consistent with the narrative salmon protection objective, even though the draft San Joaquin River inflow narrative objective included in the 2011 Revised Notice of Preparation for this proceeding explicitly included the salmon doubling objective. *See* Revised Notice of Preparation, April 1, 2011, Attachment 2.[1] We have therefore enclosed with these comments an updated redline of

[1] Similarly, the conclusion of the 2012 Technical Report on the Scientific Basis for Alternative San Joaquin River Flow and Southern Delta Salinity Objectives, which is included in the 2016 Draft SED, explicitly references the

Table 3 (Appendix A), which includes proposed changes to the San Joaquin River inflow narrative flow objective to ensure it is consistent with the existing salmon protection objective.

On the other hand, in Appendix K of the revised 2016 SED, the SWRCB appropriately included San Joaquin River inflow as a numeric objective, not just a narrative objective as in the 2013 draft SED. We strongly support this change to include flows as a numeric objective. However, the draft language in Table 3 does not appear to allow for deviations from the running average to allow for adaptive implementation (flow shifting and flow shaping) to attain the plan objectives. We have therefore also enclosed with these comments a redline of Table 3 that provides appropriately limited discretion for adaptive implementation of the running average of flows.

In addition to our prior comments, on the pages that follow we provide additional detail regarding the Board's legal obligation to ensure that the measures included in this update of the Water Quality Control Plan are sufficient to provide the instream conditions that are necessary to achieve the existing narrative salmon protection objective.

More than 20 years ago, the SWRCB adopted the narrative salmon protection objective in the 1995 Bay Delta Water Quality Control Plan. And it has been nearly 30 years since California enacted the Salmon, Steelhead Trout, and Anadromous Fisheries Act into law in 1988, which first identified the State's salmon doubling program. Cal. Fish and Game Code §§6900 *et seq*. Yet as the SWRCB is well aware, salmon populations in the Stanislaus, Tuolumne, and Merced Rivers have not only failed to achieve the doubling objectives; rather, instead of increasing in abundance, on average salmon escapement has declined since the 1995 Plan was adopted.

The 1995 Plan stated that there was scientific uncertainty whether the numeric flow objectives would achieve the narrative salmon protection objective. 1995 Bay-Delta Water Quality Control Plan at 28; *State Water Resources Control Board Cases*, 136 Cal.App.4th 674, 775-76 (2006). The SWRCB made a similar argument in Decision 1641. *See* Revised Decision 1641, at 61 ("Implementing the narrative objective for salmon protection requires a long-term process. A period of actual operation meeting the numerical objectives in the 1995 Bay-Delta Plan or the measures under the SJRA/VAMP, coupled with adequate monitoring, is required before the SWRCB can determine whether additional implementation measures are needed to meet this objective."). In the 2006 plan, it is clear that the San Joaquin River inflow objectives were intended to achieve the narrative salmon protection objective. *See* 2006 Bay Delta Water

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salmon doubling objective in its draft narrative objective for San Joaquin River flow. *See* SED, Appendix C, at 3-56. This provides additional evidence that the proceeding is intended to provide the flows necessary to achieve the salmon doubling objective. Inexplicably, this language was not included in the draft narrative objective included in either the 2012 or 2016 draft SED. In addition, Appendix K to the 2016 revised SED references the doubling objective in identifying the biological goals and objectives for the program of implementation. SED, Appendix K, at 33 ("The salmonid biological goals for this program of implementation will be specific to the LSJR and its tributaries and will contribute to meeting the overall goals for each population, including the salmon doubling objective established in state and federal law."); *see* Hearing Transcript, Nov. 29, 2016, at 128-129.

Quality Control Plan, at 33 ("D-1641 did not require separate actions to implement the narrative objective for salmon because the State Water Board expects that implementation of the numeric flow-dependent objectives and other non-flow measures will implement this objective.").

However, there is now overwhelming scientific evidence that the flows required in the 1995 Plan for the Stanislaus, Tuolumne, Merced, and lower San Joaquin River are wholly inadequate to provide in-river survival of salmon necessary to achieve the objective. In fact, such scientific evidence has been available for more than a decade. For instance, the California Department of Fish and Game concluded more than a decade ago that:

> We noted, and the Draft Plan acknowledges, that salmon populations in the basin are below State and Federal "population doubling objectives" and, rather than increasing, are in fact declining. Further, the "equivalent fishery protection" standard, assumed to be achieved by the VAMP agreement and the State Water Board's adoption, remains unsatisfied. In your workshop, we and others presented substantial science-based evidence that these tributary salmon population long-term declines are directly related to magnitude, frequency, and duration of flow in the San Joaquin River during the spring.

Letter from Ryan Broddrick to Tam Dudoc, Nov. 8, 2006 at 2. In 2013, the California Department of Fish and Wildlife concluded that higher instream flows in the winter-spring period, in the range of 50-60% of unimpaired flow, were necessary to achieve the narrative salmon protection objective. CDFW 2013 (comments on 2012 SED). The SWRCB has acknowledged this scientific information regarding the decline of salmon populations in these tributaries and the primary importance that spring instream flows play in determining survival and abundance of salmonids. *See, e.g.,* SWRCB 2010; 2012 SED; 2016 SED.

As a result of this overwhelming scientific evidence regarding the inadequacy of existing flows in the 1995 Plan to achieve the narrative salmon protection objective, the SWRCB's obligation in this proceeding is to establish new instream flows necessary to achieve the narrative salmon protection objective. As we noted in our prior comments, the Court of Appeals emphasized in 2006 that:

> [d]etermining what actions were required to achieve the narrative salmon protection objective was part of the Board's obligation in formulating the 1995 Bay–Delta Plan in the first place. (See §§ 13050, subd. (j)(3) [a water quality control plan must include "[a] program of implementation needed for achieving water quality objectives"], 13242, subd. (a) [a "program of implementation for achieving water quality objectives" must include "[a] description of the nature of actions which are necessary to achieve the objectives"].)

> …
> If the Audubon Society parties are correct in their contention that scientific evidence shows the flows needed to achieve the narrative salmon protection objective must be greater than the Vernalis flow objectives of the 1995 Bay–Delta Plan, then that evidence may provide a basis for changing the Vernalis flow objectives in the next regulatory proceeding to review and revise the water quality control plan for the Bay–Delta.

State Water Resources Control Board Cases, 136 Cal.App.4th at 776-77. The court of appeals 1986 decision in *U.S. v. SWRCB* reached a similar conclusion, holding that, "Once the Board establishes water quality objectives which ensure reasonable protection of beneficial uses (§ 13241), the Board has the added responsibility to complete the water quality control plan by preparing an implementation program to achieve the water quality objectives." 182 Cal.App.3d 82, 119 (1986). Because the scientific evidence is available and overwhelming, now is the time to adopt flow standards to achieve the narrative salmon protection objective. Commercial and recreational fishermen, businesses, communities and conservation groups have waited – and suffered – decades for adequate flows to restore and sustain salmon populations on these rivers.

Moreover, the decision by the Court of Appeals in the *State Water Resources Control Board Cases* provides a strong rebuttal to argument that the Board could now approve flows less than those necessary to achieve the narrative salmon protection objective, or could approve a plan that substantially delays implementation of flows that are scientifically demonstrated to be likely to achieve the narrative salmon protection objective.[2] Although some water users argued that the SWRCB could substitute the Vernalis Adaptive Management Plan for the full San Joaquin River inflows called for under the 1995 Plan as part of a staged implementation of the San Joaquin River inflow objectives or as an interim, experimental stage of those objectives, the Court disagreed and concluded this would constitute an unlawful, de facto amendment of the 1995 Plan. 136 Cal.App.4th at 726-736. The court emphasized that nothing in the Plan itself expressly authorized a staged or delayed implementation of the Plan, notwithstanding the language of section 13242(b) of the Water Code, and that "regardless of the timing issue, the Board has failed to identify anything in the plan that authorized it to implement a flow objective other than the Vernalis pulse flow objective, even temporarily." *Id*. at 726-27. Moreover, as the Court noted, section 13247 of the Water Code requires that a water quality plan be implemented, preventing the Board from implementing measures less than those required by the plan without changing the plan itself. *Id*. at 730. And as noted above, there has been widespread scientific understanding, for more than a decade, that current flows are inadequate to achieve the narrative salmon protection objective, undermining any argument for further delay in achieving the objective.

[2] In addition, the Board does not have discretion to delay implementation of statutory obligations, including the statutory obligation under sections 5937 or 5946 of the Fish and Game Code that requires the owner of any dam to release sufficient flows from dams and reservoirs to maintain fish downstream in good condition. *See California Trout v. Superior Court*, 218 Cal.App.3d 187, 201, 203-211 (1990).

Finally, we note that the SWRCB's Notice of Preparation for Phase I did not notify the public of any potential changes to the narrative salmon protection objective, and instead limited the notice to changes to the San Joaquin River inflow objective and South Delta salinity objective. *See* Fourth Revised Notice, December 22, 2016. Indeed, as noted above, the 2011 revised notice explicitly included salmon doubling as part of the narrative flow objective for the San Joaquin River, *see* Revised Notice of Preparation, April 1, 2011, Attachment 2, and language in the SED references the salmon doubling objective in identifying the biological goals and objectives for the program of implementation for the San Joaquin River inflow objectives. SED, Appendix K, at 33. This proceeding is not proposing any changes to the narrative salmon protection objective, nor could the SWRCB do so. As we emphasized in our 2013 comments,

> …the salmon doubling requirements of state and federal law is an expression of the Board's responsibilities under the Public Trust. The Board must abide by the Legislature's determination that the doubling of natural production of salmon is a statewide policy (Cal. Fish & Game Code § 6902(a)) and the water quality control plan should be consistent with that policy. The salmon doubling policy is intended to ensure that the State does more than meet the absolute minimum requirements of the state and federal Endangered Species Acts. As with section 5937 of the Fish and Game Code, section 6900 et seq is a legislative expression of the Public Trust, and the Board lacks authority to balance away achievement of this state policy. (*See California Trout, Inc. v. State Water Resources Control Bd*., 207 Cal.App.3d 585, 622-625, 631 (1989); SWRCB Decision 1631 at 172; SWRCB Decision 1644 at 27; Exhibit 1).

TBI et al. 2013 at 3-4; *see also* TBI et al. 2013, Exhibit 2.

After more than 20 years of waiting, it is time for the SWRCB to adopt flow requirements for the Stanislaus, Tuolumne, Merced, and lower San Joaquin River that are likely to provide the instream flow conditions necessary to achieve the narrative salmon protection objective in the existing Plan. However, as discussed below, the proposal fails to provide flow and water quality conditions that are reasonably likely achieve the narrative salmon protection objective in the Plan.

II. The SED and Existing Scientific Information Demonstrates that Current Flows Violate Section 5937 of the Fish and Game Code, and the SWRCB Must Ensure that Instream Flows Below Reservoirs Are Sufficient to Maintain Fish in Good Condition.

For more than a century, California law has required the owner of any dam to release sufficient flows to maintain fish in good condition below the dam. Cal. Fish and Game Code § 5937. The requirements of section 5937 evolved from a series of statutory protections for instream flows and fisheries, dating from California's earliest days of statehood. *See* Karrigan Bork et al., The Rebirth of California Fish and Game Code § 5937: Water for Fish, 45 U.C. Davis L. Rev. 809 (2012). The protections required by section 5937 or its predecessors have been in place since dams were constructed on the Stanislaus,[3] Tuolumne, and Merced Rivers, particularly the more recent and larger reservoirs.

Despite these legal protections, the scientific evidence in the SED and in other sources unambiguously demonstrates that salmon and other native fish below the dams on these three tributaries have not been maintained in good condition. For instance, despite historically being the largest run on many of these rivers, spring run Chinook salmon have largely been extirpated from these rivers (although remnant populations have been discovered on the Tuolumne and Stanislaus Rivers in recent years). *See, e.g.*, SED at 7-16 to 7-17; NMFS, 5-Year Review: Summary and Evaluation of Central Valley Spring-run Chinook Salmon Evolutionary Significant Unit, April 2016.[4] Similarly, despite historically large populations, Central Valley Steelhead currently is listed as a threatened species under the federal Endangered Species Act, with only remnant populations remaining on these rivers. SED at 7-17 to 7-18, 7-32. In 2016, NMFS concluded that this distinct population segment remained at risk of extinction, and observed that only small numbers of wild steelhead (as opposed to hatchery produced steelhead) were observed in recent years in most of the Central Valley monitoring programs. NMFS, 5-Year Review: Summary and Evaluation of Central Valley Steelhead Salmon Evolutionary Significant Unit, May 2016.[5] Populations of fall run Chinook salmon, the backbone of the State's salmon fishery, have remained low in most years on these rivers. SED at 7-15, 7-32 to 7-33, 7-36 to 7-38, 7-40 to 7-41. According to data from CDFW, the abundance of fall run Chinook salmon on the Tuolumne and Merced Rivers have declined substantially since the 1980s, and on all three rivers have exhibited clear boom and bust cycles with extremely low abundance in dry years and droughts. TBI et al. 2013 at 4-5; Cal. Dept. of Fish and Wildlife, California Central Valley Chinook Population Database Report, GrandTab 2016.04.11.[6] Moreover, the majority of fall run

[3] The Ninth Circuit Court of Appeals has recently reaffirmed the legal duty of the Bureau of Reclamation to comply with section 5937, holding that, "This code section not only allows, but requires BOR to allow sufficient water to pass the Lewiston Dam to maintain the fish below the Dam. The use of the unconditional "shall" indicates that such required releases are not dependent on having a proper water permit." *San Luis & Delta Mendota Water Authority v. Haugrud*, __ F.3d ___, 2017 WL 677537 at *12 (Feb. 21, 2017).

[4] This report from NMFS is available online at: http://www.westcoast.fisheries.noaa.gov/publications/status_reviews/salmon_steelhead/2016/2016_cv-spring-run-chinook.pdf and is hereby incorporated by reference.

[5] This report from NMFS is available online at: http://www.westcoast.fisheries.noaa.gov/publications/status_reviews/salmon_steelhead/2016/2016_cv-steelhead.pdf and is hereby incorporated by reference.

[6] This report is available online at: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=84381&inline=1 and is hereby incorporated by reference.

Chinook salmon that return to spawn on these rivers are hatchery fish, demonstrating that natural production of fall run Chinook salmon is even worse than absolute abundance and escapement numbers indicate. *See* Melodie Palmer-Zwahlen and Brett Kormos, Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement, Inland Harvest, and Ocean Harvest in 2012, California Department of Fish and Wildlife Administrative Report 2015-4, November 2015;[7] Melodie Palmer-Zwahlen and Brett Kormos, Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement, Inland Harvest, and Ocean Harvest in 2011, California Department of Fish and Wildlife Administrative Report 2013-2, December 2013;[8] Brett Kormos, Melodie Palmer-Zwahlen, and Alice Low, Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement and Ocean Harvest in 2010, California Department of Fish and Wildlife Administrative Report 2012-2, March 2012.[9]

Moreover, the overwhelming scientific evidence in the SED, our prior comments on the SED and these comments on the revised SED, and comments of other state and federal fishery agencies in this proceeding demonstrate that the failure to maintain fish in good condition below dams on the Stanislaus, Tuolumne and Merced Rivers is a result of the failure to release sufficient flow downstream. *See, e.g.*, SWRCB 2010; TBI et al. 2013; CDFW 2013; NMFS 2013; SED, Appendix C. As a result, there can be no question that these dam owners are and have been in violation of section 5937 of the Fish and Game Code.

The SWRCB has an obligation in this proceeding to ensure that instream flows are sufficient to maintain fish in good condition below these reservoirs, and cannot seek to balance away achievement of these statutorily mandated expressions of the Public Trust. *See California Trout v. State Water Resources Control Board*, 207 Cal.App.3d 585 (1989); TBI et al. 2013 at 45. Moreover, the Board cannot unreasonably delay the imposition of adequate permit terms and conditions to protect these Public Trust values. *California Trout v. Superior Court*, 218 Cal.App.3d 187 (1990). Chapter 1 of the SED should be revised to acknowledge the Board's authority and obligations under section 5937 of the Fish and Game Code.

For decades, water rights holders on the Stanislaus, Tuolumne, and Merced Rivers have reaped the water supply and other benefits of reservoirs and dams on these rivers, while failing to meet their responsibilities to maintain fish in good condition. There is no time for further delay. The SWRCB must take timely action to impose terms and conditions that require the release of

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[7] This report is available online at: http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=112524 and is incorporated by reference.
[8] This report is available online at: http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=75609 and is incorporated by reference.
[9] This report is available online at: http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=44306 and is incorporated by reference.

sufficient flow to maintain fish in good condition below the dams and reservoirs on these three rivers.

III. The SED Fails to Utilize Scientifically Sound Analyses Regarding the Effects of Flow Alternatives on Fisheries and Ecosystems, the SED fails to demonstrate that the Program of Implementation is Likely to Achieve the Narrative Salmon Protection Objective and the San Joaquin Migratory Fish Viability objective, and the Preferred Alternative Fails to Provide Flows that are Likely Adequate to Achieve the Narrative Salmon Protection Objective or Maintain Fish in Good Condition.

As discussed above, the Board must demonstrate that its water quality control plan is reasonably likely to attain plan objectives. Regarding the existing narrative salmon protection objective, that means that the plan must provide for levels of fresh water flow that are consistent with attaining natural production of Chinook salmon that is double the 1967-1991 average production[10] for each of the three San Joaquin tributaries. With regard to the SED's focus on maintenance of "viable" populations, the Board needs to demonstrate that its plan supports appropriate levels of all attributes that define a viable population, including abundance (e.g., production), productivity (e.g., survival rates), life history diversity, genetic diversity, and spatial distribution of populations (McElhaney *et al*. 2000; Lindley *et al.* 2007).

A variety of tools and data sets exist that permit analysis of the potential for plan alternatives to meet plan objectives; however, the SED does not employ these tools and data sets to demonstrate the adequacy of its preferred alternative. In addition, the SED does not address the need to restore self-sustaining populations of spring-run Chinook salmon to the lower San Joaquin River's three main tributaries (NMFS 2014; Franks 2012). As a result, the SED does not employ the best available science regarding the effect of flow levels on attainment of plan objectives.

a. The SED fails to adequately analyze the environmental impacts of alternatives because it fails to consider the best available scientific information showing the strong relationships between flow rates, volume, and variability with salmon survival

In our comments on the draft 2012 SED, we presented evidence of strong positive relationships between Chinook salmon escapement (and production) and several flow metrics. However, although the SWRCB has acknowledged these relationships and confirmed the likely causal connection between freshwater flow rates in the winter-spring and subsequent salmon abundance, *see, e.g.*, SWRCB 2010, the SED fails to analyze the effect of its flow alternatives in

[10] Production is the number of Age 2+ salmon in the ocean that emanate from a given watershed. The number is currently estimated based on subsequent escapement (return of adults to each watershed) and assumptions about survival of migrating adults and hatchery contributions to escapement.

light of these relationships in a scientifically credible manner. As we discuss below, there is strong scientific support for these prior analyses, and more recent scientific information that was not available in 2012. The SED must be revised to include analyses of the alternatives that accounts for the effect of these relationships on production / subsequent escapement.

1. *Production and escapement of San Joaquin salmon is strongly correlated with river flow rates during the months of egg incubation and juvenile migration; no other variable explains the pattern of salmon escapement to the San Joaquin River's main tributaries through time.*

In our previous comments (TBI et al. 2010, Ex. 3; TBI et al. 2013), we demonstrated that winter-spring flows at Vernalis are correlated with salmon production in the ocean. Similar analyses of the relationships between instream flows and subsequent escapement (or production) of Chinook salmon were included in the SWRCB's 2010 Flow Criteria Report, which the SWRCB concluded was based on the best available science. SWRCB 2010 at 56-60, 119-121; *see also* Figure 1. These and similar analyses were included in the SED, as a technical appendix on the scientific basis for San Joaquin River flow objectives. SED Appendix C.

Recently, we explored the flow-abundance analysis by investigating whether factors in addition to seasonal flow levels (as measured at Vernalis) were significantly correlated with historical San Joaquin salmon escapement. Although it has been suggested that density of predators on juvenile salmon, such as Striped Bass, plays a role in the decline of San Joaquin salmon population, *see, e.g.*, draft SED at 7-35 and 7-46, a recent analysis of the effect of predator density on Central Valley Chinook salmon productivity and abundance (Grossman 2016) concluded:

> … it has recently been proposed that Striped Bass populations be significantly reduced to facilitate recovery of endangered Central Valley Chinook Salmon …[however] the most likely outcome of Striped Bass removal is that a competing predator will increase in abundance and there will be little reduction in predation mortality for Chinook Salmon. It is likely that the most productive management strategy for decreasing predation on Chinook Salmon and other Delta fishes is to restore natural habitat and flows, especially in predation hot spots.

Grossman 2016 at 16. Moyle and Bennett 2010 raised similar concerns and noted that, "reducing the striped bass population may or may not have a desirable effect. In our opinion, it is most likely to have a negative effect. … We stress that attempting to reduce striped bass and other predator populations is unlikely to make a difference in saving endangered fishes, and will serve only to distract attention from some of the real problems." Moyle and Bennett 2010 at 3.

We analyzed whether a statistically significant relationship exists between adult Striped Bass abundance in the Delta and salmon escapement, and we found no significant negative correlation between annual indices of adult Striped Bass abundance in the Delta (Peterson Index; Stevens et al. 1985) in the year when salmon migrate to the ocean and San Joaquin River basin Chinook salmon abundance 2 or 3 years later when those same salmon return as adults (Figure 2).

Similarly, ocean conditions also have been posited as potential drivers of Central Valley Chinook salmon populations. That relationship is complex and likely results from an interaction between conditions that juvenile salmon experience in their freshwater habitat and those that they find when they enter the marine environment. For instance, Satterthwaite et al. 2014 found strong evidence of an interaction between ocean conditions and ocean entry timing of Central Valley Chinook salmon. Similarly, while documenting the potential linkage between ocean conditions in the mid-2000s and the subsequent fall-run Chinook salmon stock collapse and ocean fishery closure, Lindley et al. 2009 noted that: "…long-term declines in the condition of freshwater habitats are expected to result in increasingly severe downturns in abundance during episodes of poor ocean survival." Lindley et al. 2009 at 38. These authors also identified constrained life-history diversity among juvenile Central Valley Chinook salmon as a factor that magnifies the effect of ocean conditions on subsequent ocean production and escapement.

Both Pacific Decadal Oscillation (PDO; Mantua *et al*. 1997) and North Pacific Gyre Oscillation (NPGO; De Lorenzo *et al*. 2008) characterize variation in Pacific Ocean temperatures and have been linked to marine ecosystem productivity and salmon escapement; however, we found no statistically significant correlation between these two metrics and escapement of San Joaquin River salmon through time (Figure 3). The lack of significant linear statistical relationships between the historic pattern of San Joaquin River Chinook salmon production and ocean conditions does not mean that ocean conditions have no effect on salmon production, but it does suggest that ocean conditions are not responsible for the overall pattern in year-to-year salmon returns.

Finally, although year-to-year variation in hatchery production of Chinook salmon (both on the Merced River in the San Joaquin basin and on the nearby Mokelumne River) could potentially influence total San Joaquin River Chinook salmon escapement, we found no statistical correlation between San Joaquin River adult escapement and prior releases of fish from the Merced hatchery or total annual Merced hatchery plus Mokelumne hatchery releases (Figure 4).

These statistical analyses provide additional scientific evidence that flow is the strongest determinant of San Joaquin Chinook salmon escapement 2.5 years later. The SED should be modified to evaluate the likely effect of its flow alternatives on future abundance of San Joaquin salmon using the empirical relationship between Chinook salmon abundance in the San Joaquin's tributaries and flow levels as measured at Vernalis. Under current landscape conditions (e.g., geometry of the tributaries and lower San Joaquin River) and reservoir operations, the persistent and significant relationship between flow levels (measured at Vernalis during winter-spring in year x+1) and subsequent escapement (measured in year x+3) is a reasonable tool for predicting future abundance of salmon in response to changes in flow levels. This relationship could be further refined by incorporating spawning stock into the flow-abundance relationship (e.g., to account for the apparently strong, flow-dependent carrying capacity limitation on production of juvenile Chinook salmon from some San Joaquin River tributaries. Sturrock and Johnson 2016 presentation to the SWRCB; *see infra*).

2. *The SED fails to acknowledge or analyze recurrence frequency of flow levels that the Board and CDFW acknowledge are associated with viable populations or the attainment of population abundance levels required by state and federal law.*

Productivity (survival rate) in fresh water that supports rapid population growth, up to system carrying capacity, is an essential feature of Chinook population viability (McElhany et al. 2000; Lindley et al. 2007). As a result, both the SED's proposed narrative objective ("viable" populations of Chinook salmon on the San Joaquin tributaries) and the requirement of state law that reservoirs release flows sufficient to maintain populations of fish below dams in good condition (Cal. Fish and Game Code § 5937) require that flow rates and other environmental conditions support the potential for rapid population growth in most years. High fecundity and typical egg and juvenile survival rates make Chinook salmon populations capable of explosive growth (Healy 1991; Quinn 2005; SEP 2016[11]). For example, Quinn 2005 (Table 15-1) reports average survival rates from a range of managed Chinook salmon populations of 17.5 adults per spawning female. The health and viability of salmon populations rely on intense competition on the spawning grounds, which result from high survival rates throughout earlier stages of the life cycle. Indeed, the ecology, behavior, and even morphology of Chinook salmon are shaped by intense competition for mates and spawning territories in populations where abundance is most often limited by constrained carrying capacity for spawning salmon (e.g., Healy 1991; Quinn 2005).

Numerous studies presented to the SWRCB (e.g., CDFG 2010; TBI et al. 2010, exhibit 3; TBI et al. 2013) demonstrate the relationship between average winter-spring flow levels in the San Joaquin River at Vernalis >5,000 cfs and subsequent increases in Chinook salmon escapement. In our analyses of the effect of the flow alternatives in the 2012 SED, we found that achieving the necessary recurrence frequency of years with ≥5,000 cfs seasonal average flow (the threshold associated with potential population growth) would require a flow regime of between 50-60% of the San Joaquin's unimpaired winter-spring flow (TBI et al. 2013). In the absence of a change in the San Joaquin flow-population growth relationship, flow prescriptions <50% UIF are likely to result in a low frequency of salmon population growth that is inconsistent with attainment of the

[11] The final report of the Scientific Evaluation Process (SEP 2016) is enclosed as Appendix B.

narrative salmon protection objective or the narrative San Joaquin migratory fish viability objective. The SED fails to analyze the effects of flow alternatives in achieving these flow rates and the likely effects on subsequent escapement based on this relationship. The SED should be revised to do so.

The SED also fails to analyze the recurrence frequency of average winter-spring flow levels that are believed to correspond with attainment of the AFRP doubling target, and thus the existing salmon protection objective. TBI et al. 2010, exhibit 3 found that San Joaquin salmon populations approached target levels when average March-Jun flows were >10,000 cfs. To generate average flows >10,000 cfs during the winter-spring period in ½ of years, a flow prescription between 60-75% of unimpaired flows would be necessary (TBI et al. 2013). Under current conditions, flow prescriptions that require <60% UIF are unlikely to result in adequate habitat space for production of the number of juvenile salmon that are necessary to attain the doubling objective.

Regarding flow levels associated with population growth (>5,000 cfs Mar-Jun average) and target abundance (>10,000cfs Mar-Jun average), the State Board concluded:

> "Available scientific information indicates that average March through June flows of 5,000 cfs on the San Joaquin River at Vernalis represent a flow threshold at which survival of juveniles and subsequent adult abundance is substantially improved for fall-run Chinook salmon and that average flows of 10,000 cfs during this period may provide conditions necessary to achieve doubling of San Joaquin basin fall-run. Both the AFRP and DFG flow recommendations to achieve doubling also seem to support these general levels of flow…."

SWRCB 2010 at 119.

Attainment of these seasonal average flow levels on San Joaquin salmon escapement will not be affected by manipulation of the hydrograph within the winter-spring months ("flow shaping") because they are based on the volume of flow during the season. Of concern, however, is that in some of its alternatives the SED allows water that would otherwise flow during the Feb-Jun period to be retained in storage until later in the year (or subsequent years) in order to manage reservoir storage ("flow shifting"). Any shifting of flow out of the Feb-Jun period will necessarily result in a lower volume of flow during this season, and such flow shifting therefore is very likely to **reduce** the frequency of meeting or exceeding the critical seasonal average flow thresholds described above.

The analyses presented in our prior comments, as updated here, remain valid. These analyses demonstrate that the Preferred Alternative is unlikely to achieve the existing narrative salmon protection objective in the Plan or the proposed San Joaquin migratory fish viability objective in the SED. The SED should be revised to include these and/or similar analyses of the effects of the flow alternatives on subsequent salmon escapement, production, and/or on juvenile survival.

3. *The SED fails to examine the relationships between river flow rates and both juvenile salmon productivity and the life-history diversity that leads to greater population resilience in the face of uncertain conditions in the Delta, Bay, and Pacific Ocean environments.*

The best available science demonstrates that the relationship between freshwater flow rates during egg incubation and juvenile rearing and migration and Chinook salmon escapement back to the San Joaquin Rivers tributaries ~2.5 years later can be explained by increases in (a) juvenile salmon productivity (i.e., the number of juveniles leaving a San Joaquin tributary per adult salmon returning to that tributary the previous fall) and/or (b) survival of juvenile salmon in environments downstream of the tributaries and mainstem San Joaquin River (i.e., in the Delta, Bay, and/or marine environments) as a result of conditions experienced in the freshwater environment.

Zeug et al. 2014 documented a strong positive relationship between both flow volume and flow variance and juvenile salmon outmigration from the Stanislaus River relative to adult escapement the prior fall. Their analysis found that the cumulative volume of flow during the 120 day rearing period in the winter/ spring months was the strongest predictor (R^2=0.68) of juvenile salmon survival between the rotary screw trap ("RST") at Oakdale (near the bottom of the spawning reach) and the RST at Caswell, 9 km upstream from the confluence with the lower San Joaquin River. Similarly, discharge variance (the variability of flow during this period) was a strong predictor of survival between these RSTs on the Stanislaus River (R^2=0.66).[12] Their analysis also concluded that increased cumulative flow volume and flow variance during the rearing period resulted in higher numbers of pre-smolts successfully migrating downstream. The authors concluded that:

> A strong positive response in survival, the proportion of pre-smolt migrants and the size of smolts were observed when cumulative flow and flow variance were greater. Together, these data suggest that periods of high discharge in combination with high discharge variance are important for successful emigration as well as migrant size and the maintenance of diverse migration strategies.

[12] As the U.S. Fish and Wildlife Service demonstrated in its presentation to the SWRCB at the January 2017 hearing date, a longer averaging period for flows (7 days vs 3 days) results in reduced flow variability. In addition, flow shaping is also likely to reduce flow variability.

> Survival of migrating juveniles was higher when both cumulative discharge and discharge variance were greater.

Zeug et al. 2014 at 9. The analysis presented in our 2010 and 2013 comments demonstrated that average flow rates (which is simply a different expression of total volume) during the rearing period result in higher subsequent escapement. Zeug et al. 2014 demonstrates that total flow volume during the winter/spring months explains much of the variability in juvenile survival during the rearing periods, with substantially higher survival resulting from higher flow volumes. The authors suggest that floodplain inundation, reduced exposure to predators, and higher turbidity are potential mechanisms explaining these relationships. The analysis presented in Zeug et al. 2014 could be used in the SED to analyze the likely effects of flow alternatives on survival in the Stanislaus River, and the SED should be revised to include discussion of Zeug et al. 2014.[13]

Similarly, SEP (2016) calculated egg-juvenile survival rates on the Stanislaus by estimating the number of eggs deposited by each annual cohort of adult Chinook salmon returning to the Stanislaus River and comparing that total to estimated juvenile abundance near the river's confluence with the San Joaquin River the following spring. Those data reveal uniformly poor survival (mean = 1.1%) when flows were <~438TAF (53% of the median year unimpaired flow) in the Feb-Jun period (Figure 5). In the six years when Feb-Jun flows were >438 TAF, estimated egg-to-outmigrant survival averaged 9.4%. In every year that flow was greater than this level, estimated survival was higher than the highest survival recorded when flows were below 438 TAF. Thus, for salmon that spawn in the Stanislaus River, juvenile survival rates that are consistent with population growth are very unlikely to occur under current conditions when Feb-Jun flows <53% of the median Feb-Jun unimpaired flow for the Stanislaus River. The frequency of years with flows greater than this threshold must increase substantially in order to encourage positive population growth rates to occur frequently, as they would in a viable salmon populations and one that is being maintained in good condition. Frequent population growth will be needed to attain the narrative salmon protection objective and frequent occurrence of juvenile survival rates that support population growth will be required to maintain the required abundance of salmon after the target is attained. As with our prior analyses, which demonstrated the importance of seasonal flow rates on San Joaquin salmon success, this analysis likewise demonstrates that the Preferred Alternative is unlikely to achieve either the proposed narrative San Joaquin migratory fish viability objective in the SED or the existing narrative salmon protection objective in the Plan, and that greater seasonal volume of flow (a metric that is unaffected by flow shaping) is required.

[13] The SED's use of a 7 day running average will result in greater variability than the 14 day running average proposed in 2012, although, as discussed *infra*, variability may be reduced or eliminated through flow shaping and shifting and variability would be increased through use of a 3 day running average instead.

SEP (2016) has calculated the spawner-to-juvenile outmigrant productivity levels that are needed to support population doubling (and thus the narrative salmon protection objective) within a reasonable amount of time on the Stanislaus River, and is developing analogous targets for the Tuolumne and Merced Rivers. By making reasonable assumptions regarding improvements to salmon survival in the Delta (an important outcome for Phase II of the SWRCB's Water Quality Control Plan Update), the SWRCB can determine productivity levels that are necessary to achieve the salmon protection and San Joaquin migratory fish viability objectives. A viable population would require survival rates that are typical of Chinook salmon populations in other watersheds throughout their range (e.g., Healy 1991; Quinn 2005). Indeed, survival rates necessary to serve each of these three goals (growth, resilience, species-typical) have been determined for the Stanislaus River population of Chinook salmon (SEP 2016) and analogous targets for the Tuolumne and Merced populations are in process. The SED should adopt these SMART (specific, measurable, attainable, relevant, and time-bound) biological targets in order to guide adaptive management and ensure attainment of the existing narrative doubling objective and proposed viability objectives.

Like productivity (population growth rates), life history diversity (e.g., the range of ages and body size at migration) is considered to be a key attribute of salmonid population viability (McElhany et al. 2000; Lindley et al. 2007). A diverse portfolio of life history types is believed to stabilize population dynamics and lead to greater population resilience (Lindley et al. 2009; Carlson and Satterthwaite 2011) by improving the prospect that at least some fraction of the migrant cohort will encounter favorable conditions in subsequent environments downstream – in other words, improvements in the distribution of life history types among juvenile migrants allows for improved average survival downstream (e.g., Satterthwaite et al. 2014). The importance of providing conditions that support juvenile life history diversity within salmon populations is an emerging theme in research on and management of Pacific salmon populations, including those in the Central Valley (Beechie et al. 2006; Lindley et al. 2009; Miller et al. 2010; Satterthwaite et al. 2014; Zeug et al. 2014; Sturrock et al. 2015). Indeed, Carlson and Satterthwaite (2011) recommended prioritizing restoration of San Joaquin Basin Chinook salmon populations as the most effective means of buffering the larger Central Valley Chinook salmon fishery against catastrophic population collapses.
Whereas much research has focused on smolts, fry and parr life history strategies are critically important to maintaining population viability of Chinook salmon populations on the San Joaquin tributaries (Sturrock et al. 2015; Sturrock and Johnson 2016 presentation to the SWRCB). For instance, Sturrock et al. 2015 wrote that:

> The loss of genetic and life history diversity has been documented across many taxonomic groups, and is considered a leading cause of increased extinction risk. Juvenile salmon leave their natal rivers at different sizes, ages and times of the year, and it is thought that this life history variation contributes to their population sustainability, and is

> thus central to many recovery efforts …. Juvenile [Chinook salmon] abundance and outmigration behavior [on the Stanislaus River in 2000 and 2003] varied with hydroclimatic regime, while downstream survival appeared to be driven by size- and time-selective mortality. Although fry survival is generally assumed to be negligible in this system, >20% of the adult spawners from outmigration year 2000 had outmigrated as fry. In both years, all three phenotypes contributed to the spawning population, however their relative proportions differed...

Sturrock et al. 2015 at 1.

Yet despite the SED's emphasis on "viable" salmonid populations, and the specific mention of genetic and life history diversity as indicators of viability in the proposed narrative San Joaquin migratory fish viability objective, the SED fails to analyze the effect of tributary and mainstem flow levels and flow variance on the production of different Chinook salmon or *O. mykiss* juvenile life history types. In addition to overall greater productivity in the egg-to-juvenile outmigrant segment of the salmon life-cycle, increases in winter-spring flow rates and variability correspond to increased production of fry and parr juvenile salmon life history types that contribute to subsequent adult returns (Figure 6; Sturrock et al. 2015; Zeug et al. 2014; Sturrock et al. *in prep*) and the size of outmigrating smolt (Zeug et al. 2014). The SED should incorporate results from these studies that demonstrate a relationship between flow volume and variability on production of a range of body sizes among juvenile Chinook salmon migrants. For instance, one way that the SED can analyze effects of flow alternatives on the timing of juvenile outmigration and life history diversity is to analyze the effect of flow alternatives on the duration of suitable migration temperatures.

Finally, the SED should adopt SMART targets for life-history diversity among San Joaquin River Chinook salmon juveniles. These targets can and should include a minimum seasonal period in which juvenile Chinook salmon migration is expected to occur and minimum distribution of size classes that should be detected during migrations. Such SMART targets have been developed for the Stanislaus River populations (both spring-run and fall-run) of Chinook salmon (SEP 2016) and are in process for the other two tributaries and lower San Joaquin River; the SED should incorporate these targets in order to ensure attainment of the narrative salmon protection objective, narrative San Joaquin migratory fish viability objective, and requirement that fish populations be maintained in good condition on the San Joaquin tributaries.

4. *The SED fails to analyze the need and potential for re-establishing self-sustaining viable populations of spring-run Chinook salmon in the lower San Joaquin River's three main tributaries and the positive effect that such restoration will have on the persistence of this run across the Central Valley and on the maintenance of the Chinook salmon commercial fishery.*

The number and diversity of somewhat independent units of Chinook salmon populations (their spatial distribution) is another key attribute of population viability (McElhany et al. 2000; Lindley et al. 2007). The San Joaquin River, and in particular, its Stanislaus River, Tuolumne River, and Merced River tributaries, historically supported some of the Central Valley's largest populations of spring-run Chinook salmon (Yoshiyama et al. 1998; Moyle 2002). These populations were extirpated at the end of the 20th century, but spring-run Chinook salmon (or, at least, Chinook salmon displaying behaviors typical of the spring-run evolutionary significant unit) have been observed recently in these waterways (e.g., Franks 2012) and restoration of multiple self-sustaining populations to Central Valley rivers draining the southern Sierra is a prime element in the NMFS' Endangered Species Act recovery plan for this species (NMFS 2014). Restoration of spring-run Chinook salmon populations in the Central Valley and eventual ESA de-listing will have important benefits to recreational and commercial fishing off the California coast (the spring-run's endangered status constrains the public fishery); the Board should analyze the effects of alternative flow levels on the restoration and maintenance of spring-run Chinook salmon populations below the dams on the Stanislaus, Tuolumne, and Merced Rivers.

b. The SED fails to examine how inadequate flows limit carrying capacity and the production of juvenile salmon populations from the three tributaries.

The SED fails to analyze how flow alternatives contribute to the existence of adequate habitat to support juvenile salmon production that is consistent with attainment of the narrative salmon protection objective. The maximum number of individuals of a given species that an area's habitat can sustain over the long term is known as the area's "carrying capacity." The carrying capacity of habitats on the San Joaquin Rivers tributaries and lower San Joaquin River mainstem must be adequate to support salmon doubling– in other words, there must be adequate space of sufficient quality to accommodate the number of spawning adults, eggs and juveniles, respectively, that are necessary to attain the production targets (i.e., after accounting for mortality between the different life stages). There is strong evidence that low flows cause insufficient carrying capacity (spawning/incubation habitat or juvenile rearing habitat or both) that limits production of juvenile salmon from the San Joaquin River's tributaries and on the lower San Joaquin River; at higher flow rates, carrying capacity constraints on juvenile production are reduced. The SED must analyze how flow alternatives affect the ability of the tributaries and lower San Joaquin River mainstem to achieve and maintain the salmon protection objective, and the influence of different flow levels on the potential for and efficacy of other approaches to generating additional habitat space (i.e., increasing carrying capacity). Below, we demonstrate that such analyses are possible using available data and tools.

Evidence suggests that the salmon carrying capacity of San Joaquin tributaries is driven by flow levels and that AFRP production targets cannot be achieved or maintained when low flow conditions occur frequently, as they do currently. The SWRCB's finding that seasonal average flows >10,000 cfs correspond with attainment of AFRP doubling objectives is consistent with the idea that habitat availability limits total population size on the San Joaquin tributaries. Similarly, Zeug et al. 2014 found that prior abundance of spawners is, in general, a poor predictor of juvenile survival/passage on the Stanislaus. In addition, in their 2016 presentation to the SWRCB, Sturrock and Johnson reported that the number of juvenile salmon produced on the Stanislaus River was unresponsive to the adult spawning stock in years with low winter-spring flow rates, but that production of juveniles (in all size classes studied) was well-correlated with the number of spawning adults in years with high flows (Figure 6; Sturrock et al. *in prep.; see also* SEP 2016). These findings indicate that carrying-capacity on the tributaries is limited at low flow conditions and increases at higher flows during winter and spring.

Flow-mediated carrying capacity may result from the effect of flow levels on a number of factors (or combination of factors) that are important determinants of salmon spawning and juvenile rearing and migration success. For example, through their effect on suitable temperatures, flow levels may affect the spatial and temporal availability of potential spawning and incubation habitat. Similarly, flow levels affect river temperature and availability of migration cues in ways that permit or prohibit successful juvenile rearing and migration. Also, river flow levels determine the magnitude and timing of availability of shallow off-channel rearing habitats that affect juvenile salmon growth and survival during their residence in fresh water (Sommer et al. 2001; Jeffres et al. 2008).

We note that the need for improved river flows to increase juvenile salmon survival and carrying capacity for various life history strategies on the San Joaquin River mainstem or its tributaries will not be eliminated (and, in some cases, may not even be reduced) as a result of physical manipulation of the riverbed or floodplain ("habitat restoration"). Indeed, the suitability of salmon habitat is an interaction of water quality (broadly construed) and the landforms that the water flows over and through. The relationship between the success of salmon habitat restoration and river flow rates is evident in the outcomes of restoration projects such as the multiple components of the "Special Run Pool 9 and 7/11" project led, in part, by Turlock Irrigation District and Modesto Irrigation Districts, which were intended to "reduce/eliminate habitat favored by predatory bass species and replace it with high quality Chinook salmon habitat" (TID and MID 2006 at ES-2) and increase juvenile Chinook salmon rearing habitat availability and quality, among other purposes.[14] Consultants to these water districts have admitted that post-project monitoring revealed that these projects largely failed to reduce density of salmon predators, increase Chinook salmon rearing habitat, or increase Chinook salmon survival; these

[14] This multi-part, multi-million dollar project, funded in part by CBDA, was the subject of a presentation to the State Water Board during its December 20, 2016 Modesto hearing on the Phase I SED.

outcomes were each attributed to low flows in the years that followed project implementation. For example, in explaining the "continued high abundance of smallmouth and largemouth bass at the SRP 9," the synthesis report concludes:

> The most important goal of the project was to increase Chinook salmon outmigrant survival. Several studies have identified a positive relationship between spring flows and Chinook salmon outmigrant survival from the Tuolumne River, as well as recruitment to the population in subsequent years (e.g., TID/MID 1992b, 2004a). This restoration project was based on studies conducted in the early 1990s that concluded that predation by largemouth and smallmouth bass was a significant source of density independent mortality for outmigrant salmon (TID/MID 1992a). *It is notable that this study was conducted during low flow years, when bass are expected to be most abundant (Brown and Ford 2002) and predator efficiency is expected to be high. The results may be most applicable to dry year conditions*.

TID and MID 2006 at 133 (emphasis added). The report then hypothesizes that the project may have successfully reduced the rate of river flow needed to provide a "safe velocity corridor" from >2000 cfs pre-project to >300 cfs post-project; discussion of other elements of the project reveal that "the greatest benefits of the project for rearing salmon occur during flows > 1,500 cfs." *Id*. at 135. The success or failure of these particular projects notwithstanding, it is clear that project proponents acknowledge that their benefits are flow-dependent and generally increase as flows increase. Thus, even if the SWRCB is presented with evidence that habitat restoration activities will occur on the tributaries or lower San Joaquin River mainstem, it cannot assume that these restoration activities will be protective of Chinook salmon populations without increases in river flow rates (below we address how the SWRCB should estimate the flow levels needed to provide benefits from one kind of habitat restoration – floodplain inundation).

The SED does not explore the carrying capacity of the San Joaquin River or its three main tributaries or the effect of flow regime alternatives on the imposition or alleviation of carrying capacity constraints on local Chinook salmon populations. Although it is possible that the current relationship between flow levels and carrying capacity for Chinook salmon juveniles (and thus, attainment of the AFRP doubling targets) could be affected by significant and widespread improvement in the quality and availability of off-channel rearing habitats (generically, "floodplains"), precise tailoring of releases to achieve particular environmental services, carryover storage requirements that improve temperature conditions, or a mixture of these approaches, the SED fails to analyze both the potential for this effect and the appropriate level of flow combined with specific levels of non-flow restoration. It is essential to analyze the interaction between the required flow regime and of any of these "alternatives" to flow, because the performance of these "alternatives" depends directly on the amount of water dedicated to environmental purposes. The SED must be modified so that it accounts for the effect of flow on available habitat and the efficacy of physical manipulations to the river (e.g., gravel augmentation or earth-moving on the floodplains) that are intended to expand carrying capacity for juvenile salmon.

c. The SED's analysis of the effect of flow alternatives on the availability of shallow inundated rearing habitat for juvenile salmon is flawed.

The SED acknowledges the importance of periodic inundation of shallow water habitats (loosely "floodplains") to the health and productivity of both aquatic and riparian ecosystems. SED at §19.3. The SED identifies specific benefits (including increased survival and growth) of short-term inundation for salmonid populations of the San Joaquin River valley as well as benefits that accrue to "steelhead, sturgeon, splittail…, bank swallow, western pond turtle, Fremont cottonwood and many other species." SED at 19-54. However, the SED does not describe a specific target for inundated floodplain habitat that is needed to support desired populations of salmon, populations of other organisms, or key ecosystem processes (e.g., food generation and transport; aquifer recharge; seedling germination) that rely on floodplain inundation. Instead, the SED reports a wetted-acre days metric in its assessment of the availability of shallow inundated salmon rearing habitat under different flow prescriptions, and the SED's analysis of changes in this metric boils down to 'more is better.' Because there is no quantified objective for salmon production (or other SMART targets), the SED does not provide a way to evaluate whether incremental changes in habitat availability, as indexed by "wetted acre days," produce meaningfully better outcomes that support viable salmonid populations and/or contribute to meeting salmon doubling targets.

In fact, "wetted acre days" is an inadequate indicator of actual useful habitat available to fish populations. Habitat is defined by numerous physical variables that can be measured in the field (e.g., cover and substrate) and measured or modeled assuming different flow conditions (e.g., depth, velocity, and duration of inundation). Acres that are inundated to a depth that is too shallow, for too short a period, at the wrong time, and/or that lack appropriate cover and substrate, may be included in the calculation of "wetted acre days," but they would provide little ecological value to migrating juvenile salmon and other fish.

In contrast to the approach in the SED, the Central Valley Flood Protection Plan (CVFPP; CDWR 2016a) modeled the habitat needed to support the salmon doubling objective for fall run Chinook salmon, including habitat needs in the San Joaquin Basin. As explained in more detail in the attached appendix to these comments (Appendix C), the CVFPP used estimated mortality rates for Chinook salmon after they exit Central Valley rivers to determine the number of juveniles that would need to exit each Central Valley tributary in order to result in AFRP production targets for that tributary (i.e., [number of juveniles exiting rivers] = [AFRP population natural production target] ÷ [post-riverine survival rate for Central Valley Chinook salmon]) and then used the Emigrating Salmonid Habitat Estimation model (ESHE; SJRRP 2012) to determine the number of acres of suitable rearing habitat required to support that number of juveniles. EHSE employs user-defined inputs (including field and laboratory estimates) of Chinook salmon juvenile growth, migration rate, and territory size, spawning location and timing (where and when fish enter the model), initial abundance, and mortality rates to estimate total habitat need in defined river reaches for each day that juvenile salmon are in the river. After "fish" enter the model, the population need for habitat at any location changes as individuals grow, migrate, and die. For each reach, the maximum habitat area needed on any one day during the migration season represents the total inundated habitat acreage needed in that reach to support the juvenile population that will lead to AFRP doubling targets. The sum of these reach-specific maxima across a river is the total area of inundated habitat needed on that river.

The SED should use the ESHE model to analyze rearing habitat required on the three tributaries and the lower mainstem San Joaquin River to support required salmon populations. The estimate of required rearing habitat for each waterway should be incorporated into the final SED as SMART environmental targets that guide adaptive implementation of plan. Below, we illustrate the proper approach to estimating habitat needs necessary to support the existing narrative salmon protection objective.

We analyzed the potential for different flow regimes (30-60% UIF as a 7-d running average) to produce CVFPP 2016 estimates of habitat need in the Stanislaus, Tuolumne, and Merced Rivers during the median year of inundation (which differs from the median year of volume; *see* Appendix D). The ESHE model estimates acreage of habitat required to support a target population assuming that each of the acres is 100% suitable; however, perfect habitat suitability is never found in the real world, so ESHE habitat estimates must be expanded based on an estimate of habitat suitability (i.e., [total actual rearing acreage required] = [ESHE estimated acreage] ÷ [habitat suitability][15]). We made several liberal assumptions regarding how much suitable rearing habitat would be generated by different flow regimes. For example, we assumed that available floodplain acreage would be relatively high quality when inundated for the proper duration (i.e., mostly appropriate depth, flow velocity, cover, etc.). Floodplain habitat must be inundated for a certain amount of time in order to attain high quality. Specifically, in low gradient areas, habitat must inundate for a minimum of 10 consecutive days before it will begin to generate significant prey items for Chinook salmon (Jeffres *unpublished data*) and reaches high levels after approximately 14 days (Grosholz and Gallo 2006); thus, we assumed that inundated habitat through the lower half of the tributaries and all of the lower San Joaquin mainstem would reach high suitability after 10 days. High gradient floodplains generate a different kind of food supply more quickly (i.e., terrestrial invertebrates that fall into the water

[15] Habitat suitability is expressed as a percentage of perfect suitability.

column; R. Henery, California Science Director for Trout Unlimited, *personal communication*), so we assumed that those reaches of habitat would reach their highest suitability after just 3 days of inundation. We also assumed that the timing of peak habitat need corresponded with the timing of peak flow (i.e., habitat inundation).

Our analysis revealed that, under current conditions, the full acreage of habitat identified in the CVFPP (2016) will not be inundated on any of the tributaries or the lower mainstem San Joaquin River during the median year of inundation, assuming a 7d average of unimpaired hydrograph (Figures D2 through D-5, Appendix D). This is a result of the current geometry (e.g., levees, incised channels) of these rivers; habitat restoration involving significant earth-moving will be necessary to increase the area inundated under future flow regimes. If reservoir releases are timed optimally ("flow shaping"), a flow regime between 50-60% UIF will inundate all of the targeted rearing habitat needed required in the lower San Joaquin in the wettest one-third of years (i.e., the 33% exceedance year for floodplain inundation; Figure D-6, Table D-4, Appendix D). Even in such an above-normal year, flow prescriptions ≤40% will not result in any days of complete inundation of the necessary habitat and will require that more than 5100 ac of habitat to be restored to a condition that will inundate under the 40% UIF hydrograph (and almost 6800 ac under the 30% hydrograph).[16]

Migrating juvenile salmon require rearing habitat throughout the course of their migrations (or, more accurately, individuals require feeding and resting habitat wherever their metabolism demands on their journey – the distribution of those different individual needs creates a need for well-distributed habitat along the migratory corridor). It is worth noting that outputs from the ESHE model can be used to determine the optimal spatial (and temporal) distribution of Chinook salmon rearing habitat. The SWRCB should evaluate habitat distribution results from new ESHE model runs as candidates for environmental objectives to include in the final SED.

Our estimates, based on CVFPP findings, illustrate the approach the SWRCB should take to (a) develop SMART environmental targets for rearing habitat and (b) evaluate how different flow levels contribute to attainment of those habitat targets. However, the model can and should be re-run for the final SED in order to incorporate appropriate assumptions. For example, because

[16] The necessary inundated habitat acreage may be achieved with less physical habitat restoration if habitat is restored to higher suitability than that assumed here or by using more aggressive flow shaping (effectively creating temporary flows that reflect much higher % UIF flow prescriptions). Aggressive flow shaping would require "borrowing" flows from other parts of the Feb-Jun measurement period which could result in negative conditions for juvenile salmon (e.g., increased temperature, poor migration cues, less habitat inundation) during the period from which the needed water was "borrowed" (*see* Temperature Appendix E). For example, flow could be reduced in the early part of the season because the size of the block (i.e., the seasonal volume of unimpaired flow) is highly uncertain until at least April. However, reductions in flows during the early part of the Feb-Jun period will tend to reduce success of the fry outmigrant life history type, which represents an important component of subsequent escapement and overall life history diversity on the tributaries (Zeug et al. 2014; Sturrock et al. 2015; Sturrock et al. *in prep.*). As noted above, flow shaping is also likely to result in reduced flow variability, and Zeug et al. 2014 demonstrates that decreased flow variability is associated with decreased migratory survival.

available habitat is likely to be of lower quality than we assumed, the habitat needs we identified from CVFPP outputs likely underestimate the actual need for inundated habitat acreage on the tributaries and the lower San Joaquin River mainstem to achieve either the existing narrative salmon protection objective.[17] Similarly, because the timing of peak habitat need and the timing of peak flow may not match, the flow-habitat levels identified in our example may underestimate the % UIF required to inundate the requisite habitat. Also, the CVFPP estimates did not cover habitat needs upstream of the CVFPP's geographic purview and so they do not include habitat needs in the upper reaches of the rivers. Furthermore, juvenile salmon survival rates assumed in the CVFPP do not account for likely improved future survival rates in the tributaries and in the Delta that result from improved standards in Phase I and Phase II. Finally, the CVFPP habitat estimates do not account for fish entering the lower San Joaquin River from the SJRRP reaches upstream of the Merced confluence; the SWRCB should account for the flow and habitat related needs of restoration program fish as they migrate through the lower San Joaquin River. The SEP (2016) has developed SMART targets for the extent of rearing and spawning habitat in the Stanislaus River and analogous objectives for the Tuolumne, Merced, and lower San Joaquin Rivers are in process, as are targets that specify the proper distribution of that habitat; the Board should adopt these targets to guide adaptive implementation of the plan and ensure that the tributaries and lower San Joaquin mainstem are a capable of supporting the existing narrative salmon protection objective as well as the survival and life history diversity targets associated with the proposed narrative San Joaquin migratory fish viability objective.

Regardless of specific inputs and outputs, our habitat analyses illustrate relationships between flow and availability of inundated salmonid rearing habitat that have important implications for the feasibility and implied costs of any flow regimes for the San Joaquin tributaries and mainstem. In general, at higher flow levels:

- <u>More habitat acreage will be inundated</u>. For example, our analysis indicates that 3,820 additional acres of habitat would be inundated in the median year for inundation on the tributaries and lower San Joaquin mainstem under a 60% flow alternative than under a 30% UIF flow regime
- <u>Less habitat restoration will be needed</u>. In our example, the increase in inundated habitat produced by differing flow levels alone resulted in a 28% reduction in the amount of habitat that would need to be restored under a 60% UIF versus a 30% UIF flow regime
- <u>Less flow shaping will be necessary</u> to achieve the desired inundated habitat acreage and duration. As a result, the risk of modifying the hydrograph in a way that produces poor conditions for migrating or rearing juvenile salmon is reduced.
- <u>Availability of potential restoration sites increases</u>. A greater range of elevations can be inundated under higher river stages that would accompany flow regimes of 50-60% UIF than would occur under those ≤40% UIF; this translates to a greater acreage of potential restoration sites.

[17] This analysis is focused solely on habitat needs for fall run Chinook salmon, not on spring run Chinook salmon or other species.

- The cost of needed habitat restoration will decrease, as will the time and resources needed to complete the necessary habitat restoration.

In short, habitat restoration will be necessary to reconnect the tributaries and lower mainstem San Joaquin Rivers to an acreage of their floodplains that is sufficient to support target salmon populations; however, the amount of restoration and cost of the required earth-moving decrease at higher flows and the availability of potential restoration sites increases under higher flow prescriptions. The analysis in the SED is flawed because it does not analyze the benefits of different flow prescriptions with respect to a population objective (i.e., the existing doubling targets); such an approach is necessary to generate SMART targets for rearing habitat. As a result, the SED ignores major societal obligations, costs, and obstacles associated with low flow prescriptions; any cost-benefit analysis of the SED's different alternatives is incomplete and biased without accounting for the effect of flow regimes on habitat availability.

Failure to attain the habitat restoration targets identified by the CVFFP (or more refined estimates that should be produced) should not be interpreted to mean that attainment of the existing narrative salmon protection standard is not possible. Rather, challenges in attaining needed rearing habitat for salmon reveal limitations on the potential for this management option to replace the need for flow and its associated in-channel habitat improvements (e.g., attainment of satisfactory temperatures). If inundated rearing habitat needs are not satisfied on the tributaries, additional improvements to in-channel survival upstream will need to be combined with additional rearing habitat downstream (i.e., in the lower San Joaquin River mainstem or the Delta).

d. The SED's analysis of the effect of flow alternatives water temperature conditions in the San Joaquin River and its tributaries is flawed.

Analyzing temperature effects of different flow management alternatives is valuable because temperature dictates many processes and outcomes in the aquatic environment, particularly for ecothermic (cold-blooded) organisms like salmon, their prey, and many of their predators. However, temperatures must be linked to actual biological relationships and thresholds in order to understand the effect of temperature differences among alternatives. The draft SED presents all temperature changes of 1^{o}F as though they have equal benefit, regardless of the absolute temperatures or life stages involved. However, as discussed below, the approach in the SED is scientifically inaccurate.

Temperature tolerances differ among Chinook salmon life stages and are characterized by thresholds and curvilinear effects (Temperature Appendix E, Figure E-2). For example, a 1^{o}F temperature difference between alternatives that both produce lethal results, detrimental results, or optimal results is not a biologically meaningful outcome. For any life stage, temperature changes in the range between "optimal" and "detrimental" (i.e., within the "sub-optimal" range of temperatures; *see* SEP (2016) for a discussion of the terms “optimal”, “sub-optimal”, and “detrimental”) are likely to produce real biological effects that translate to differences in population dynamics; however, within the “sub-optimal” temperature range, a 1^{o}F change between two alternatives will have different population consequences depending on where the absolute temperatures fall in the “sub-optimal” range. As a result of its simplistic rule for identifying meaningful temperature differences among alternatives, the SED fails to identify significant effects of its flow alternatives and implies that there will be different outcomes even when and where none are likely.

We analyzed the potential for different flow alternatives described in the draft SED to produce temperature-related effects that would translate to meaningfully different biological outcomes, including those that may prevent the tributaries from supporting required populations of salmon (Appendix E). We used temperature modeling results presented in Chapter 19 of the draft SED and temperature thresholds reported in USEPA (2003) and SEP (2016). Chapter 19 of the SED employs USEPA (2003) thresholds as a benchmark for effects. SEP (2016) also uses the USEPA values but includes additional temperature levels found in the literature that define “optimal” conditions and biologically significant thresholds that fall in the temperature range between EPA’s beneficial and its lethal thresholds; this latter set of intermediate temperature thresholds allowed us to distinguish between “fair” and “poor” temperature conditions (Appendix E, Figure E-2). The overarching point is that a range of temperature related effects with real biological significance occur between well-defined temperatures that create “optimal” (no temperature stress) conditions and lethal conditions.

The SED’s temperature results reveal that different flow alternatives can be expected to produce very different biological outcomes as a result of the different temperature regimes they generate during the February-June period.[18] On the Stanislaus River, flow regimes between 50% and 60% unimpaired flow (“UIF”) result in optimal incubation conditions (no temperature related mortality) to river mile 28.2 (“1/2 river”) through February of the warmest 10% of years, as opposed to fair conditions (associated with some temperature-related mortality) for alternatives ≤40% UIF (Appendix E, Figure E-3). Fair conditions persist through March at river mile 43.7 (“3/4 river”) under 50% and 60% UIF flow regimes, whereas poor incubation conditions (high temperature-related mortality) or worse are expected at this point in the river under alternatives ≤40% UIF. These are very real and important differences in temperature conditions that will result in significant reduction in the miles of the Stanislaus River that will available for salmon incubation (and a reduction in carrying capacity) under the 40% UIF flow regime during warmer years than would occur under ≥50% UIF conditions.

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[18] The carryover storage requirements in the SED resulted in few meaningful temperature differences among alternatives on any of the rivers between September and January.

All flow regimes are expected to produce poor-temperature conditions, on average, on the Stanislaus River during May of the warmest 10% of years (Figure E-3), and this makes successful migration during April of the warmest 10% of years all the more important. Migrating juvenile Chinook salmon will experience some temperature stress, on average, from at least RM 13.3 under the 40% UIF alternative during April, whereas conditions remain optimal or close to optimal to the confluence under the ≥50% UIF flow regimes. As with spawning and incubation conditions, there will be significant temperature benefits to juvenile Chinook salmon migrating from the Stanislaus River under the ≥50% UIF alternatives in the warmest years as compared to alternatives that reserve less water for environmental protection.

Temperature conditions modeled in the draft SED can be expected to produce severe constraints for the Tuolumne River salmon population that impair population viability and the prospect of achieving or maintaining federal and state salmon doubling requirements (Figure E-4). At 40% UIF, both incubation and migration periods for Chinook salmon on the Tuolumne River will be truncated by a month as compared to ≥50% UIF alternatives. Under flow regimes ≥50% UIF, incubating salmon eggs on the Tuolumne River can be expected to experience low levels of temperature-related mortality during February and March of the warmest years down to at least RM 38.29 ("3/4 river"); temperature related mortality at this point in the river would be high under 40% UIF and incubation failure would occur here under alternatives with ≤30% UIF (Figure E-4). Whereas temperature conditions remain optimal-to-fair for migrating and rearing juvenile salmon through May at 60% UIF, and are at worst "fair" through May at 50% UIF, temperature related mortality for migrating juveniles will increase significantly at ≤40% UIF. Temperatures experienced by migrating juvenile salmon at 40% UIF are substantially higher (1.4-1.7^{o}F) under 40% UIF than at 50% UIF in April for at least 13 river miles (between "¼ river" and "confluence") and become "poor" under 40% UIF upstream of the confluence during May. These results clearly indicate that the Tuolumne River's carrying capacity for Chinook salmon will be severely constrained by limited incubation habitat in at least 1 of 10 years (and probably more frequently) at flow levels ≤40% UIF and carrying capacity will increase at flow levels ≥50% UIF.

Major differences in temperature-related stress between alternatives with ≤40%UIF and those with ≥50% UIF can be expected for juvenile Chinook salmon rearing and migrating along the Merced River corridor in April and in May during the warmest 10% of years (Figure E-5). In April, ≥50% UIF leads to conditions that are "fair" (low stress) in the lower 13 miles of the river, whereas 40% UIF flow levels produce "poor" (high stress) temperature conditions. Average temperature conditions in May of the warmest years will be poor under ≥50% UIF, but under ≤40% UIF, temperatures during May are "detrimental" (a level associated with nearly complete failure to complete the life cycle). Thus, flows ≥50% UIF result in 2 additional months, and many additional river miles, of suitable rearing and migration habitat compared to regimes ≤40%

UIF – temperature related impacts at ≤40% UIF represent a severe constraint on the Merced's ability to support a viable and self-sustaining salmon population.

Analysis of 7DADM temperature values in years with average temperature conditions (50% exceedance values) revealed similar patterns to those detected in the analysis of the warmest years (90% exceedance values; Figures E-3 through E-5). Higher % UIF flow prescriptions generally led to lower temperatures during the incubation and/or juvenile rearing and migration life stages. Although monthly mean temperatures of average years were, by definition, lower than those for the 90% exceedance years, temperature limitation on salmon productivity and carrying capacity in the tributaries would still be expected at flows ≤40%UIF.

Finally, temperatures expected in the lower San Joaquin River at Vernalis would prevent juvenile salmon migration during the average day in Mays of the warmest years under flow alternatives with ≤30% UIF; the 60% UIF flow regime produced temperatures that were more than 1^{o}F less than those expected under 40% UIF (Figure E-6) – such a temperature difference is expected to produce real improvement in salmon survival and condition. Under average temperature conditions (i.e., "mean" year temperatures), juvenile rearing and migration in the lower San Joaquin River during June will be more successful (especially during the earlier parts of the month) under flows ≥50% UIF than at lower flows. The truncation of juvenile Chinook salmon migration as a result of high temperatures expected under lower flow alternatives described in the SED represents a severe impact to the tributaries' ability to attain the existing narrative salmon protection objective, both through its impact on population survival rates (productivity) and because the limited time for successful development under low flow alternatives represents a reduction in the rivers' carrying capacity. Furthermore, because the reduction in migration opportunities will affect late migrating, smolt-sized salmon disproportionately, the low flow alternatives are likely to have severe negative effects on the life-history diversity attribute of population viability. The SED must analyze and account for these potential limitation son population viability and condition in evaluating and selecting a flow alternative.

The draft SED's analysis of temperature effects is flawed because it does not discriminate meaningful temperature differences from those which are unlikely to produce detectable biological responses. Substantial benefits to the productivity and resilience (i.e., viability) of San Joaquin valley salmon populations accrue under flow regimes ≥50% UIF that will not occur under flow regimes with ≤40% UIF. Temperatures presented in the draft SED for flow regimes ≤40% UIF would be expected to produce frequent catastrophic declines in fall-run Chinook salmon populations, with concomitant impacts to the ecosystems and fisheries that rely on these fish. Also, because temperature conditions that occur under flow proposals with ≤40% UIF would limit carrying capacity of the San Joaquin River's tributaries, even under average conditions, such flow alternatives would not be expected to support attainment and maintenance of AFRP population targets for these rivers.

Lastly, the analysis of temperature impacts in the SED and that performed above assumes no flow shifting or flow shaping (i.e., "borrowing" water from one part of the Feb-Jun period in order to produce desired effects in another part of the year). However, these adjustments to a 7 day moving average of unimpaired approach are almost certain to result in worse temperature conditions for the time periods from which the flow is borrowed. The draft SED does not anticipate or clearly describe how the water budget (the % UIF) will interact with (and potentially limit) flow-shaping operations and/or the need to restore juvenile rearing habitat for Chinook salmon even though these elements of the Draft SED's proposed management regime are inextricably linked. The draft SED fails to reveal these linkages or to explore how they will affect the implementation or efficacy of future flow standards.

e. The SED fails to analyze the effect of alternatives on dissolved oxygen levels in the lower San Joaquin River or its tributaries.

The SED incorrectly claims "adverse effects associated with low DO levels have not been documented in reaches of the SJR or the three eastside tributaries" (SED at 7-66). This statement is contradicted by the observation that

> "During the fall adult salmon migration season, when LSJR inflows to the Bay-Delta are less than 1,500 cfs, low DO levels in the SJR at the Stockton Deep Water Ship Channel (e.g., less than 6 ppm) create a chemical migration barrier to upstream migrating adult salmon. Failure of SJR Basin salmon to reach the spawning grounds results in negative spawning impacts on the SJR fall-run Chinook salmon population (CDFG 2011a)."

SED at 7-50.

As described in our previous comments (TBI et al. 2013), low dissolved oxygen levels are a longstanding and persistent problem in the lower San Joaquin River and some of its tributaries (citing CVRWQCB and CBDA 2006). Low DO levels can block migration of adult salmon and such effects have been documented on the lower San Joaquin River (Hallock et al. 1970); sturgeon are even more sensitive to low DO levels than salmon (Cech and Doroshov 2004) and conditions that frequently prevail in the lower San Joaquin River would be expected to block migrations of both green and white sturgeon adults and juveniles (CVRWQCB and CBDA 2006).

A mechanical oxygenation system has been installed in the Stockton Deepwater Ship Channel (SDWSC) to combat low DO levels. We demonstrated in our prior comments (TBI et al. 2013) that violations of the existing DO standard for this area are frequent when flows in the SDWSC are <1,000 cfs. We also demonstrated that when flows are <2,000 cfs at Vernalis flows in the SDWSC are generally <1,000 cfs. The Draft SED's proposed minimum flow levels (1,000 cfs at Vernalis) will result in flows in the SDWSC that are well below 1,000 cfs. Thus, despite the implementation of non-flow measures (the SDWSC aeration system), it is likely that the preferred alternative will result in DO levels that are below the minimum required for migrating salmon, steelhead, green sturgeon, white sturgeon, and other aquatic organisms. When such conditions prevail in the fall, adult fall-run Chinook salmon and steelhead migrations will be affected; when these conditions occur in the spring, migrations of adult spring-run Chinook salmon, adult steelhead, juvenile spring-and fall run Chinook and steelhead, green and white sturgeon, and striped bass are likely to be adversely impacted by low DO in the SDWSC. The SED must adopt flow standards that are reasonably likely to eliminate dissolved oxygen impairment of fish and wildlife beneficial uses in the lower San Joaquin River (including, but not limited to, the Stockton Deepwater Ship Channel); the best available science indicates that flow levels greater than the SED's proposed 1,000 cfs minimum at Vernalis will be required.

f. The SED Fails to Adequately Analyze the Effect of Flow Alternatives on in-Channel Habitat Conditions such as Turbidity and Flow Variability.

The SED's analysis of flow alternatives on in-channel habitat conditions is limited to temperature effects. The effects of increased sediment transport and turbidity in the river channels and the southern Delta as a benefit to fish populations were not analyzed, despite the fact that:

- increased flows will tend to transport additional sediments and increase water column turbidity;
- increased turbidity generally improves habitat quality (i.e., survival) for both migrating and estuarine-resident native fishes that live in the south Delta, including Delta smelt (SED at 7-133); and
- turbidity levels in the lower San Joaquin River and southern Delta are unnaturally low (SED at 7-133) and increases in turbidity can have significant positive effects in limiting known ecological stressors such as invasive aquatic macrophytes (Boyer and Sutula 2015) and threats to water quality, such as toxic algal blooms (Berg and Sutula 2015).

The draft SED (Chapter 6) evaluates only the potentially adverse effects of turbidity and erosion (they are "less than significant"). Because it fails to describe the potential for increased frequency of sediment mobilizing flows and changes in baseline turbidity of the lower San Joaquin River and southern Delta, the draft SED ignores differences in potentially important ecological benefits of the flow alternatives. The SED should be revised to account for these positive effects and analyze, to the extent possible, potential differences in sediment transport and turbidity under hydrographs that track natural runoff timing (e.g., a 7 day moving average of UIF) as compared to fully engineered (shaped) hydrographs.

The SED must integrate evaluations of flow on habitat and water quality conditions. Flows that inundate floodplains but do not produce adequate temperatures for juvenile salmon attempting to rear in those habitats will not lead to attainment of the existing salmon protection objective or proposed San Joaquin migratory fish viability objective. Flow levels that achieve adequate temperature protections throughout the juvenile Chinook salmon migration and rearing season, and inundate adequate habitat area while simultaneously supporting other important habitat characteristics are those that have a reasonable likelihood of attaining plan objectives for salmonids.

We have identified multiple quantitative approaches that the SWRCB should apply to evaluating the likelihood that flow alternatives will attain the narrative salmon protection objective and the San Joaquin migratory fish viability objective. In a system that will not be physically modified (i.e., "restored" by earth-moving activities), the strong and significant empirical relationships between seasonal flow and both abundance and productivity of San Joaquin River salmon populations remain the best predictors of the potential for flow alternatives to meet plan objectives. In addition, the relationship between flow and productivity (survival) and diversity of successful life-history types emigrating from the tributaries provides a strong basis for evaluating the effects of different flow alternatives at a local level. Finally, data and analytical tools are available to analyze some (but not all) of the functional mechanisms by which flow alternatives produce salmon habitat so that the SWRCB can analyze the likely efficacy and relative costs of some "alternatives" to flow – integration of results from temperature and floodplain inundation-habitat creation models is required, at a minimum, to evaluate the potential for widespread restoration of rearing habitat to support the narrative doubling objective and the salmon viability objective.

g. The SED's reliance on outputs of the SALSIM model is not consistent with the best available scientific information, as the SED acknowledges, and the SED should not rely on these results.

Rather than incorporate the wealth of scientific information and robust relationships that link flow levels to San Joaquin Chinook salmon abundance, productivity, life history diversity, and both spatial and temporal habitat availability, the draft SED only analyzes the relative performance of its flow alternatives using the CDFW SALSIM model. The SED itself, as well as comments from SWRCB and CDFW staff in the public hearing, acknowledge that the SALSIM model is flawed and currently does not represent the best available science. As CDFW staff acknowledged, inputs to the model are known to be flawed, and that the modeled estimates of salmon production in the draft SED "are likely substantially lower than they should be." CDFW presentation to the SWRCB on 1/3/2017. CDFW's presentation shows that the current model overestimates egg mortality and underestimates juvenile mortality, and that it fails to adequately account for the effects of flows and water temperatures during the winter/spring period. *Id*. Regarding SalSIM results, the SED admits that the effects of floodplain inundation and water temperature "are not represented by the model in a manner that is consistent with current scientific information." SED at 19-74. In addition, the SED admits that the SALSIM model also understates the effects of improved instream flows on success of migrating and rearing juvenile salmon because salmon returns during the first several years of the model (1994-1997) are not affected by any instream flow improvements in those years, and years 2005-2009 are affected by ocean conditions and the model forces production to decline in those years regardless of the flow conditions. SED at 19-85.

The SalSIM results do not track the historical response of San Joaquin salmon production and escapement with winter-spring flows in the San Joaquin River, as measured at Vernalis. As the SED notes, even were the model inputs valid, model outputs are useful only for relative comparison. SED at 19-76 and 19-85. However, even relative comparisons among model alternatives presented in SED Table 19-32 (also Figure 19-14) do not support the SED's choice of preferred alternative because (a) there is no indication that the preferred alternative is likely to attain the existing narrative salmon protection objective or the proposed San Joaquin migratory fish viability objective (*see analyses below*) and (b) there is no comparison of the relative performance of the specific operational schemes (flow shifting and aggressive flow shaping) that are part of the preferred alternative under any environmental allocation other than 40% UIF.

CDFW explained in its presentation to the SWRCB that they are recalibrating the model after correcting flawed model inputs. However, we recommend that the final SED should not rely on SALSIM results. SALSIM modeling that is included in the Final SED should be accompanied by appropriate caveats regarding reliability of the model results, and any SALSIM model results that are presented in the SED should focus on juvenile production, rather than escapement, since this proceeding is focused on actions during the winter/spring time period that affect juvenile production.

IV. The SED Fails to Analyze Potential Adverse Environmental Impacts of Waiving Instream Flow Requirements in Future Drought Emergencies, as Authorized in the Program of Implementation.

In the Program of Implementation, the SWRCB proposes to authorize waivers of the proposed flow requirements,[19] based upon a determination of a state or local state of emergency. SED, App. K, at 35. Although not specifically stated, we presume that the SWRCB would consider

[19] Notwithstanding this language in the SED, state law requires the SWRCB and all other state agencies to implement water quality standards that are in an adopted water quality control plan. Cal. Water Code § 13247. The SWRCB cannot use an administrative action, such as a petition for temporary urgency change petition, to change water quality standards absent the waiver of section 13247 by the Governor, an action that is wholly inappropriate for drought conditions that are reasonably certain to recur. In addition, any such waivers of water quality standards, such as through adoption of a temporary urgency change petition, would likely violate the Clean Water Act without review and approval of the U.S. Environmental Protection Agency.

extended droughts to constitute a state of emergency under this section. However, droughts should not be considered an unexpected emergency, because they are a fact of life in California. The modern hydrologic record includes several multiyear drought sequences, and hydrologic modeling accounts for these historic droughts. The SED's failure to plan for extended drought conditions is wholly inappropriate and unlawful, and the failure to identify likely adverse environmental impacts that would result from future waivers – and potential mitigation measures for such impacts – violates CEQA.

We recognize that specific off-ramps from the proposed flow requirements may be appropriate during extended multi-year drought periods, provided that the SED: (1) establishes in advance of these periods the hydrologic criteria and triggers to determine when such waivers would be appropriate, rather than ad hoc or arbitrary political criteria; (2) identifies default compliance measures during such waivers, and; (3) analyzes the likely effects of imposing the default compliance measures in order to ensure that these waivers would not result in significant adverse environmental impacts and that the objectives are still achieved over time.[20] However, the SED wholly fails to take these steps: it fails to quantify the frequency, magnitude, and duration of such waivers; it fails to identify potential measures that would be required instead, and; it fails to analyze the environmental impacts of implementing alternative measures. As a result, the SED fails to identify likely adverse impacts of the proposed action, and fails to analyze whether the proposed action is likely to achieve the narrative salmon doubling objective. This is unlawful.

As the SWRCB is well aware, the approval of temporary urgency change petitions to weaken or waive existing water quality standards during the recent drought has had devastating impacts on fish and wildlife. *See, e.g.*, Defenders of Wildlife et al., Request for Emergency Regulations, August 9, 2016;[21] Central Valley Project and State Water Project, 2016 Drought Contingency Plan (January 15, 2016), at 13-15;[22] letter from NMFS to USBR and DWR regarding reinitiation of consultation, August 17, 2016.[23] Waiving the proposed flow requirements during future droughts is also likely to cause significant adverse environmental impacts on salmon and other fish and wildlife. For instance, increased water temperatures are likely to result from reduced instream flow requirements, which would likely cause significant adverse impacts on incubating egg and/or juvenile salmonid survival. Reduced instream flows also would likely increase

[20] Equally important, the SWRCB must evaluate whether more protective measures are needed in non-drought years to ensure population viability and achievement of objectives will be maintained in light of the expected frequency and duration of drought years in the future.

[21] This document is available online at: https://www.defenders.org/publications/dow-nrdc-tbi_request_for_emergency_regulations_final.pdf and is hereby incorporated by reference.

[22] This report is available online at: http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/docs/plans/2016dcpfebnov.pdf and is hereby incorporated by reference.

[23] This letter is available online at http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/nmfs_response_to_reclamation_s_request_to_reinitiate_the_2009_cvpswp_operations_consultation_-_august_17__2016.pdf and is incorporated by reference.

predation, reduce dissolved oxygen in the river, and ultimately result in lower salmon survival. This conclusion is consistent with the scientific information presented in our comments and in the SED, which demonstrates lower salmon survival at lower flow volumes.

However, the SED completely fails to analyze the potential environmental impacts of waivers of instream flow objectives pursuant to this authority. Moreover, the declaration of a state of emergency resulting from drought conditions is an arbitrary political, not a specifically defined hydrologic, determination; for instance, in recent years, drought declarations have remained in place during the first wet year following a drought sequence (2011, 2017), and this could result in major hydrologic alteration and adverse impacts to fisheries. Instead of relying on an arbitrary political determination of drought, the SED must identify hydrologic conditions that could justify an offramp from the instream flow objectives. We recommend that the Board should not allow such offramp conditions to be implemented unless and until unimpaired flow conditions are critically dry for at least the prior two consecutive years, and have provided similar language in our redline of Appendix K.

V. The Program of Implementation Fails to Ensure that Discretion in Flow Shaping and Volume will Achieve Water Quality Control Plan Objectives and the SMART Biological and Environmental Targets Used to Track Compliance and Effectiveness.

In Appendix K of the SED, the SWRCB proposes a deeply flawed governance scheme, and inappropriate levels of discretion to change flows and flow standards, without analyzing whether such foreseeable changes are likely to achieve the plan objectives and without requiring that the narrative salmon protection objective and all SMART biological and environmental targets will be met with the change. *See* Draft SED, Appendix K, at 29-31. In addition, Table 3 is inconsistent with this language in the Program of Implementation allowing for greater flexibility. We have provided a redline of this language in Appendix K and Table 3 of the SED, consistent with the discussion below.

The draft plan relies on "adaptive implementation" of the preferred alternative (Appendix K). Adaptive implementation is expected to reflect scientific information that emerges from monitoring or studies on the tributaries or from elsewhere. The intent of "adaptive implementation" is thus quite similar to the better-known rubric of "adaptive resource management" ("ARM"), proposing to use adaptive implementation to optimize flows to achieve the objectives. SED, Appendix K at 30. However, the draft plan provides very little specificity regarding what it means to "optimize" flows or what information will be utilized to determine the optimal level of flow in any given year or time period within that year. ARM requires the expression of desired outcomes in terms of targets that are specific, measureable, achievable, relevant to a plan goal, and time bound (SMART); without such targets, it is impossible to know if the plan is successful or when and to what end plan elements should adapt. The draft SED suggests that future adaptive management decisions should be focused towards achieving such targets, but it does not provide examples of the targets or incorporate known SMART targets that are integral to achieving the existing narrative salmon protection objective and proposed San Joaquin migratory fish viability objective.

The SEP (2016) has defined SMART targets that define the biological outcomes (i.e., egg-to-juvenile survival/productivity; life history timing and diversity) necessary to attain the narrative salmon protection objective for San Joaquin River fall-run Chinook salmon, and the requirement that dam operators maintain fish populations in good condition for fall-run, spring-run Chinook salmon, and both resident and anadromous populations of *Oncorhynchus mykiss*. In addition, SEP (2016) identifies the timing and spatial extent of the physical, chemical, and biological conditions that best available science indicates are necessary to achieve those biological targets. Several of these targets are referenced in section III of these comments. The SWRCB should adopt key SMART targets (particularly, egg-to-juvenile survival/productivity, and both timing and size-distribution targets for life history diversity) for fall-run and spring-run Chinook salmon, and both resident and anadromous forms of *O. mykiss* as well as the supporting environmental objectives into its final SED so that these targets can guide adaptive management and the program of implementation.

More generally, the proposed standards for making adaptive changes in Appendix K, and the proposed governance scheme for who would decide to make such changes, are deeply flawed and fail to ensure that the plan objectives are likely to be achieved. With respect to the standards for making changes in implementation, Appendix K would authorize changes in implementation that would change the percent of unimpaired flow, shape flows within the February to June period , shift flows to later in the year, or modify the minimum base flow. SED, Appendix K at 29-31. As currently drafted, the language would allow changes if they would achieve "any" biological goals and would not require the Board to find that with the change, implementation is likely to achieve the Plan's existing salmon protection objective. *Id*. at 30. In addition, the language creates a huge loophole for experiments in implementation, which do not require the changes to be based on meeting SMART targets and/or plan objectives. *Id*. at 31. This is wholly inappropriate, and instead, any changes in implementation must be made solely to achieve all SMART targets and plan objectives, including the narrative salmon protection objective.

With respect to the governance scheme, the SED proposes to establish a working group of water users, fishery agency staff, and other experts who would have a decision-making role. *Id*. at 32. However, the SED does not require any members to represent the public interest, conservation groups, or the fishing industry (let alone roughly equal representation of interests), raising basic issues of fairness. Moreover, the specific decision rules, to the extent identified in the SED, are likely to lead to gridlock and a failure to achieve the Plan objectives and SMART targets.

For instance, the governance proposal requires the concurrence of all members of the working group for the Executive Director to approve any changes to the percent of unimpaired flow within the range, or changes to the minimum flows. *Id*. at 30-31. Given the broad opposition from tributary water users to a percent of unimpaired flow approach and to the specific flow range in this and the prior draft SED, their rejection of the scientific information that justifies flow requirements, and their refusal to participate in the scientific process to establish SMART targets, it is exceedingly unlikely that water users would agree to higher unimpaired flows within the range. At the same time, it is wholly inappropriate to give water users power to veto changes on flows within the range; changes on the percent of unimpaired flow and minimum flow levels must be made, based on the best available science, on the likelihood to achieve the plan objectives and SMART targets. With respect to adaptive implementation decisions that shape flow (instead of relying on the running average) or which shifts flows to later in the year, the SED proposes that the Executive Director can approve the changes if one or more members of the working group agrees. *Id*. As a result, for any of these proposed changes, the likely outcome is gridlock where unanimity is required, and dueling recommendations when it is not. And the process will likely be very resource intensive process, as DWR and USBR's various stakeholder processes have demonstrated, with very little benefit.

Instead of the expensive, unwieldly, and unfair process proposed in the SED, we urge the SWRCB to create a public process for all stakeholders – including water users and the public – to provide input on decisions, but ultimately the SWRCB must require that fishery agencies and SWRCB make final decisions on adaptive implementation. This is consistent with the approach taken in the 2008 and 2009 biological opinions, after the prior consensus based approach to adaptive implementation was an abject failure that jeopardized the continued existence of endangered species and was found to violate the Endangered Species Act. Of course water users and reservoir operators should provide input, but all decisions should be made by the fishery agencies and SWRCB. Absent such changes, the governance scheme is almost certain to fail, jeopardizing achievement of the objectives. Regardless of the structure, the decision-making process and the results should be subject to periodic independent scientific review organized by the Delta Science Program or the SWRCB itself.

In addition to these problems that apply to all of the adaptive implementation measures, the specific adaptive implementation measures (a) through (d) also must be revised.

First, Appendix K proposes to allow the Executive Director to alter the required percent of unimpaired flow within the 30-50% flow range every year.[24] However, given the 3 year life cycle of Chinook salmon, it is very likely that several years of monitoring data from

[24] There is no scientific justification for allowing for 30% of unimpaired flow, as the best available science demonstrates this flow level is not likely to achieve a viable salmon population, let alone achieve the narrative salmon doubling objective required by the Plan.

implementation will be necessary before there is sufficient information to justify a change within the flow range, particularly given the changes in year to year hydrology. In addition, by changing the percentage of unimpaired flow on an annual basis, the scientific information generated by the monitoring program will be of limited utility, because there will be even smaller sample sizes and additional covariates (changes in flow volumes / rates and other operations) against which to evaluate effects. Instead, we recommend that Appendix K explicitly require a review of percentage of flow within the flow range every 5 years, reviewing the monitoring data, progress towards achieving the salmon doubling objective, and independent scientific peer review by the Delta Science Program. This provides greater certainty to stakeholders and ensures a more robust scientific framework for decision-making.

Second, we agree that changes from a 7 day running average[25] can be appropriate in some instances order to achieve SMART targets and the plan objectives, but as discussed above, before making any such change the SWRCB or Executive Director must make a finding that the change is necessary to achieve the plan objectives (including the doubling objective) and all SMART targets. A key benefit of the use of a running average is to mimic the variability of the natural hydrograph, which is critical to juvenile salmonid survival. In addition, the language in the SED may unintentionally result in lesser flow volume than that required by a strict running average, and we have included language to ensure that the full flow volume available on a running average is also available through flow shaping.

Lastly, the SED inappropriately proposes to allow substantial shifting of flow from the spring period to the summer or fall months. Such flow shifting is likely to cause significant adverse effects on achieving the plan objectives, since best available science demonstrates that the actual volume of flow in this period is the strongest statistical predictor of juvenile salmon survival. *See* Zeug et al. 2014. Moreover, the SED largely fails to analyze the potential environmental effects of such flow shifting, particularly at levels below 40% of unimpaired flow (the draft currently would allow for less than 30% of the unimpaired flow during these months). Instead of allowing flow shifting from February through June, we recommend allowing flow shifting only from flows in the month of June; this allows some flexibility to address water temperatures and other concerns, but also ensures that the bulk of flows are released in the spring months when they affect juvenile salmon survival. To the extent there are substantial problems in other months that do not arise from implementation of increased spring flows, the SWRCB should establish water quality objectives for those other months.

[25] As demonstrated by the testimony of the U.S. Fish and Wildlife Service on DATE, using a 7 day running average already loses much of the variability of flow. Given the importance of flow variability, *see* Zeug et al. 2014, a 3 day running average should instead be encouraged.

VI. The Program of Implementation Must Include Enforceable Carryover Storage Requirements in Upstream Reservoirs to Mitigate and Avoid Impacts, Consistent with the Substitute Environmental Document.

The SED appropriately analyzes and discloses that it requires implementation of enforceable carryover storage requirements at upstream reservoirs, in order to mitigate potentially significant adverse impacts that might otherwise result. Such measures are clearly within the SWRCB's authority, and they are appropriate. Moreover, because the SED fails to analyze potential adverse impacts in the absence of carryover storage requirements, it would be unlawful for the SWRCB to fail to implement these requirements. Nonetheless, we recommend that the SWRCB, consistent with the analysis in the SED, should revise the Program of Implementation to more clearly require implementation of enforceable carryover storage requirements at upstream reservoirs.[26]

The SWRCB unquestionably has the legal authority to impose downstream water temperature or carryover storage requirements at upstream reservoirs, in order to prevent harm to Public Trust resources. *See, e.g.,* Water Rights Order 90-5; Water Rights Order 91-03, at 10-11 (explaining that, "[i]f the Bureau failed to meet the temperature control requirements in Order WR 90-5 because it did not retain sufficient cold water in storage, and retention of cold water was within the Bureau's reasonable control, the Bureau would be in violation of Order 90-5."); Water Rights Order 2015-0043 (order denying in part and granting in part petitions for reconsideration and addressing objections, upholding requirements to establish carryover storage requirements for Shasta, New Melones, and Folsom reservoirs); letter from Tom Howard to Ron Milligan, July 8, 2016, at 2 (approving the 2016 Shasta water temperature plan, conditioned upon meeting cold water pool requirements and requiring reductions in reservoir releases if such conditions are not met); Order Approving in Part and Denying in Part a Petition for Temporary Urgency Changes in permit Terms and Conditions Requiring Compliance with San Joaquin River Flows, April 19, 2016, Term and Condition 5 ("Reclamation shall achieve an end of September 2016 carryover storage level of 415 TAF in New Melones Reservoir."); Water Rights Decision 1644, at 177-78 (requiring implementation of temperature management plan and reserving continuing authority to establish water temperature requirements for the lower Yuba River for the protection of fishery resources). Reservoir carryover storage requirements are appropriate mitigation measures under CEQA, intended to avoid significant adverse environmental impacts that might otherwise result.[27]

[26] Appendix K appropriately includes language in the Program of Implementation requiring the imposition of mitigation measures to avoid unreasonable impacts to groundwater using its existing authorities, including authorities under Article X, Section 2 of the Constitution and the Sustainable Groundwater Management Act. SED, Appendix K at 28.

[27] Similarly, under the physical solution doctrine and section 5937 of the Fish and Game Code, the Board has authority and duty to require reservoir operations to maintain fish in good condition, such as maintaining carryover storage and/or a coldwater pool, when at other times the water rights holder benefits from substantial water

The SED appropriately includes reservoir carryover storage requirements in the modeling and analysis of potential environmental impacts. Implementation of such measures is necessary to avoid the likely adverse impacts that would otherwise result, and because the SED does not analyze these potential adverse impacts in the absence of such requirements. The SWRCB would violate CEQA if it failed to implement carryover storage requirements consistent with those included in the SED, because the SED does not analyze potential impacts if such reasonable carryover storage requirements are not implemented.

VII. The SED Fails to Consider the SWRCB's Legal Authority to Require Water Rights Holders to Invest in Habitat Restoration and Other Non-Flow Measures.

As discussed in our prior comments, the SWRCB has legal authority to require water rights holders to invest in habitat restoration and other non-flow measures under the physical solution doctrine. *See* 2013 Comments, Exhibit 2, at 6-7. For instance, in Decision 1631, the SWRCB ordered the Los Angeles Department of Water and Power to undertake habitat restoration projects in order to reduce flow requirements, stating that, "as part of a physical solution allowing for diversion of water for municipal use, LADWP can be required to undertake waterfowl habitat restoration measures. Waterfowl habitat restoration can serve to restore public trust uses while requiring a smaller commitment of water." Decision 1631 at 118; *see* SWRCB Water Rights Order 98-05 (approving habitat restoration measures implementing Decision 1631). The SWRCB and the courts have discussed the physical solution doctrine in other decisions and orders as well. *See, e.g.*, SWRCB Water Rights Order 90-16 (holding that under the physical solution doctrine and section 5937 of the Fish and Game Code, the Board can require releases from a reservoir greater than unimpaired inflow during certain times of the year, in order to keep fish in good condition); Decision 1630 (discussing the physical solution doctrine in the context of the SWRCB's decision finding waste and unreasonable use and mandating water conservation measures in the Imperial Irrigation District); *City of Barstow v. Mojave Water Agency*, 23 Cal.4th 1224, 1249-51 (2000). The SED ignores the authority of the SWRCB to

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diversions from the river. *See also* SWRCB Water Rights Order 90-16. As the California Department of Fish and Wildlife concluded in a recent amicus brief to the Ninth Circuit Court of Appeals,

> As early as 1932, a California Court of Appeal held that a water right holder has no authority to divert and use the waters of the state "regardless of its duty in so doing to protect the fish therein" and that "the grant of the right to erect a dam" must "be construed to be under the implied condition to keep open the fishways." *People v. Glenn-Colusa Irrigation Dist.*, 127 Cal. App. 30, 36-37 (1932).

Amicus Curiae Brief of the California Department of Fish and Wildlife in Support of Federal Cross-Appellants/Appellees, San Luis & Delta Mendota Water Authority v. Jewell, Case No. 14-17479, Ninth Circuit Court of Appeals, December 21, 2015.

require water rights holders to invest in habitat restoration and other non-flow measures as part of the program of implementation, and it should be revised accordingly.

VIII. The SED's Analysis of Changes in CVP/SWP Water Exports is Flawed Because it Fails to Consider the Right of Upstream Water Users to Dedicate these Flows Under Section 1707.

As we discussed in our prior comments, tributary water rights holders have the right to temporarily dedicate water to instream flow through the Delta under sections 1707(c) and 1725 of the Water Code, and prevent downstream water users, including the CVP and SWP, from diverting any of this flow absent a transfer agreement between the parties. *See* TBI et al. 2013 at 42. By dedicating flow to instream use under section 1707(c), these flows would not contribute to meeting instream flow requirements such as new Delta outflow requirements adopted in Phase II. Cal. Water Code § 1707(c). As we discussed in our prior comments, this would not cause an injury to downstream water rights holders. TBI et al. 2013 at 42 (citing *State Water Resources Control Board Cases*, 136 Cal.App.4th 674, 798-806 (2006)). However, the SED's analysis of potential changes in water exports by the CVP and SWP fails to consider this legal right, and the draft Program of Implementation likewise ignores this legal right. *See* SED at 5-78 and Appendix K. The SWRCB should revise the SED and Appendix K to explicitly recognize this right, and condition the discussion of changes in Delta exports in the SED accordingly.

IX. The SED Fails to Adequately Consider the Feasibility of Protecting Public Trust Resources Because it Fails to Consider Improvements in Water Use Efficiency and Alternative Water Supplies.

In order to fulfill its mandatory duty to protect the Public Trust to the extent feasible, as well as to balance potential impacts to other beneficial uses of water in setting water quality standards, the SWRCB must consider the availability of water supplies from wastewater recycling, improved water use efficiency, urban stormwater capture, and other sources. Unfortunately, the SED fails to do so. We have discussed the necessity of this analysis of alternative supplies at length in our prior comment letters, and those prior comments are fully incorporated by reference. *See* TBI et al. 2013; TBI et al. 2013 Exhibit 2. We briefly summarize those points again:

- First, the SWRCB has considered the availability of recycled water and other water supplies in determining the feasibility of protecting Public Trust resources in Mono Lake. *See* Decision 1631 at 165-168, 176-177. Similar feasibility analysis was required by the courts in decisions to protect Public Trust resources in Putah Creek and the American River. *See* Brian Gray, Ensuring the Public Trust, 45 U.C. Davis Law Rev. 973 (2012).
- Second, the SWRCB is required to consider the need to develop and use recycled water in establishing water quality objectives, *see* Cal. Water Code § 13241(f), and this

approach of considering alternative water supplies is consistent with the statutory obligation to reduce reliance on the Delta and invest in regional and local water supplies, *see* Cal. Water Code § 85021. The necessity of consideration of alternative water supplies in determining the feasibility of protecting Public Trust resources is essentially an exercise of the physical solution doctrine, where such a physical solution can reasonably accommodate both consumptive uses and protection of the Public Trust. *See* Brian Gray, Ensuring the Public Trust, 45 U.C. Davis Law Rev. 973 (2012). Unlike consumptive users of water, there are no alternative water supplies for salmon and other native fish species in these tributaries.

- Third, the SWRCB lacks the authority to balance away statutory expressions of the Public Trust, such as section 5937 of the Fish and Game Code or the California Endangered Species Act, and likewise lacks the authority to balance away achievement of the narrative salmon doubling objective. *See, e.g., California Trout, Inc. v. State Water Resources Control Bd.*, 218 Cal.App.3d 187, 195 (1990); Decision 1631 at 12, 172; Decision 1644 at 27.
- Fourth, while the SWRCB must consider economic impacts, it must also consider economic benefits of protecting Public Trust resources, including the benefits of improved water quality, recreation, and sport and commercial fishing. In addition, the fact that alternative water supplies would incur some additional costs does not preclude protecting Public Trust resources; instead, the question is whether these costs make protection of the Public Trust infeasible. *See* Decision 1631 at 176-177.

Unfortunately, the revised SED fails to meaningfully analyze the availability of alternative water supplies, including improved agricultural and urban water use efficiency, water recycling, or groundwater banking and recharge projects. As a result, the SED overstates likely water supply impacts and fails to provide the information necessary for the Board to determine the feasibility of fully protecting Public Trust resources consistent with the SWRCB's 2010 report (or any lower flow alternative). The SED must be revised to consider alternative water supply projects, including those discussed *infra*.

X. The SED's Analysis of Water Supply Impacts is Flawed and Overestimates Likely Impacts

The SED also fails to accurately assess likely water supply impacts to both urban and agricultural water users. The analysis of potential water supply impacts in the SED appropriately begins by modelling the potential reduction in total surface water supplies under the alternatives. However, the analysis of total water supply impacts in the SED is inaccurate because it fails to consider the likely effects on water supply from waiving flow requirements during future droughts, as authorized in the Program of Implementation. As the SED demonstrates, potential water supply impacts under the alternatives are minimal in wet and above normal years and higher in dry and critically dry years. *See* SED at ES-26. As a result, the failure to consider the effects of weakening or waiving flow requirements in future droughts – as the SED authorizes – results in substantially overestimating likely water supply impacts, as well as potential impacts to agricultural acreage, economics, and employment. The analyses and text in the SED should be revised to be consistent with the authority in the Program of Implementation to waive or weaken flow standards during future drought emergencies, and with our comments regarding changes to this authority.

a. The analysis of potential agricultural water supply impacts is flawed.

The SED then assumes that the City and County of San Francisco would enter into water transfer agreements with agricultural water users, paying those users to bear the water supply impact. However, while the SED accounts for the economic impact to SFPUC from these water transfers, it fails to account for the economic benefits to agricultural users from such transfer agreements; thus it overstates the economic impacts to agricultural users in its analysis of economic impacts. Some stakeholders have argued that such water transfer agreements are not likely to occur, in which case, the water supply impacts to agricultural users would be lower than the 14% reduction in surface water supplies under the 40% flow alternative demonstrated in the SED (and impacts to urban users would be higher by an equal amount, consistent with the estimates in Appendix I of the SED).[28] The SED should be revised to quantify the reduced water supply impacts to agricultural water users without the assumed water transfers to SFPUC, consistent with the analysis of potential urban water supply impacts in Appendix I.

The SED also assesses potential impacts to groundwater, providing estimates of potential water supply impacts with no increase in groundwater pumping, with 2009 levels of groundwater pumping, and with 2014 levels of groundwater pumping. *See* SED, Appendix G at G-28 to -29.

However, because this is a water quality plan, and not a water rights decision, the specific impacts to any water rights holder or category of user cannot be determined with great specificity. Importantly, while the SWRCB has the general obligation to follow the rule of priority in implementing new flow objectives, the rule of priority is not absolute:

> Although the rule of priority is not absolute, the Board is obligated to protect water right priorities unless doing so will result in the unreasonable use of water, harm to values protected by the public trust doctrine, or the violation of some other equally important principle or interest.

[28] Indeed, San Francisco appears to have waived any legal argument regarding the assessment of economic or water supply impacts as those are apportioned between agricultural and urban water users. *See* City and County of San Francisco 2013 comments on draft SED, at 5 ("the draft SED should not draw conclusions in its current analysis about how water rights issues will be addressed between the SFPUC and the Districts.").

El Dorado Irr. Dist. v. State Water Res. Control Bd., 142 Cal.App.4th 937, 944 (2006). Thus, where application of the rule of priority would result in impacts to drinking water for human health and safety, or would allow the continuation of wasteful irrigation practices, it likely must yield. Similarly, if urban water users offered to pay agricultural water users for improvements in agricultural water use efficiency, which would enable those agricultural water users to conserve water that would be available for transfer, such an offer may constitute a physical solution that the Board could order be implemented. Such an agreement would be substantially similar to the SWRCB's actions regarding the funding of water conservation measures by the Imperial Irrigation District (including lining of the All-American Canal) through water transfer agreements that paid for the conserved water. *See* Decision 1600; Water Rights Order 88-20; Revised Water Rights Order 2002-0013.[29]

Indeed, as we discussed in detail in our 2013 comments and attached analysis by the Pacific Institute, there are substantial opportunities to improve agricultural water use efficiency by water rights holders in this proceeding that could create significant conserved water. TBI et al. 2013; *id*., Exhibit 4. However, the revised SED fails to consider potential improvements in agricultural water use efficiency, and thus fails to accurately assess the likely water supply impacts of the alternatives on agricultural water rights holders. As we also noted in our prior comments, the Board has the authority to require implementation of conservation and efficiency measures to avoid waste and reduce or avoid impacts. *Id*. The SED wholly fails to analyze the potential to reduce or avoid water supply impacts through improvements to irrigation efficiency, including pressurizing water supply systems so water is available on demand and other analyses in our prior comments. The SED also fails to analyze the potential for multi-benefit projects, such as floodplain restoration, to provide ecosystem benefits while also increasing groundwater recharge and supply (particularly on the Merced and Stanislaus Rivers).

b. The analysis of potential water supply impacts to the SFPUC is flawed.

With respect to potential water supply impacts to the San Francisco Public Utility Commission's ("SFPUC) retail and wholesale service area, the SED also inaccurately estimates potential impacts. First, the analysis in the SED assumes urban water demand levels that are dramatically higher than current uses. In assessing urban water supply impacts, the SED assumes a demand level of 260 MGD (290TAF); however, according to SFPUC's 2015 Urban Water Management Plan,[30] urban demand in the wholesale and retail area was reduced to 175 MGD (222TAF) in 2015-2016. Even prior to the imposition of mandatory water conservation measures, SFPUC

[29] By citing this authority, we do not take a position regarding the merits of this transfer agreement, including with respect to impacts to the Salton Sea and its Public Trust resources. The SWRCB would have to carefully analyze any such agreement for transfer of conserved water, either as part of Phase III or in a separate water rights proceeding.

[30] SFPUC's 2015 Urban Water Management Plan is available online at: https://sfwater.org/modules/showdocument.aspx?documentid=9300 and is hereby incorporated by reference.

has estimated total wholesale and retail demand in 2012-2013 was 223 MGD. *See* Appendix F.[31] By using inflated urban demand numbers, the SED overestimates likely water supply impacts, and the SED at a minimum should use the 2012-2013 estimate of 223 MGD. *See infra*. In addition, the substantial reduction in urban water demand in the SFPUC service area occurred with virtually no economic impacts, contrary to the extravagant claims by SFPUC's economist in 2013, demonstrating the absurdity of those prior estimates. Indeed, SFPUC's economist has published research concluding that urban water agencies substantially overestimate future water demand. *See* Steven Buck, Hilary Soldati, and David Sunding, Forecasting Urban Water Demand in California: Rethinking Model Evaluation.[32]

In addition, the analysis in the SED and Appendix I wholly ignores potential for wastewater recycling, improved urban water use efficiency, groundwater banking, urban stormwater capture, and additional local projects to offset or reduce demand for water from the Tuolumne River. Appendix I only considers water transfers, desalination, and Delta water exports, ignoring the substantial potential increases in supply and reductions in demand resulting from other local water supply projects (including several projects that are being planned or actually being implemented).

For instance, the 2014 report by NRDC and the Pacific Institute entitled *Untapped Potential* estimated that the Bay Area region could increase water supply by 980,000 acre feet per year through stormwater capture, improved water use efficiency, agricultural water use efficiency, and wastewater recycling.[33] It is important to keep in mind that the estimates in that report account for the fact that these water supply tools may not always be additive; for instance, increases in urban water use efficiency (particularly indoor water use, and assuming no population growth) will reduce the water supply available from wastewater recycling. In addition, while that 2014 analysis is broader than the SFPUC wholesale area, it demonstrates the great potential for improving sustainable water management in the SFPUC region.

Information from *Untapped Potential*, from the 2015 Urban Water Management Plan for SFPUC, and from other sources[34] provide more detail regarding the potential yield from these

[31] Appendix F includes a PDF file and an Excel spreadsheet prepared by SFPUC, both of which were transmitted by staff from SFPUC to staff from NRDC.
[32] This paper is available online at: http://ageconsearch.umn.edu/bitstream/205737/2/buck%20et%20al_forecasting%20water%20demand_aaea2015.pdf and is hereby incorporated by reference.
[33] This paper is available online at: https://www.nrdc.org/resources/untapped-potential-californias-water-supply and is hereby incorporated by reference.
[34] For instance, SFPUC, BAWSCA, and other Bay Area agencies are collaborating on a Bay Area Regional Reliability effort, which has identified a number of existing projects to improve regional water supply reliability and is evaluating investments in additional projects, including potable reuse projects, groundwater projects, and interties and transfer agreements. A summary is available online at: http://www.bayareareliability.com/wp-content/uploads/2016/04/Bay-Area-Regional-Reliability-2014-Fact-Sheet-5-6-14.pdf?545d25 and is hereby incorporated by reference.

sustainable water supply tools, which should be considered in the SED.[35] Cumulatively, these water supply sources and improvements in water use efficiency can reduce water supply impacts and help offset reductions in surface water supplies from the Tuolumne River. The SED should be revised to account for these potential measures.

1. *Stormwater Capture:*

In the 2014 *Untapped Potential* report, NRDC and the Pacific Institute estimated potential increases in urban water supply from stormwater capture within counties in the SFPUC service area as follows:

County	**Potential yield of stormwater capture**
San Francisco	5,427 Acre Feet
San Mateo	7,466 Acre Feet
Santa Clara County	58,000 Acre Feet
Alameda County	17,937 Acre Feet
Total	88,831 Acre Feet

Of course, the SFPUC wholesale area is not conterminous with these county boundaries, particularly for Santa Clara and Alameda Counties, so the total potential for increased water supply from stormwater capture within the wholesale service area is lower than that shown in the table above.

In addition, SFPUC's 2015 Potable Offset Investigation Summary Report found that onsite non-potable water supplies could offset up to 6.73 MGD (approximately 7,500 acre feet per year) of retail potable demands from the Regional Water System by 2040, assuming 100% participation and installation of onsite infrastructure. *See* SFPUC, Potable Offset Report at ES-4.[36] This includes onsite non-potable supplies from rainwater and stormwater (e.g. rain barrels), graywater (e.g. retrofitted clothes washers, laundry-to-landscape systems), blackwater (e.g. in dual-plumbed buildings), and seepage water (e.g. in municipal open spaces). That report established a target of 1 MGD from onsite reuse by 2040. *Id*. at ES-5. The SFPUC's 2015 UWMP, in contrast, projects only 0.4 MGD of non-potable water supplies by 2040 (SFPUC 2015 UWMP, Table 6-7). While it may not be feasible to generate the full 6.73 MGD from non-potable supplies, there is clearly additional potential to develop onsite water reuse systems to reduce demand for water from the Tuolumne River. The SED should be revised to discuss how

[35] For information regarding the cost of these and similar sustainable water supplies, we recommend that the SWRCB consider the Pacific Institute's 2016 report entitled *The Cost of Alternative Water Supply and Efficiency Options in California*. That report and appendices are available online at: http://pacinst.org/publication/cost-alternative-water-supply-efficiency-options-california/ and are hereby incorporated by reference.

[36] That report is available online at: http://sfwater.org/Modules/ShowDocument.aspx?documentID=9363 and is hereby incorporated by reference.

stormwater capture and offsite non-potable water supply projects could reduce water supply impacts and help offset reductions in surface water supplies from the Tuolumne River.

2. *Wastewater recycling:*

There is tremendous potential for dramatic increases in sustainable water supplies through investments in wastewater recycling in the SFPUC retail and wholesale area. Currently, very little of the treated wastewater in the retail or wholesale area is recycled, and the vast majority of it is discharged into the ocean or bay. For instance, in its 2015 UWMP, SFPUC estimates that in the retail service area only 0.2MGD of recycled water was delivered in 2015, accounting for only 0.29% of retail water supply, and that this will increase to only 3.9MGD by 2040 (accounting for less than 5% of total supply).

	2015	2020	2025	2030	2035	2040
Recycled Water (all projects, in MGD)	0.2	1.9	1.9	3.9	3.9	3.9
Total Retail Supply (MGD)	70.1	77.5	79.0	82.3	85.9	89.9
Recycled Water % of Retail Supply	0.29%	2.45%	2.41%	4.74%	4.54%	4.34%

Source: SFPUC 2015 UWMP at Table 6-7.

Table 6-6 from the UWMP demonstrates that even in drought conditions in 2015, more than 65 MGD (approximately 72,800 acre feet per year) of treated wastewater was discharged from wastewater treatment plants in SFPUC retail service area. For both the retail and wholesale service area, there is substantial potential for increased water recycling. Data compiled from the SWRCB's California Integrated Water Quality System Project (except as noted below) identified the following discharges from wastewater treatment plants located in the SFPUC wholesale and retail service area:[37]

Agency	2014 Discharges	2015 Discharges
Palo Alto Regional WQCP	19.55 MGD	19.47 MGD
Millbrae WPCP	1.45 MGD	1.29 MGD
San Mateo WWTP	10.39 MGD	9.30 MGD
SFIA, Mel Leong Sanitary and Industrial Treatment Plants	2.27 MGD	1.99 MGD
South San Francisco / San Bruno WQCP	11.39 MGD	10.21 MGD
Southeast WPCP, North Point WWF, Bayside WWF (Flow	138.27 MGD	96.31 MGD

[37] Note that this table includes discharges in the retail service area that were included above.

average of wet and dry weather)		
Sunnyvale WPCP	11.95 MGD	9.42 MGD
Burlingame WWTF	2.95 MGD	2.73 MGD
Oceanside WWTP	14.90 MGD	13.95 MGD
San Jose / Santa Clara Regional Wastewater Facility[38]	Not available	28,733 acre feet discharged (3,607 acre feet recycled)
Total	213.12 MGD Approx. 238,000 Acre Feet	Approx. 213,000 Acre Feet

Sources: SWRCB, 2015 San Jose Municipal Water System UWMP

Of course, increases in indoor water use in the retail or wholesale service area will also increase potential for wastewater recycling; indeed, the table above shows that in some areas, there were substantial declines in wastewater discharges between 2014 and 2015 as urban water use declined. While SFPUC has not identified significant increases in water recycling in its UWMP, other agencies in the service area have done so. For instance, San Jose's UWMP explains that the Santa Clara Valley Water District is in the process of developing at least 20,000 acre feet per year, and up to 45,000 acre feet per year of potable reuse capacity. *See* San Jose 2015 UWMP at 61. Ultimately, while not all of these discharges may feasibly be recycled, there can be no question that there is substantial untapped potential in terms of increased water supply from water recycling in the service area that were not considered in the SED. The SED should be revised to discuss how water recycling could reduce water supply impacts and help offset reductions in surface water supplies from the Tuolumne River.

3. *Urban Water Use Efficiency:*

San Francisco is rightfully proud of its urban water use efficiency, and residents in the City have substantially reduced per capita water use in recent years. As the table below shows, in 2015 SFPUC's retail per capita water use was 81 gallons per capita day (GPCD) and its residential per capita water use was 44 residential gallons per capita day (R-GPCD). In addition, SFPUC estimates that it achieved approximately 9.6 MGD in water savings through conservation from 2005-2015. SFPUC 2015 Retail Water Conservation Plan at ES-2.[39]

	2005	2010	2015	2020	2025	2030	2035	2040
Gross Per Capita Use	110	95	81	86	84	83	83	82

[38] 2015 Urban Water Management Plan San Jose Municipal Water System, at Table 6-4. This UWMP is available online at: https://www.sanjoseca.gov/DocumentCenter/View/57483 and is hereby incorporated by reference.
[39] This document is available online at: https://sfwater.org/modules/showdocument.aspx?documentid=8760 and is incorporated by reference.

(GPCD)								
Residential GPCD (R-GPCD)	61	53	44	44	43	44	44	45
Population (1,000)	782	807	859	892	937	984	1,034	1,087

Source: SFPUC 2015 Retail Water Conservation Plan, Table 1

In contrast, water use within the wholesale service area is higher than within the retail service area. In 2014-2015, per capita water use amongst the member agencies of the Bay Area Water Supply and Conservation Agency (BAWSCA), all of whom are SFPUC wholesale customers, averaged 105.7 GPCD and a residential average of 64.7 R-GPCD. *See* BAWSCA Annual Survey FY2014-15 at ES-9.[40] Only 8 of the BAWSCA member agencies had a residential per capita water use less than 50 R-GPCD.

More importantly, the UWMP predicts dramatic increases in wholesale demand that greatly outpace population growth. According to data in the UWMP, from 2015-2020, the retail population is expected to increase by 3.8%, while demand is expected to increase by 10.6%; the wholesale population is expected to increase by 4.6%, with an expected increase in demand of 24.2%. *See* 2015 SFPUC UWMP at Tables 3-3, 3-4, 4-1, and 4-2. As the table below demonstrates, this results in a dramatic increase in demand that outpaces population growth.

	2015	**2020**	**2025**	**2030**	**2035**	**2040**
Total Population (Retail + Wholesale)	2,660,173	2,775,511	2,908,876	3,045,995	3,191,733	3,330,074
		4.34%	4.81%	4.71%	4.78%	4.33%
Total Demand (Retail + Wholesale)	198.1	236.5	243.1	249.7	256.2	263.8
		19.38%	2.79%	2.71%	2.60%	2.97%

Source: SFPUC 2015 UWMP, Tables 3-3, 3-4, 4-1, and 4-2

The dramatic increase in demand between 2015 and 2020 is not a function of population growth; indeed, the UWMP estimates that water demand will increase at a *slower* rate than population growth from 2025 to 2040. As discussed above, even SFPUC's outside economist has acknowledged that urban water agencies routinely overestimate future water demand. Buck et al.

[40] This report is available online at: http://bawsca.org/uploads/userfiles/files/BAWSCA_AnnualSurvey_FY2014-15.pdf and is hereby incorporated by reference.

2015. Other experts have reached similar conclusions. *See, e.g.*, Matthew Herberger et al., A Community Guide for Evaluating Future Urban Water Demand, Pacific Institute 2016.[41]

For instance, if demand in the SFPUC service area increases by only 4.34% between 2015 and 2020 (identical to rate of population growth), then demand in 2020 would be 206.7 MGD, and demand in 2035 would be 223.9 MGD, as shown in the table below. Instead of assuming an unrealistic and dramatic increase in demand between 2015 and 2020, which is necessary to justify use of a 260 MGD demand estimate, the SED should use an estimated demand of 223 MGD for SFPUC.

	2015	**2020**	**2025**	**2030**	**2035**	**2040**
Increase in Demand *(identical to population growth)*		4.34%	2.79%	2.71%	2.60%	2.97%
Total Demand	198.1	206.7	212.5	218.2	223.9	230.5

Reductions in demand in recent years have demonstrated that the region can successfully reduce per capita water use without impacting the economy. If per capita demand remains near 2015 levels, overall demand will be substantially lower than predicted in the UWMP and could help reduce or avoid impacts from reduced surface water supplies from the Tuolumne River. The SED should be revised to analyze how improved water use efficiency could reduce water supply impacts and help offset reductions in surface water supplies from the Tuolumne River.

4. Groundwater Banking and Recovery Projects

According to materials provided by the SFPUC, the San Francisco groundwater project is expected to begin operating in 2017, and will reduce demand by 4 MGD. *See* Appendix F. In addition, SFPUC anticipates that the Westside Basin Conjunctive Use project could reduce drought year demand by 7 MGD on the San Francisco Peninsula. *Id.* The SED should be revised to discuss how these and related projects could reduce water supply impacts and help offset reductions in surface water supplies from the Tuolumne River.

5. Los Vaqueros Reservoir Expansion

The Contra Costa Water District is currently evaluating a substantial additional expansion of the Los Vaqueros reservoir, increasing storage capacity to as much as 275,000 acre feet. *See* Contra Costa Water District, Los Vaqueros Reservoir Expansion, available online at:

[41] This report is available online at: http://pacinst.org/app/uploads/2016/08/A-Community-Guide-for-Evaluating-Future-Urban-Water-Demand-1.pdf and is hereby incorporated by reference.

http://www.ccwater.com/706/Los-Vaqueros-Studies. SFPUC and other wholesale customers are helping to fund completion of studies of the reservoir expansion and are considering partnering in this project. The SED should be revised to discuss the potential for this project to reduce water supply impacts and help offset reductions in surface water supplies from the Tuolumne River.

c. SFPUC's analyses of potential impacts are deeply flawed and misleading.

In 2013, SFPUC presented highly misleading and inaccurate estimates of potential economic impacts from reductions in water supply, which have been proven faulty by SFPUC's reduction in demand during the drought without major economic impacts. Unfortunately, in recent months SFPUC has continued to publicly present highly misleading and inaccurate analyses and claims regarding water supply impacts from implementation of the preferred alternative. *See* Appendix F. It is important for the SWRCB and public to understand the significant flaws in their analysis.

First, SFPUC has not analyzed potential water supply impacts from the preferred alternative, but instead has analyzed how SFPUC might *choose* to implement any water supply impacts. In order to calculate potential rationing, SFPUC's model assumes an 8.5 year design drought (1987-1992 followed by 1976-1977), and therefore assumes that any dry or critically dry year is the beginning of an 8.5 year drought sequence that is longer and more severe than any drought in the modern record. While it is clearly commendable to plan for droughts, these model assumptions predict rationing in many years where SFPUC has substantial water in storage. Indeed, our review of their spreadsheet model results indicate that total storage in the SFPUC system over the period of record analyzed in the model never drops below 400,000 acre feet (and does so only after the 1987-1992 5 year drought sequence). For example, under the 265 MGD demand assumption and 40% unimpaired flow scenario,[42] the following amounts of water are in system storage:

Year (June of that year)	SFPUC Estimated Rationing	Total System Storage (June of prior FY)
FY24-25	40%	1,105,173
FY29-30	40%	1,075,401
FY30-31	40%	987,671
FY31-32	54%	724,619
FY33-34	40%	1,149,109
FY34-35	40%	912,257
FY64-65	40%	1,185,547
FY92-93	54%	497,122
FY94-95	54%	972,422

[42] Storage levels are generally higher under lower demand scenarios, which makes intuitive sense.

FY08-09	40%	1,000,809

The extremely conservative nature of SFPUC's 8.5 year design drought drives these conclusions, and SFPUC can of course modify that design drought. SFPUC's model simply does not demonstrate water supply impacts, but instead how they may choose to implement those impacts – assuming that SFPUC does not take any other actions to develop water supplies.

However, that assumption – that the model fails to consider reasonable investments in improved water use efficiency, wastewater recycling, stormwater capture, and other projects – is unreasonable, and is the second flaw in their analysis. The model results demonstrate that at lower levels of system demand, the frequency and severity of rationing declines even using their model assumptions:

	265MGD Base (Max contract)	**223MGD Base (FY 12-13 demand)**	**175MGD Base (FY 15-16 demand)**
# of years with Rationing under 40% Alt	24 years (15 years at 40%, 9 years at 54%)	19 years total (16 years at 39%, 3 years at 49%)	16 years total (13 years at 20%, 3 years at 32%)
Max rationing under 40% Alt	54%	49%	32%
Delivery shortfall under maximum rationing under 40% Alt	142MGD (121MGD deliveries vs 265MGD Demand)	110MGD (113 MGD deliveries vs 223MGD demand)	57MGD (118 MGD deliveries vs 175MGD demand)
# of years with no rationing under 40% Alt	68 (92-24)	73 (92-19)	76 (92-16)

This demonstrates that improvements to water use efficiency and development of local and regional water supplies will reduce or avoid these impacts. Yet SFPUC only included a few potential projects in the 265 MGD model scenario (Westside Basin Conjunctive Use, SF Groundwater, and existing SF recycled water), and their analysis did not include those projects in the lower demand scenarios. As discussed above, there are substantial opportunities for improved water use efficiency and local water supply projects in the SFPUC service area that are ignored in this analysis.

Third, SFPUC's model assumes that water supply impacts will be split between SFPUC and agricultural districts in a manner similar to the SWRCB's Scenario 2 in the SED. This would suggest that even in years when SFPUC would otherwise divert no water from the river, they would have to contribute substantial flow from the water bank in the reservoir. However, if the split between SFPUC and the agricultural districts is more similar to Scenario 1 in the SED, the impacts on SFPUC would be lower.

Fourth, like the SED, SFPUC's model fails to consider the authority to waive or weaken instream flow requirements during drought emergencies, as authorized in the Program of Implementation. This is likely to dramatically change the model results, particularly as suggested in our comments, because it would provide greater certainty regarding the hydrologic conditions that would trigger that authority and the default flow conditions that would result.

Ultimately, like their deeply flawed economic analysis in 2013, SFPUC's rationing analysis in 2016 is substantially flawed, and overestimates how SFPUC is likely to implement changes resulting from the Board's decision. Rather than continuing to provide such misleading analyses, we hope and expect that SFPUC will work with the conservation community and the public to help develop sustainable water supply projects, including expanded wastewater recycling and continued water use efficiency efforts, which help reduce reliance on the Delta and sustain the economy and the environment.

XI. Conclusion

Now is the time for the SWRCB to act decisively to restore ecological balance and protect the Public Trust by requiring the flows necessary to achieve the narrative salmon protection objective, the proposed narrative San Joaquin migratory fish viability objective, and maintain salmon and other native fish in good condition. For the reasons stated herein, we urge the SWRCB to adopt an alternative that establishes a range of 40-60% of unimpaired flow, with a starting point of 50%, and to revise the SED consistent with the comments herein.

Thank you for consideration of our views. We would be happy to answer any questions regarding these comments or work with staff to help address these comments.

Sincerely,

Doug Obegi
Natural Resources Defense Council

Jon Rosenfield
The Bay Institute

Ben Eichenberg
San Francisco Baykeeper

Rachel Zwillinger
Defenders of Wildlife

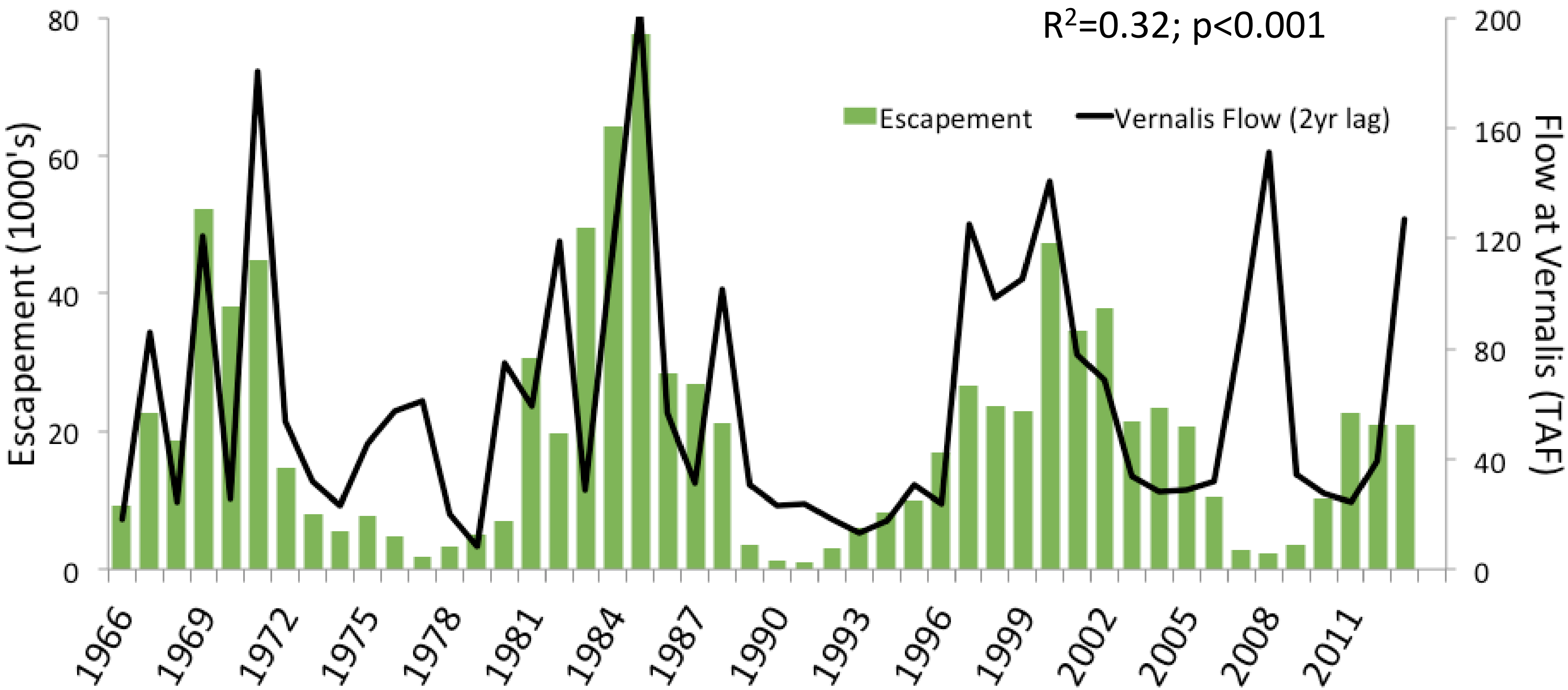
Enclosures:

Appendix A: Redline of Proposed Revisions to Appendix K (Program of Implementation and Table 3)
Appendix B: SEP 2016
Appendix C: Documentation Regarding the Central Valley Flood Protection Plan, Emigrating Salmonid Habitat Estimation model
Appendix D: Floodplain Inundation Appendix and Figures
Appendix E: Temperature Appendix and Figures
Appendix F: Documents from SFPUC regarding potential rationing and system storage
Appendix G: Literature Cited in Section III

Figures Referenced in Section III

San Joaquin Salmon Escapement

strongly correlated with winter-spring flows



Modifed from Sturrock et al. 2015

Figure 1

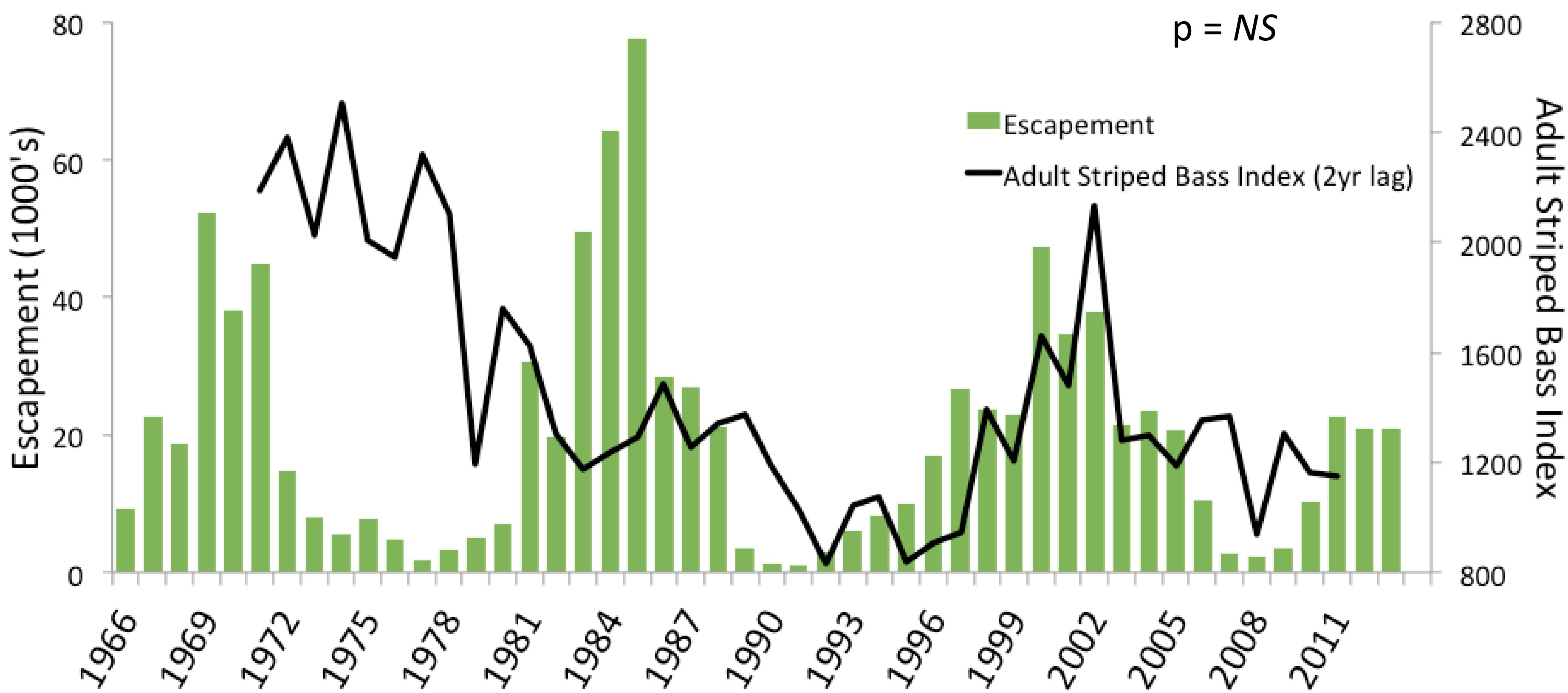


Figure 2: Striped bass abundance in the Delta v. Chinook salmon escapement 2.5 years later. If Striped Bass abundance explained the pattern of salmon escapement, there would be a negative correlation between the two parameter, because striped bass are expected to prey on migrating juvenile salmon. No significant correlation was detected.

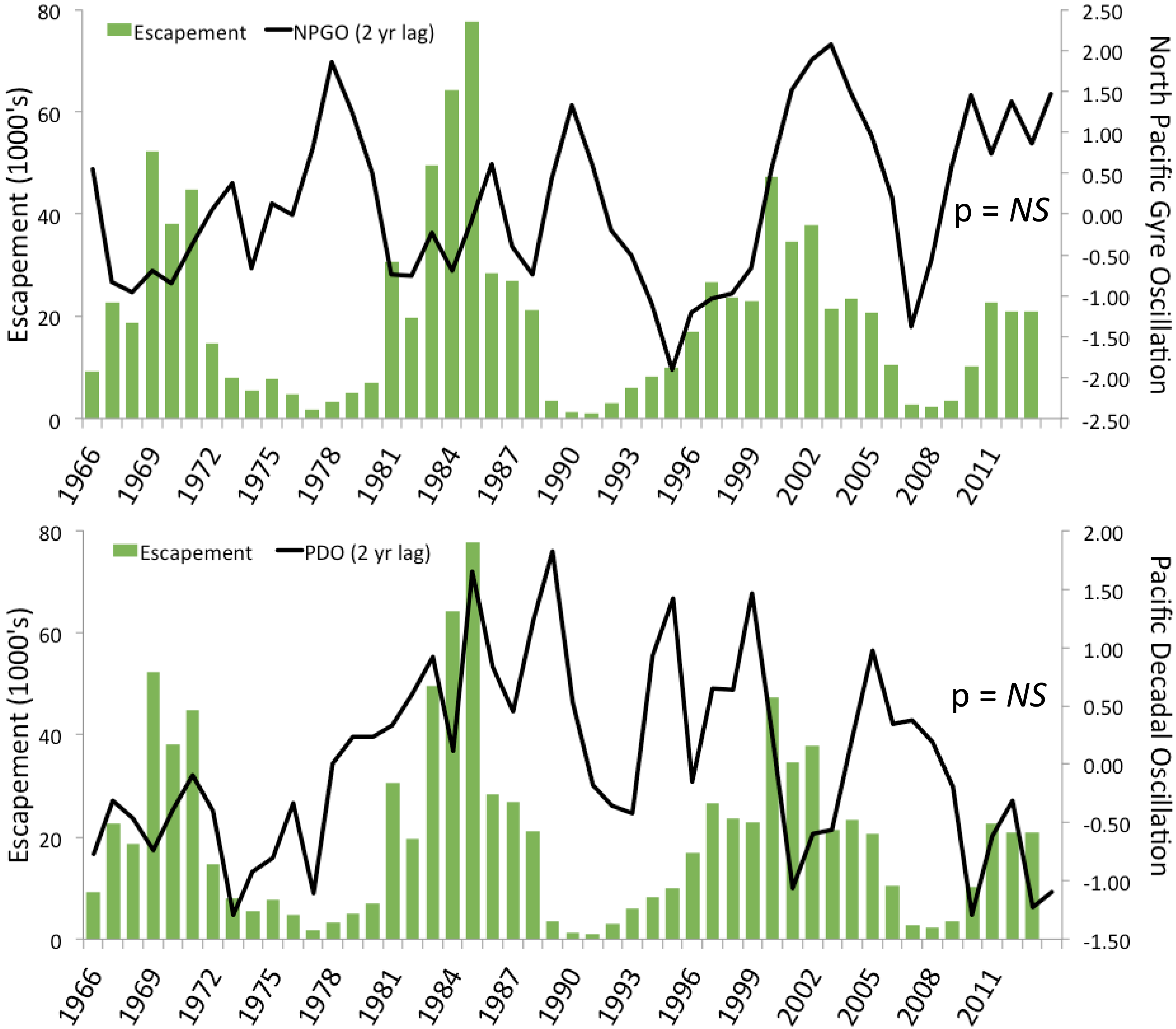


Figure 3: Two measures of ocean condition hypothesized to be relevant to Central Valley Chinook salmon success in the ocean vs. Chinook salmon escapement 2.5 years later. No significant correlation was detected.

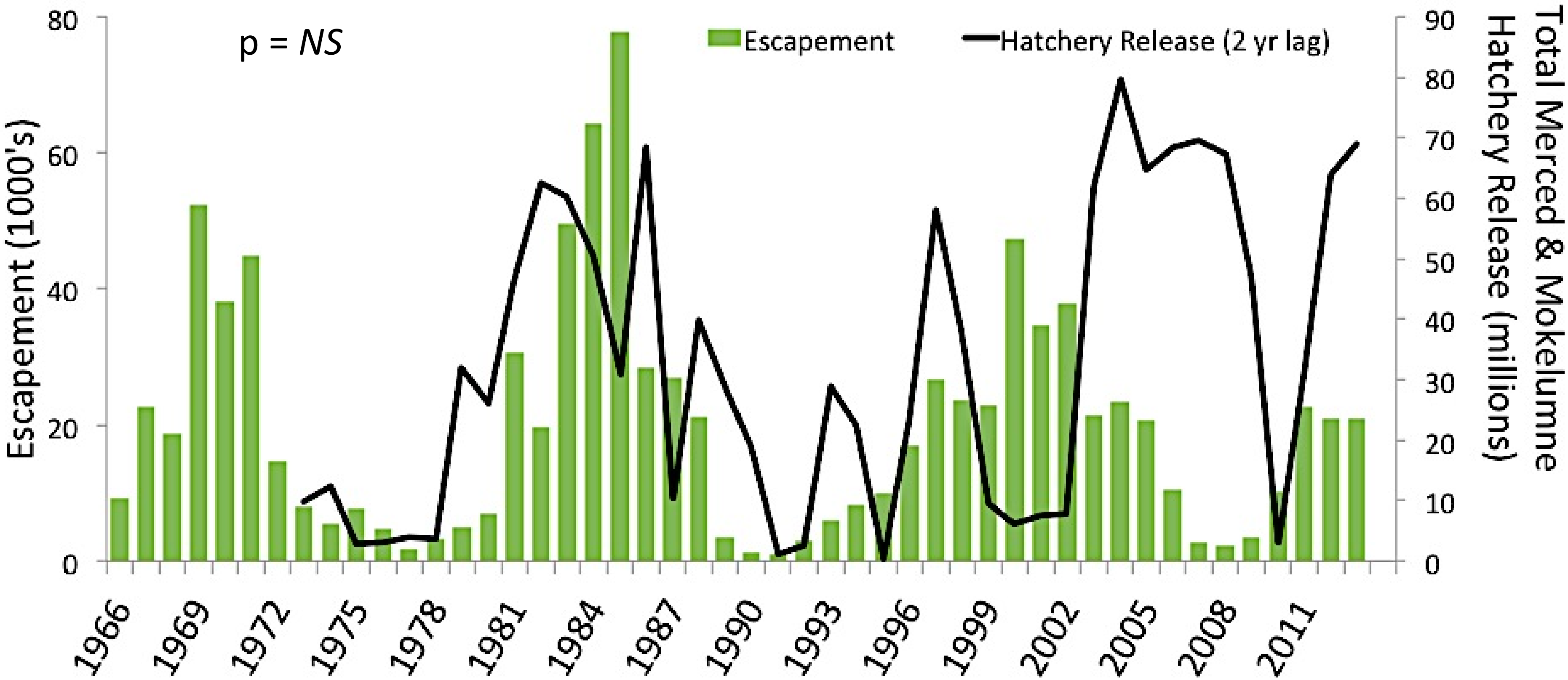
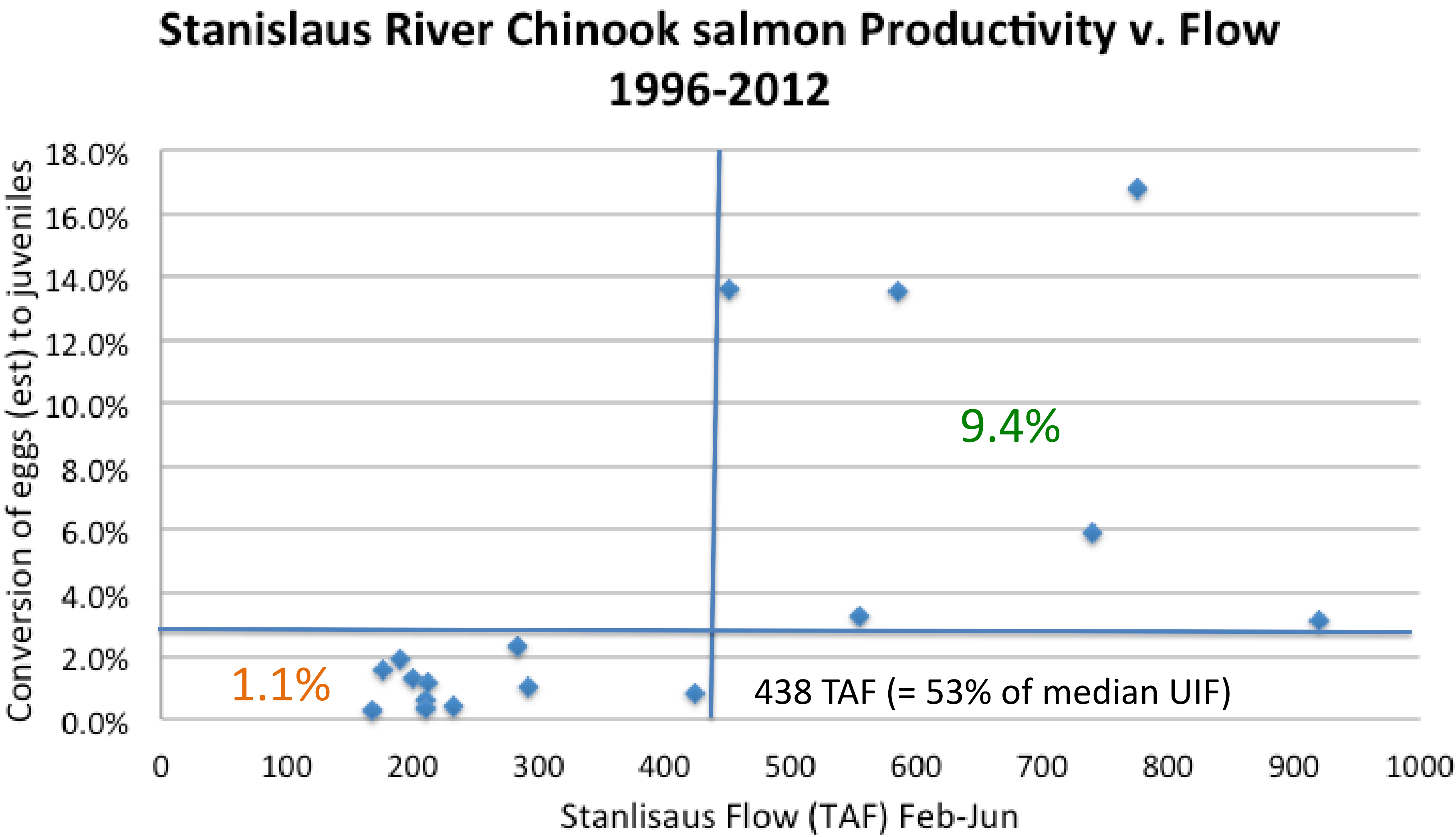
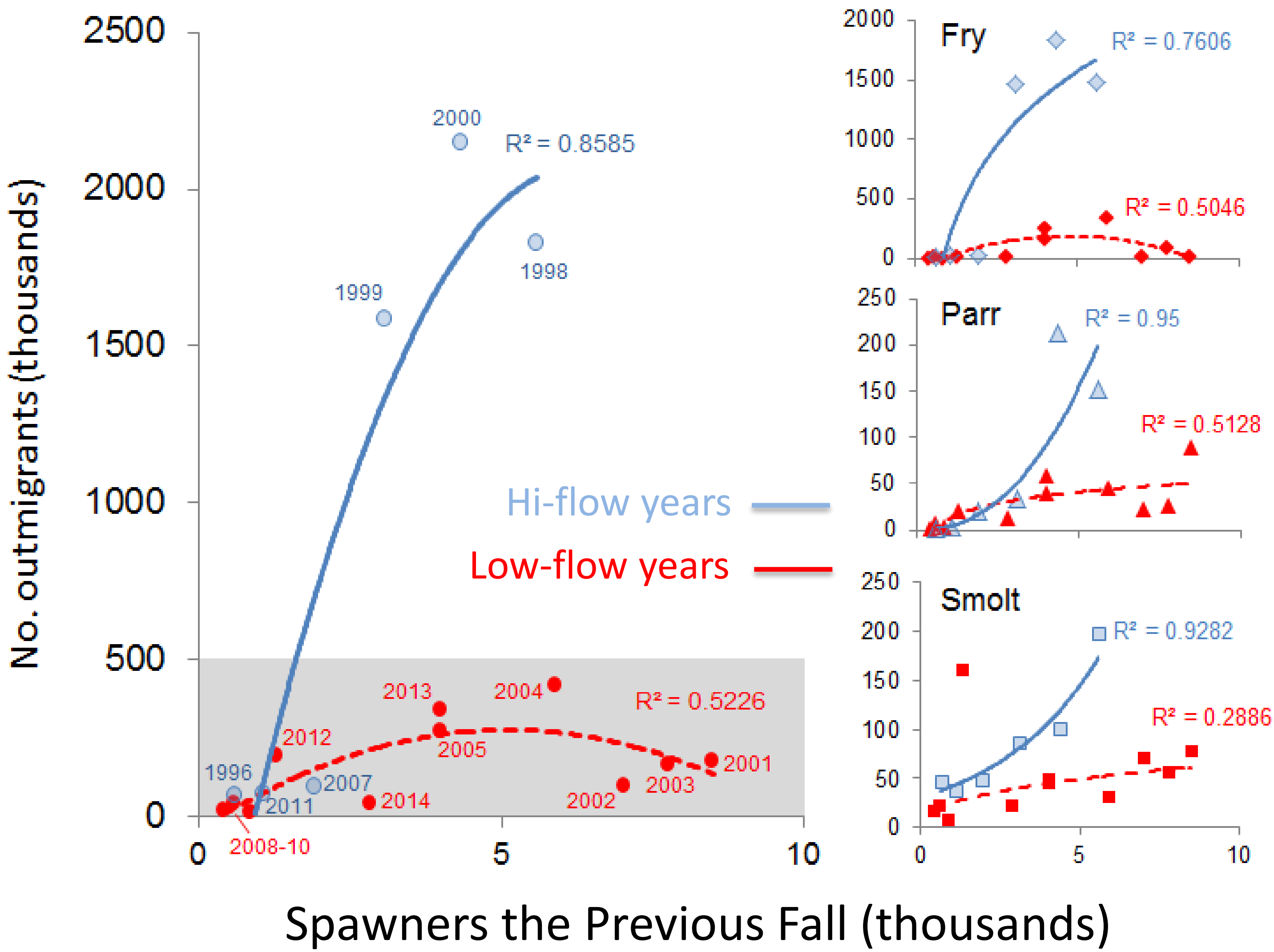


Figure 4: Combined releases of fall-run Chinook salmon at Merced and Mokelumne River hatcheries vs. Chinook salmon escapement to the San Joaquin River 2.5 years later. No significant correlation was detected.



Data from USF&WS

Figure 5: Estimated survival of fall-run Chinook salmon versus flow in the Stanislaus River. Survival is calculated as [expanded juvenile production as detected by Caswell Rotary Screw Trap] divided by {Chinook salmon escapement to the Stanislaus River the previous fall (GrandTab) * estimated sex ratio * eggs per spawning female).



Sturrock et al., *in preparation*

Figure 6